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Unlocking Performance Potential: Power BI Implementation and its Transformative Impact on Proef's Business Intelligence

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Dissertation

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Abstract

In recent years, Business Intelligence (BI) has acquired great importance for all organisations due to internet and digital advancements.

BI consists of turning large volumes of raw data into actionable insights and information capable of enhancing decision-making, consequently leading to improved performance and competitive advantages.

For Proef Group, a multinational company, two BI solutions are developed in the course of this dissertation, through Power BI. Dashboard I offers an operational view, monitoring the KPIs of a department. Dashboard II combines operational and financial perspectives, creating a dashboard for a specific company of the Group.

Therefore, this study assesses, specifically, the suitability of Power BI and, in general, the impact of BI on performance and financial results. The literature review suggests favourable results, emphasising that Power BI is an excellent tool for implementing BI solutions and underscoring the essential role of BI in decision-making processes.

To develop the dashboards, Proef's databases are utilised to extract the necessary tables. The collected data undergoes a transformation process to better suit the intended analyses. Once all the foundational data is prepared, dimensional models are created using a Galaxy schema, enabling analysis that encompasses various business units and activities in both dashboards.

Subsequently, calculated tables, columns, and measures are generated to further enrich analysis and dashboard creation with more advanced knowledge. The dashboards are designed to be intuitive, user-friendly, and dynamic to facilitate analysis.

It is important to note that the developed dashboards meet Proef's needs and have since been widely used by the relevant stakeholders, serving as support for monitoring operational and financial performance and significantly contributing to strategic decision-making.

In conclusion, BI is indeed highly valuable and essential for informed decision-making. In this context, Power BI is an excellent software capable of producing enlightening and powerful BI solutions.

Keywords: Business Intelligence; Power BI; Data; Information; Decision-making; Business Performance

Resumo

Nos últimos anos, a Inteligência de Negócios adquiriu uma grande importância para as organizações devido aos avanços da internet e da tecnologia digital.

A Inteligência de Negócios consiste em transformar dados brutos em informações acionáveis capazes de aprimorar a tomada de decisões, levando consequentemente a melhorias no desempenho e vantagens competitivas.

Para o Grupo Proef, duas soluções de Inteligência de Negócios são desenvolvidas, através do Power BI. O Dashboard I oferece uma visão operacional, monitorizando os KPIs de um departamento específico. O Dashboard II combina perspectivas operacionais e financeiras de uma empresa do Grupo.

Portanto, este estudo avalia a adequação do Power BI e o impacto da Inteligência de Negócios no desempenho e nos resultados financeiros da Proef. A revisão da literatura sugere resultados favoráveis, enfatizando que o Power BI é uma excelente ferramenta para implementar soluções de Inteligência de Negócios, destacando o seu papel essencial nos processos de tomada de decisão.

Para desenvolver os painéis, tabelas são extraidas das bases de dados da Proef e os dados coletados passam por um processo de transformação para se adequarem melhor às análises pretendidas. De seguida, um esquema de Galáxia é criado, permitindo análises que abrangem várias unidades de negócios e atividades nos dois paineis.

Posteriormente, tabelas, colunas e medidas calculadas são geradas para enriquecer a análise com conhecimentos mais avançados. Os painéis são projetados para serem intuitivos, de fácil utilização e dinâmicos.

É importante destacar que os painéis desenvolvidos atendem às necessidades da Proef e têm sido amplamente utilizados pelos stakeholders, servindo como suporte para monitorizar o desempenho operacional e financeiro e contribuindo significativamente para a tomada de decisões estratégicas.

Em conclusão, a Inteligência de Negócios é realmente muito valiosa para uma tomada de decisões informada. Neste contexto, o Power BI é um excelente software capaz de produzir soluções poderosas.

Palavras-chave: Inteligência de negócios; Power BI; Dados; Informação; Tomada de Decisão; *Performance*

Glossary

AI - Artificial Intelligence
AR - Augmented Reality
BI - Business Intelligence
BIS - Business Intelligence System
DAX - Data Analysis Expressions
DSS - Decision Support Systems
DW - Data Warehouse
ETL - Extract, Transform, Load
ERP - Enterprise Resource Planning
FTEs - Full-Time Equivalents
IoT - Internet of Things
IT - Information Tecnology
KPIs - Key Performance Indicators
ML - Machine Learning
NLP - Natural Language Processing
OLAP - Online Analytical Processing
P&L - Profits and Losses Statement
VR - Virtual Reality
YTD - Year-to-Date

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Context and Motivation

Since the late 1990s, and especially at an accelerated pace in recent years, the internet has grown heavily. Several technological advances have taken place as well as a great development of digital devices, Internet of Things (IoT) devices, social media and e-commerce. With their proliferation and widespread adoption, the data generated is growing exponentially. According to a report by Forbes published in 2018, 2.5 quintillion bytes of data were created every day in that year, and 90 % of the world's data has been generated in the last two years alone, at the time of the report (Marr, 2018). In 2023, the amount of data created daily has increased to 3.5 quintillion bytes of data. So, around 120 zettabytes of data will be generated this year, corresponding to approximately 60 times more than in 2010 (when two zettabytes of data were generated) (Fabio Duarte, 2023; Jason Wise, 2023). More 181 zettabytes of data are expected to be generated in 2025, continuing the high growth trend into the future (Fabio Duarte, 2023; Jason Wise, 2023). Therefore, this digital age drove the explosion of data and what came to be called big data. The explosion of data and the term big data refer to the rapid increase in the volume, variety, and velocity of data being generated and collected all the time, and that can come from a wide variety of sources. Hence, with the advent of the internet and technology, organisations began to gather, store and access large amounts of data, such as sales data, financial records, customer information, market conditions and more, from various sources (Antunes, Cardoso, & Barateiro, 2022).

Nevertheless, as data has increased, business environments have become more dynamic with ever-changing conditions. Furthermore, the internet has also boosted and intensified competition. While offline, the competition is just neighbours; online, everyone is a competitor because everyone is very close (just a click away). Moreover, in today's digital world, customers are becoming increasingly demanding and complex, and there is an enlarged focus on customer experience, as it has become a critical differentiator in many industries. A Forrester Research report found that businesses prioritising customer experience outperform their peers by a significant margin (Schmidt-Subramanian, 2014). Thus, the analysis of customer's data can provide insights into their behaviour, preferences, and satisfaction levels, enabling businesses to improve (and personalise) the customer experience. Organisations must also be able to access and analyse market data in real-time or near real-time to adapt and respond quickly and effectively to market variations, threats and opportunities to survive in the present fast-paced, unstable business environment and stay ahead of the competition.

Thus, the massive amounts of data presented an opportunity for organisations to gain valuable insights into customer behaviour, market trends, competitor activity and other external key factors that could influence their success (Jahantigh, Habibi, & Sarafrazi, 2019; Olszak, 2016; Romero, Ortiz, Khalaf, & Prado, 2021).

Internally, data augmentation can leverage better visibility into business performance by tracking Key Performance Indicators (KPIs) and other metrics, helping companies better understand their business operations and identify areas for improvement. Thus, organisations can make more informed decisions about everything from sales to supply chain management and financial planning to improve internal operations, ultimately also enhancing external competitiveness (Apraksin, Stylianou, & Shcherbinin, 2018).

Therefore, the explosion of data has significant implications for organisations, as it can lead to increased operational efficiencies and strengthened market understanding and positioning. Hence, companies began to realise the potential value of data in informing business decisions and, according to Romero et al. (2021, p. 1), data now constitutes a "new class of economic asset". However, tracking the dynamic changes within and outside companies while maintaining sustainable goals presents challenges. One is integrating and consolidating data from multiple sources (multiple systems and applications within an organisation that generate data), enabling businesses to get a holistic view of their operations. In addition to data integration and consolidation, the difficulty for companies to analyse lots of data is also a major challenge since large amounts of data are hard to understand, transform into actionable insights and use to inform decisions. According to Simon (2013), despite 2.8 trillion gigabytes of data being generated and used worldwide, only 0.5 % is processed and analysed. As such, and given the growing trend in the amount of data available, managing companies is increasingly challenging (Abai et al., 2019; Apraksin et al., 2018; Romero et al., 2021; Sharda, Delen, & Turban, 2014; Simon, 2013).

For these reasons, Business Intelligence (BI) has emerged and acquired great importance within companies in recent years. It is a way to manipulate the data, extract meaningful wisdom from it and use this wisdom to apprise decision-makers and empower better business decisions. Thus, BI has allowed organisations to move from intuition to using data and creating information, knowledge and intelligence, becoming data-driven to gain competitive advantage (Abai et al., 2019; Apraksin et al., 2018; Romero et al., 2021).

Besides the knowledge about the past and the present, BI can also give insights and predictions about the future, making it even more powerful and crucial for companies (Apraksin et al., 2018).

BI solutions are becoming increasingly and easily available, allowing organisations of all sizes to access powerful BI tools and technologies, contributing to its wide adoption. An example is Power BI, a well-known software from Microsoft, which is currently being used by many companies (Microsoft Power BI, 2023c).

Moreover, businesses are increasingly subject to regulatory requirements, which often require detailed data reporting and analysis. As such, BI tools provide a way to quickly generate reports and comply with regulatory requirements (Baruti, 2023; Bettin, 2023; Mohammad, Al-Okaily, Al-Majali, & Masa'deh, 2022; Sujitparapitaya, Shirani, & Roldan, 2012).

Overall, BI has emerged as a solution to organisations' growing need to effectively manage and analyse large amounts of data to make informed decisions. Specifically, it intends to analyse how and where value can be created within an organisation. Namely, it can provide information quickly, evidencing new market opportunities and threats, improve the customer experience, enhance performance, comply with regulatory requirements, gain competitive advantage, and address other business needs. Indeed, BI constitutes a critical tool for businesses, enabling data-driven, informed and intelligent organisational decisions.

1.2 Study Description

The importance that BI has for organisations in today's world makes its study and its employment extremely relevant. In this sense, this dissertation aims to implement two BI solutions at Proef.

Proef is a group of companies that operate globally in the telecom, power, corporate and cities sectors. The group was founded in Portugal and currently has more than 37 years of experience in these areas, operating in 12 countries across Europe, Africa, and South America, employing around 1500 people, with an annual turnover of approximately 160 million euros (Proef, 2023).

As mentioned, it operates in 4 different sectors, with several activities within each and with many employees, making the alignment of all the company's activities a complicated task. To give it even more meaning, these sectors are dynamic, marked by various changes and innovations over time. In addition, the group is present in several countries with different stages of development, distinct regulations, incomparable needs and diverse cultures. For all these reasons, managing the group seems very challenging and demanding. As such, it would be essential for Proef to use BI to treat better the enormous amount of data it collects and stores, transforming it into useful information for improved decision-making and, consequently, gaining a greater competitive advantage in the market.

However, in general, Proef's data culture has been static and fragmented, hindering efficient data exploration and making the process time-consuming. The multitude of data sources, stakeholders, and diverse economic, accounting, fiscal, and regulatory contexts across markets further complicate the provision of cohesive, comprehensive, and timely information.

Acknowledging the evolving information requirements and expanding data volume, Proef has recently started shifting from traditional Excel spreadsheets to BI automation, employing Power BI. Proef has outlined several improvements for its reporting process and operational monitoring within this framework. These encompass augmenting process integration, standardising practices and methodologies, reducing information availability time, minimising labour dependency, increasing information flexibility, and cultivating a data-driven decision-making culture across all organisational tiers. These enhancements ensure a seamless transition to BI without losing deliverables while safeguarding the integrity and quality of information. So, during the transition phase, the organisation strives to guarantee that there is no loss of deliverables and, most importantly, that the quality and integrity of the information remain uncompromised, safeguard that the delivery lead time is at least the same (and expectedly lower in the long term), and ensure that all parties involved have at least the same ability to obtain and interpret the information.

By embracing these improvements and the power of BI, Proef endeavours to conquer its management challenges, harmonise its operations, and make informed decisions that drive its sustained success in the complex and diverse markets it operates within.

Therefore, striving to assist Proef during this transitional period, two Power BI dashboards will be created, one for Department A of Company X (coded names for privacy and ethical reasons, explained in Chapter 3), which will be named as Dashboard I, and another denoted by Dashboard II for the entire Company X.

Besides contributing to the BI automation transition at Proef, the purpose of creating these two dashboards in this study is to demonstrate the different scopes BI can cover within an organisation. Concretely, these dashboards aim to obtain both operational and financial views. Also, it intends to provide evidence that it can cover more decentralised (detailed) or more centralised (aggregated) data since it can be used for a single department and a whole company, respectively.

The Dashboard I aims to provide an operational view of the department's performance over time, with KPIs monitoring. For this, it visually evidences in the main tab, through graphics, the reports delivered over the months and the percentage of reports that were delivered on time, the reports already automated and the reports that are intended to be automated in the future and their timings, the subprojects, projects, global projects and contracts analysed by the team over time and the actions developed, under development and to be developed soon. This dashboard will also contain detailed information from the main dashboard tab on other additional tabs.

The goal of Dashboard II is to exhibit economic and financial measures, namely, the Profits and Losses statement (P&L) and the Balance sheet of the company, and operational measures that reflect the number of hours worked by each employee or department in every task and client, the list of the activities under development and the evolution of the departments' evaluations over time and by category.

The ultimate goal, or, in other words, the question under investigation, is to understand whether BI can generate information and knowledge to significantly and positively impact the company's decisions, leading to better performance and, consequently, to greater competitive advantage. The other research question is whether Power BI is a valuable BI tool and whether it has the potential to be widely and intensively used by companies.

1.3 Study Contributions

The contributions and insights gained from this dissertation are substantial and varied.

Firstly, this project adds valuable insights to the BI field, serving as a real-world study of BI system implementation within an organisation. It also makes a notable contribution to the Power BI domain, given its exclusive utilisation throughout the entire process.

Specifically, this dissertation brings significant benefits to Proef.

First, the two dashboards now consolidate information for Department A and Company X, ensuring all stakeholders access the same standardised data, reducing fragmentation.

Thoroughly validated data ensures precise and reliable insights, leading to informed decision-making.

The dashboards enable real-time performance monitoring, allowing proactive interventions to optimise performance and respond swiftly to challenges and opportunities.

Enhanced visibility into operational data aids in resource allocation and cost management, identifying inefficiencies and focusing resources for maximum returns.

The dashboards transform strategic planning with data-backed insights, improving strategic decision-making and reducing uncertainty.

Daily data updates, automation, and reduced manual efforts lead to cost savings, higher productivity, and lower error rates.

Well-structured, user-friendly dashboards provide extensive and high-quality information, enhancing data comprehension.

Enhanced interactivity and flexibility in data exploration offer drill-down, roll-up, and filtering options.

Dashboards shared on Power BI service facilitate cross-functional collaboration, aligning efforts with organisational goals.

Improved access to critical business data empowers data-driven decision-making, positively impacting organisational performance.

In summary, the dissertation's contributions span decision-making, efficiency, performance monitoring, strategy formulation, cost management, collaboration, and adaptability, enhancing Proef's competitiveness and positioning it for sustained success in the data-driven business landscape. These findings can potentially guide other businesses undertaking similar Power BI implementations, making this dissertation a valuable asset applicable to various companies.

1.4 Dissertation Structure

The dissertation begins with the present introductory chapter addressing first the context and motivation of the study, where the subject under investigation and its current relevance are introduced, followed by the description of the study, in which the objectives of the practical implementation are explained, the contributions of this study, highlighting the benefits it has brought to Proef as well as the potential advantages it may offer to other companies adopting similar strategies, and finally, the ongoing subsection which contains the structure of the dissertation, where the chapters and their content are explained briefly.

In order to clarify the concepts and deeply understand and frame the main theme of this dissertation, BI, a literature review on the subject is carried out in Chapter 2. It includes its history, its state of the art and its benefits. The second chapter also contains a complete explanation of Power BI, which is the BI software to be used in the practical implementation of the study.

Chapter 3 comprises the methodology used to conduct the research. Specifically, it starts evidencing the research questions and the primary objectives of this study in the Sub-chapter 3.1. Then, it explains the research methodology and strategy used to implement the BI solutions to achieve the research objectives. Finally, Sub-chapter 3.3 addresses data protection and ethical principles, detailing the procedure to safeguard the privacy and confidentiality of the individuals and entities involved in the study.

The following chapter (Chapter 4) consists of implementing the solution: creating the Power BI dashboards. This chapter provides a comprehensive breakdown of the entire procedure that was executed. It begins with an overview of the data sources that were utilised and an explanation of both dimension and fact tables. From there, it delves into an in-depth explanation of the Extract, Transform, Load (ETL) process, followed by the clarification of the calculated tables, calculated columns, and measures created. The chapter further explores the dimensional models that were employed, pursued by an examination of the visualisation reports. Finally, it concludes with discussions on the validation process and the steps taken for publication. This chapter serves as a comprehensive guide, offering insights into the meticulous and comprehensive process of creating the Power BI dashboards for this project.

Chapter 5 addresses the conclusions taken during the project, ending with the main limitations encountered and suggestions for future work.

Finally, the Bibliography comprises a complete list of all the bibliographic references used throughout the paper.

Chapter 2

Literature Review

2.1 Business Intelligence

2.1.1 History

The emergence of BI as a field can be traced back to the late 1950s and early 1960s when companies first started using computers to store and analyse large amounts of data.

The term was first introduced by Hans Peter Luhn in 1958, whose paper named "A Business Intelligence System" (Luhn, 1958) is considered a seminal work in the field of BI. This IBM journal article is considered to be the earliest and one of the most influential works on BI, and it provided a framework for thinking about the role of data in organisations and laid the foundation for the development of modern BI systems and practices (Chee et al., 2009; Grossmann & Rinderle-Ma, 2015; Olszak, 2016).

In the paper, Luhn defined a Business Intelligence System (BIS) as an "automatic system [that] is being developed to disseminate information to the various sections of any industrial, scientific or government organisation" (Luhn, 1958, p.1), advocating the utilisation of BIS to offer organisations an all-encompassing perspective of their activities while facilitating data-informed decision-making. He argued that such a system would be essential for organisations in order to remain competitive in the rapidly changing business environment of the time (Apraksin et al., 2018; Grossmann & Rinderle-Ma, 2015; Luhn, 1958).

Luhn's paper introduced several key concepts that are still important in the field of BI today. It proposed manipulating data to obtain information to support organisations' decisions and, specifically, using analytical tools and techniques to extract insights and knowledge from the data. It also emphasised the importance of involving various stakeholders in the BI process, including managers, analysts, and end-users. That is actually similar to BI's modern notion. However, it was still a vague rationale (Abai et al., 2019; Luhn, 1958; Yahaya, Abai, Deraman, & Jusoh, 2019).

Therefore, to enhance its clarification, after 30 years, Howard Dresner depicted it as "a broad category of software and solutions for gathering, consolidating, analysing and providing access to data in a way that lets enterprise users make better business decisions" "by using fact-based support systems", as cited by Chee et al. (2009) and (Elena, 2011), respectively. Thus, in 1989, he coined BI as being a data-driven decision support and, concretely, an umbrella term for characterising concepts and methodologies of data gathering, accessing and analysis using support systems based on facts to empower data-driven and informed decision-making (Antonelli, 2009; Apraksin et al., 2018; Grossmann & Rinderle-Ma, 2015; Olszak, 2016).

Dresner is an analyst at Gartner Group who is widely recognised as the "father of BI", with many people believing he was the first to conceive the term. He is one of the foremost experts in the field, having founded the Dresner Advisory Services, a research firm focused on BI, big data, and analytics. He is also a speaker, consultant, and frequent contributor to various technology industry publications (Chee et al., 2009; Smashwords, Inc, 2023).

Going back to the mid-20th century, despite Luhn's attractive concept of data analysis, high financial costs and limited technology prevented practical implementation (Limp, n.d.).

The emergence of computers in the 1960s enabled data extraction, and the use of those computers for data analysis increased, leading to the development of database systems and Decision Support Systems (DSS). However, the lack of centralised data storage and accessibility outside Information Technology (IT) spaces at the time posed challenges (Limp, n.d.; Watson, 2009).

In 1970, E. Codd, an IBM researcher, authored the paper titled "A Relational Model of Data for Large Shared Data Banks" (Codd, 1970) and revolutionised data storage by introducing the relational database model. This publication marked a pivotal moment, ushering in a new database era. This development stands as the most notable achievement of the 1970s, as it revolutionised the very foundations of database design. Consequently, databases evolved into powerful tools for uncovering hidden relationships within data, drastically simplifying data access and query processes. This breakthrough idea ignited a wave of inspiration across various industries, leading to the emergence of numerous players in the market. Industry giants like SAP and Oracle Corporation were drawn to this innovative concept. As a result, the landscape of BI became alluring for the first time, and many actors joined the burgeoning industry. However, early databases faced "silo" limitations and lacked flexibility due to their one-dimensional nature. But, Nielsen's Audimeter and Oracle's database improved data processing in the late 1970s (Lago, 2018; Limp, n.d.).

During the 1980s, the BI industry saw rapid vendor growth and, consequently, continuous development of databases. Competitive pressures lowered storage costs, leading to better databases and innovative strategies for managing diverse data sources for analysis. As a result, William H. Inmon and Raph Kimball introduced distinct yet comparable methods for storing data in a single, fully integrated location, even when originating from diverse sources. This led to the development of Data Warehouses (DW), central databases that gather extensive data from multiple sources, enhancing cross-referencing and analysis possibilities. Inmon and Kimball developed the concept of the DW and their books "Building the Data Warehouse" (Inmon, 2005), "The Data Warehouse Toolkit" (Kimball & Ross, 2013) and "The Data Warehouse Lifecycle Toolkit." (Kimball, Reeves, Ross, & Thornthwaite, 1998) are considered classics in BI still widely referenced today. DW represented a pivotal advancement, albeit technologically complex and costly compared to today. While maintenance demanded skilled technicians, data access time significantly improved as data consolidation streamlined information retrieval. Despite the technical challenges, BI became essential for decision-making, with tools like Crystal Reports and Microsoft Excel gaining prominence (Biere, 2003; Heinze, 2014; Lago, 2018; Limp, n.d.; Velosa, Quijano, Martínez, Pabón, & Portella, 2021).

In the 1990s, as competition increased and IT professionals gained expertise, the cost of maintaining DW decreased. This led to wider data access for top management and company employees, marking the era as BI 1.0. However, limitations persisted as generating new queries remained expensive, and quick answers were specific and unsatisfactory for all user needs. To address this, new BI tools emerged, notably for ETL and Online Analytical Processing (OLAP), to provide more detailed and efficient answers. These tools played a significant role in speeding up processes and are essential to modern BI solutions (Heinze, 2014; Limp, n.d.).

The early 2000s ushered in BI 2.0, where the adoption of BI became crucial for companies to remain competitive. Large and medium-sized enterprises considered BI solutions essential and mandatory, leading to intense competition among industry giants like IBM, Microsoft, SAP, and Oracle. BI tool development focused on speed and user-friendliness, making data accessible even to non-technical individuals. Predictive analytics, cloud technologies, the widespread adoption of the internet and the growth of social media and e-commerce expanded data sharing, collection and analysis opportunities. The need for real-time data integration grew as the world became more interconnected, and BI 2.0 integrated real-time data and self-service features, reducing the reliance on IT departments. The launch of Google Analytics in 2005 marked a significant step in allowing real-time data integration and self-service functions and, subsequently, led to the creation of the term big data by Roger Magoulas from O'Reilly Media. This term referred to vast data volumes beyond traditional management capabilities due to complexity and size (Heinze, 2014; Lago, 2018; Limp, n.d.).

In recent years, BI has evolved into the present era of BI 3.0, which has become more widely adopted by organisations of all sizes and across all industries. This is partly due to the increasing availability of data and the ability to process and analyse it more easily, as BI tools are progressively becoming more user-friendly seamless, and incorporating new features for enhanced efficiency. Amidst a proliferation of software applications, companies handle vast amounts of data stored in disparate repositories, often necessitating significant physical space. In this sense, cloud computing has emerged as a prevalent solution to address this data volume, and the emergence of quantum computers offers prospects. Integrating data from diverse sources also challenges data quality due to differing structures. Then, concepts like data governance and data management have gained traction to establish unified data handling practices, that is, to create and enforce standardised, universally accepted rules and regulations for proper data utilisation and management within companies. Data governance and management have encountered substantial obstacles concerning data security and privacy. Escalating cybersecurity threats and breaches highlights the importance of safeguarding sensitive data, ensuring controlled access, and deterring unauthorised intrusions. Simultaneously, data privacy regulations have gained prominence, compelling organisations to protect customer privacy rights, leading to an increased emphasis on data governance practices. Data quality assurance, adherence to compliance standards, and privacy protection are paramount for upholding trust and adhering to regulatory obligations (Lago, 2018; Limp, n.d.; Watson, 2009).

Looking ahead, the future of BI is predicted by several key trends. Natural Language Processing (NLP) and conversational BI have already joined BI, but are expected to be enhanced further to allow users to interact, in a seamlessly manner, with data using language and voice, simplifying access and analysis for a wider audience. Additionally, augmented analytics will leverage Machine Learning (ML) and NLP to automate data preparation and analysis, empowering non-expert business users to access and understand data and to make data-driven decisions, consequently reducing reliance on data analysts. More advanced data visualisation will offer interactive and immersive representations, like emerging techniques like Augmented Reality (AR) and Virtual Reality (VR) dashboards, which are expected to provide engaging ways to explore data and compelling experiences. Artificial Intelligence (AI) and ML will streamline data processing, automating modelling and analysis, offering predictive and prescriptive views and enabling intelligent insights. These trends collectively shape the future of BI, making it more user-friendly, insightful, and immersive while reducing barriers to data-driven decision-making (The European Business Review, 2023).

In conclusion, the history of BI has been marked by a steady progression of technological advancements and this trend is anticipated to persist in the future. These developments have enabled organisations to access and analyse data in new and powerful ways and have led to the emergence of a wide range of BI tools and techniques that are now widely used to support decision-making and improve business performance. BI's development has undoubtedly been a collaborative effort involving researchers, practitioners, technology companies, and various industries that recognised the value of leveraging data for better decision-making.

2.1.2 Concept and Importance

BI refers to the tools, software and techniques organisations use to collect, store, access, analyse and present data to make informed and data-driven decisions in a business environment. That is, using technologies and methods to transform raw data into meaningful knowledge can inform decision-making (Abai et al., 2019; Antunes et al., 2022; Apraksin et al., 2018).

The importance of BI in today's business world cannot be overstated. With the increasing amount of data being generated every day, it has become critical for organisations to leverage this data to gain a competitive edge. As such, several sectors have already adopted BI solutions. They are transportation, banking, healthcare, education, retail, manufacturing, insurance, telecommunications, gaming, agriculture, sports, energy, pharmaceuticals and others (Antonelli, 2009; Briney, 2018; Olszak, 2016).

The use of BI helps businesses to make informed decisions, stay ahead of the competition, and ultimately drive growth and success.

One of BI's primary and key components is data analysis, which involves collecting data from multiple sources such as databases, spreadsheets, and cloud-based systems and processing and analysing it using statistical, mathematical and ML techniques to extract meaningful insights. These insights can then be used to inform decisions about various aspects of the business, such as product development, marketing strategies, and customer behaviour. The analytics can include descriptive analytics, which provides a summary of historical data, and predictive analytics, which uses data to predict future events (Elena, 2011; Grossmann & Rinderle-Ma, 2015; Rud, 2009).

For BI to be effective, businesses must clearly understand their data needs and how they want to use the insights generated by BI. This requires developing a clear BI strategy that outlines the goals and objectives of the organisation and how BI can be used to support these goals. Moreover, organisations need the right resources, including personnel with the necessary skills and experience to manage and analyse data (Maheshwari, 2015; Patil & Hilary, 2015).

In fact, BI is a multifaceted concept that represents the systematic utilisation of data to enhance decision-making processes within an organisation. It encompasses a broad array of technologies, strategies, and methodologies aimed at transforming raw data into actionable insights, ultimately steering businesses towards improved performance, efficiency, and competitiveness (Apraksin et al., 2018; Patil & Hilary, 2015; Rud, 2009).

At its core, BI is the practice of gathering, analysing, and presenting data in a coherent and understandable manner. This process involves a series of steps: data collection, data integration, data analysis, data visualisation, reporting and dashboards, business insights, data-driven decision making, and continuous improvement (Patil & Hilary, 2015).

BI begins with the collection of data from various sources, both internal and external to the organisation. These sources can range from databases and spreadsheets to web analytics, social media, and market research (Olszak, 2016).

Once collected, data needs to be integrated and consolidated into a central repository. This step is crucial in ensuring data consistency and accuracy (Olszak, 2016).

With the integrated data in place, BI tools and technologies are employed to perform various types of analyses. This can include descriptive analysis to summarise historical data, diagnostic analysis to identify trends and outliers, predictive analysis to forecast future outcomes, and prescriptive analysis to recommend actions based on insights (Grossmann & Rinderle-Ma, 2015; Patil & Hilary, 2015).

Human beings are inherently visual creatures, and data visualisation plays a pivotal role in BI. It involves the creation of graphs, charts, dashboards, and reports that make complex data more accessible and comprehensible (Patil & Hilary, 2015).

BI systems often produce regular reports and interactive dashboards, providing stakeholders with up-to-date information and real-time insights. These tools enable decision-makers to track key performance indicators (KPIs) and respond promptly to changes in the business environment (Grossmann & Rinderle-Ma, 2015).

The ultimate goal of BI is to extract valuable insights from data that can inform strategic decisions. These insights can relate to customer behaviour, market trends, operational efficiencies, cost optimisations, and more (Grossmann & Rinderle-Ma, 2015; Olszak, 2016; Patil & Hilary, 2015).

BI empowers organisations to make data-driven decisions. This means that instead of relying solely on intuition or past experiences, decisions are grounded in empirical evidence and analysis (Burton et al., 2006; Patil & Hilary, 2015).

BI is not a one-time process, it is an ongoing journey of continuous improvement. Businesses use feedback loops to refine their BI strategies, adapting to evolving market conditions and technological advancements (Grossmann & Rinderle-Ma, 2015).

BI systems can take various forms, from on-premises software solutions to cloud-based platforms. They utilise a wide range of tools and technologies, such as DW, data mining, ML, and AI, to extract insights from data (Grossmann & Rinderle-Ma, 2015; Rud, 2009).

In summary, BI is the art and science of converting raw data into actionable knowledge, fostering informed decision-making, enhancing efficiency, and giving businesses a competitive edge in an increasingly data-centric world. BI is a critical tool for organisations to stay ahead in today's fast-paced and data-driven business environment. Its ability to access, analyse and act on data quickly and effectively is becoming increasingly important. Based on data analysis, BI can provide organisations with a wealth of insights and intelligence that can be used to improve performance, identify new opportunities, and make relevant, accurate, timely, and smart decisions, driving growth and success. Therefore, it plays an important role in business survival by enhancing productivity and profitability.

2.1.3 Benefits

In today's data-driven world, businesses have access to an ever-expanding treasure trove of information. This data, when harnessed effectively, can be a powerful tool for organisations to gain a competitive edge and make informed decisions. BI is the key that unlocks this potential, offering a myriad of benefits to companies of all sizes and across various industries.

One of the most significant advantages of BI is its ability to transform raw data into actionable insights. Through advanced analytics and reporting tools, BI systems help organisations make data-driven decisions. This means less reliance on gut feelings and more reliance on concrete evidence, reducing the risk of costly errors (Jourdan, Rainer, & Marshall, 2008; Rud, 2009).

BI streamlines the process of data collection, analysis, and reporting. It consolidates data from various sources into a single, user-friendly platform, saving time and effort. Teams can spend less time gathering and manipulating data and more time interpreting it and devising strategies. Traditional manual reporting processes can be time-consuming and prone to errors. BI automates reporting tasks, ensuring that stakeholders have access to up-to-date, accurate information whenever they need it (Antonelli, 2009; Antunes et al., 2022; Rud, 2009).

Accurate forecasting is a cornerstone of successful business operations. BI systems use historical data and predictive analytics to generate forecasts, helping businesses anticipate market trends, customer behaviour, and demand fluctuations. This is invaluable for inventory management, staffing decisions, and overall resource allocation (Burton et al., 2006; Maheshwari, 2015).

BI can help identify different customer segments based on various criteria, enabling businesses to tailor marketing efforts and product development to specific demographics or behaviours. Understanding customer preferences, behaviour, and feedback is then essential for tailoring products and services. BI tools can help in this regard by providing a 360-degree view of customer interactions. This information can be used to personalise marketing campaigns, improve customer service, and drive customer retention (Rud, 2009).

BI allows organisations to identify areas of inefficiency and wastage. By analysing operational data, companies can pinpoint cost-saving opportunities, optimise supply chains, and reduce overheads, ultimately improving their bottom line (Jourdan et al., 2008).

BI can analyse external data sources, such as social media trends, news, and economic indicators, to provide a comprehensive view of the market landscape. This enables businesses to adapt to changing market dynamics. In a crowded marketplace, gaining a competitive advantage is crucial. BI enables businesses to stay ahead of the curve by providing real-time insights into market trends and competitor performance. This information empowers organisations to make strategic decisions that can set them apart from their rivals (Antonelli, 2009; Jourdan et al., 2008).

In industries with stringent regulatory requirements (e.g., healthcare or finance), BI tools can help ensure compliance by tracking and reporting on data in accordance with industry standards. BI tools help businesses monitor compliance with industry regulations and internal policies. They can also assess and mitigate risks by identifying potential issues in real time, allowing for proactive interventions to prevent problems from escalating (Antonelli, 2009; Jourdan et al., 2008; Yahaya et al., 2019).

BI doesn't just benefit top-level executives, it empowers employees at all levels. Access to relevant data and analytics tools enables teams to make more informed decisions in their day-to-day tasks, fostering a culture of data-driven decision-making throughout the organisation

(Maheshwari, 2015).

Businesses can track the impact of BI investments more precisely than ever before. ROI can be measured through KPIs and analytics, demonstrating the tangible benefits of data-driven strategies (Maheshwari, 2015; Rud, 2009; Yahaya et al., 2019).

BI solutions are highly scalable, making them suitable for businesses of all sizes. BI tools can be tailored to the specific needs of any organisation and expand as the business grows (Yahaya et al., 2019).

BI systems often provide real-time or near-real-time data, allowing businesses to react swiftly to changing market conditions, customer preferences, or operational issues. This agility is vital in today's fast-paced business landscape (Patil & Hilary, 2015).

BI tools can be customised to meet specific business needs. Whether it is creating custom reports, dashboards, or data models, organisations can tailor BI solutions to align with their unique objectives and workflows (Olszak, 2016).

Implementing BI often necessitates data cleansing and standardisation. This focus on data quality not only improves the accuracy of reporting but also ensures that decisions are based on reliable information (Antonelli, 2009; Rud, 2009).

BI platforms often support collaboration features, allowing teams to share insights, reports, and findings with ease. Collaborative BI fosters better teamwork and knowledge sharing within an organisation (Patil & Hilary, 2015).

Cloud-based BI solutions have become more prevalent, eliminating the need for substantial upfront investments in hardware and software. This makes BI more accessible to small and medium-sized enterprises (Antonelli, 2009).

BI is not a one-time implementation, it is an ongoing process of analysing, learning, and refining strategies. It encourages a culture of continuous improvement, where organisations learn from past data and adjust their tactics accordingly (Antonelli, 2009; Jourdan et al., 2008; Olszak, 2016).

For businesses looking to expand globally, BI can help assess the suitability of new markets, understand local consumer behaviour, and adapt strategies to fit different cultural and economic contexts (Jourdan et al., 2008).

BI can also be used for monitoring cybersecurity threats. By analysing network and system data, organisations can detect unusual patterns or potential security breaches and respond proactively Antonelli (2009); Jourdan et al. (2008).

BI tools can assist in tracking and reporting on sustainability metrics, helping organisations meet environmental and social responsibility goals and communicate their efforts to stakeholders (Olszak, 2016; Patil & Hilary, 2015).

In conclusion, Business Intelligence is no longer a luxury, it is a necessity in today's competitive landscape. By harnessing the power of data, BI provides a multitude of benefits, from improved decision-making and operational efficiency to a deeper understanding of customers and markets. As organisations continue to generate and collect data, those that embrace BI will be better equipped to thrive in an ever-evolving business environment.

2.2 Power BI

Power BI is a self-service and user-friendly platform and a powerful and versatile BI tool developed by Microsoft. Its purpose is to allow users to connect to and import data from various sources; transform, clean and model that data; create custom queries; build very intuitive, interactive and dynamic reports and dashboards with various types of visual elements; automate reports and share them and collaborate on the results with others. Thus, it aims to bridge the gap between data and decision-making (Microsoft Power BI, 2023c; Microsoft Power BI Documentation, 2023i).

Being a BI platform, Power BI has become an essential tool for organisations of all sizes to make informed decisions and gain a competitive edge in today's data-driven business landscape. Adopting Power BI can yield significant benefits and advantages for organisations and drive impactful outcomes (Microsoft Power BI, 2023c; Microsoft Power BI Documentation, 2023i).

This BI tool consists of a collection of software services, apps, and connectors that transform data into actionable insights. The platform includes the Power BI Desktop, a Windows desktop application used to create, design, develop and edit BI solutions, namely, reports and dashboards; the Power BI Service, a web-based application used to publish, share and collaborate on the mentioned BI solutions; and the Power BI mobile app, for viewing the reports and dashboards on mobile devices with a responsive and optimised experience on the go (Microsoft Power BI, 2023b; Microsoft Power BI Documentation, 2023i, 2023j, 2023m).

The Power BI Desktop user interface consists of three core components. First, the Report View is the tool for controlling the layout of the dashboard presented to the end user by creating a visual layer of the data model using interactive visualisations. The second component is the Data View, which provides the ability to see raw data for each table in the model and where columns can be sorted, renamed, formatted, deleted, hidden, or have their datatype defined or changed. A hidden column will always appear in the Data View but not in any field list in the Report View. Latter, Power BI Desktop user interface also has the Relationship View. This section shows the dimensional model of the data and every table present in the data model and allows adding, changing, or removing relationships between those tables (Microsoft Power BI Documentation, 2023j). It is possible to add or change calculations from all views.

To empower users to transform raw data into actionable insights, Power BI boasts an array of powerful and robust features and capabilities, including data connectivity, integration, preparation, modelling, interactivity, advanced analytics features, scalability, collaboration, mobile support, security, ease of use, automation and alerts. All represent large benefits and advantages in using Power BI to treat data inside organisations.

Data connectivity is the Power BI's ability, through Power Query, to connect to various data sources, including Excel, SQL Server, SharePoint, various cloud-based services such as Azure and Google Analytics, and many other popular data sources using connectors and gateways. This represents a huge advantage since it makes it possible and easy for users to access all the data they need for their reporting and analysis purposes (Microsoft Power BI Documentation, 2023a).

Data integration, on the other hand, goes beyond just connecting to data sources. It also combines, integrates and visualises the data from different sources in a unified manner, providing a more comprehensive view of the organisation's data by transforming data from multiple sources into a unified and coherent format suitable for analysis and reporting. Data integration often includes tasks like data cleaning, data transformation, and data modelling (Microsoft Power BI Documentation, 2023e).

In this context, Power BI offers a range of data preparation features, such as data cleansing, transformation, and shaping, to ensure that the data is accurate, consistent, and formatted correctly, making it suitable for analysis and visualisation. This includes activities like filtering, removing duplicates, handling missing values, standardising data formats, merging, etc. Concretely, data cleansing consists of removing or correcting inconsistent or incorrect data. Data transformation is applying splitting, merging, pivoting, unpivoting, and merging to reshape the data. Data shaping consists of filtering, sorting, grouping, and aggregating data to prepare it for visualisation. Power Query is the primary tool within Power BI for data preparation tasks (Aspin, 2017; Ferrari & Russo, 2016; Microsoft Power BI Documentation, 2023e).

In turn, data modelling refers to the process of designing the data structure within Power BI to create a coherent and efficient foundation for analysis and reporting. Data modelling aims to transform raw data into a format that enables meaningful insights and visualisation. It involves defining tables, columns, relationships, and calculations to create a coherent and logical data model. Tables represent various data entities or categories, each comprising columns containing specific information types. Columns represent individual data fields within a table and can contain various data types, such as text, numbers, dates, and more. Relationships define how data across different tables is related to each other. Thus, establishing relationships between tables is a crucial part of data modelling. Power BI uses relationships to combine data from multiple tables when needed. These relationships are typically based on primary key and foreign key relationships. A primary key uniquely identifies each row in a table, while a foreign key in another table refers back to the primary key in the related table. Still, in this context, cardinality specifies the number of related records between two tables, often categorised as "one-to-many" and "many-to-one.". Measures are calculated values involving complex calculations and aggregations of the data and are used on reports and visualisations. Calculated columns are similar to measures but are computed at the row level and stored as part of the table as new columns. Calculated tables are new tables built by defining calculations based on existing data. Unlike regular tables that store raw data, calculated tables store computed results. Measures, calculated columns and calculated tables are built using the Data Analysis Expressions (DAX) language. Moreover, hierarchies establish multi-level data grouping, aiding in drilling down and user-friendly navigation within reports. Undeniably, data modelling is crucial for producing accurate, consistent and insightful reports and dashboards. Power Query and DAX are the tools for effective data modelling (Russo & Ferrari, 2015).

Power Query is an intuitive ETL tool that allows users to connect to various data sources, import, clean, shape and transform data, and create a unified and clean dataset. It provides a user-friendly interface to transform and manipulate data before loading it into Power BI for further analysis, ensuring data accuracy and consistency before analysis (Microsoft Power BI Documentation, 2023l).

DAX is the formula language used in Power BI to create custom calculations and aggregations in the data model. It is a key feature of the platform and is used to build calculated measures, columns, tables, and relationships in Power BI data models. DAX functions resemble Excel formulas, yet they are specifically crafted to operate within relational data frameworks and execute dynamic aggregation processes. Using DAX, it is possible to create calculations based on filters in the report, create dynamic hierarchies, and perform time intelligence calculations. One of the key advantages of using DAX in Power BI is that it allows performing complex calculations and aggregations on data while maintaining the model's performance.

Because DAX formulas are calculated on the fly as the data is loaded, they don't require the data to be pre-aggregated. This means the data model remains smaller and more performant (DAX Patterns, 2023; Microsoft Power BI Documentation, 2023b).

Power BI is characterised as having interactivity as it includes a variety of built-in visualisations, such as charts and graphs (including bar charts, line charts and scatter plots), tables, matrices, maps, gauges, cards, KPI indicators, and others, which can be customised to fit the user's and/or organisation's specific needs. Users can also create their custom visualisations using the Power BI developer tools. For instance, users can use Power Map, a 3D data visualisation tool, to create dynamic and interactive maps and explore geographic and time-based data on a 3D map, providing a visual representation of data trends and patterns across different locations. All visuals, from tables to 3D maps, allow to present and communicate data in a compelling and easy-to-understand manner, making it effortless to convey insights effectively. With them, users can create interactive and visually appealing reports and dashboards. In addition, users can employ drill-through functionality to explore data at various levels of granularity (Microsoft Power BI Documentation, 2023h).

This BI tool also offers a number of advanced analytics features, such as AI, ML, and NLP. It integrates with Azure AI services, allowing users to incorporate ML and AI capabilities into their reports and dashboards to automatically identify trends, anomalies, and patterns within the data, helping users discover valuable insights. Power BI's Q&A feature enables users to query data using natural language, that is, to ask questions about their data in plain language and receive instant visualisations, making it easier to explore data and gain insights. These features allow users to perform complex calculations and analysis on their data, augmenting data analysis (Canvas Intelligence, 2023; Microsoft Power BI Documentation, 2023d, 2023g).

Notably, Power BI provides the advantage of personalised dashboards and interactive reports, allowing companies to move away from a one-size-fits-all approach. With customisable, intuitive, and interactive dashboards, businesses can cater to their specific needs (Canvas Intelligence, 2023; Mounika Narang, 2023).

Scalability is another key capability since the platform can store and analyse millions of records (opposite to Excel and other similar software), and it can easily adapt to accommodate the increased data and user requirements as the needs of an organisation change. Whether for small-scale projects or enterprise-wide implementations, Power BI is versatile, and so it is designed to scale with organisational needs, making it suitable for businesses of all sizes. Additionally, it is available in both free and paid versions, with the free version, named Power BI Desktop, enabling users to create and share reports and visualisations with others in the organisation, and the paid version, denoted by Power BI Pro, adding additional features such as collaboration, data refresh, and additional data sources. This allows organisations to scale their usage of Power BI as their needs grow (Ian Littlejohn, 2023; Microsoft Power BI, 2023d).

Another valuable feature is collaboration. As aforementioned, Power BI includes a cloud-based service, called Power BI Service, for creating and sharing dashboards and reports and collaborating on them in real time. This promotes teams to work on the same reports simultaneously and share insights in real-time while ensuring that decision-makers are always working with the latest insights, making it an extremely useful tool for businesses and organisations of all sizes (Microsoft Power BI, 2023d; Mounika Narang, 2023).

Power BI also has a mobile app (mentioned before) for iOS and Android, allowing users to access their dashboards and reports on the go, which is essential for remote working and fieldwork. Reports and dashboards created in Power BI can be optimised for mobile devices, providing a seamless and interactive experience for users (Microsoft Power BI, 2023b).

Security is a key capability. Dashboards are only accessed by authorised stakeholders and thus they are shared securely with specific individuals, groups, or the entire organisation. Power BI offers robust security features, enabling users to control data access through access permissions in each dashboard and share insights securely within the organisation. Besides the permissions for access to the whole dashboard, the platform also includes row-level security by defining roles and filters in Power BI to control who can access specific data within a dashboard. Also, Power BI's Gateway Connectivity enables secure and efficient data transfer between on-premises data sources and the Power BI service in the cloud (Edwin Lisowski, 2018; Ian Littlejohn, 2023; Microsoft Power BI, 2023a; Mounika Narang, 2023).

In addition, the ease of use is another benefit of the tool, allowing all users to interact with it since it is considered easy to use, even for users with limited technical skills. The user interface is intuitive, and the tool includes a wide range of built-in templates and sample reports that can be used as a starting point for creating new reports (Canvas Intelligence, 2023; Ian Littlejohn, 2023; Mounika Narang, 2023).

Moreover, Power BI has a feature called Power Automate, which ensures that reports and dashboards always reflect the latest data, as it allows users to schedule and automate or on-demand the data refresh, create custom connectors to connect to other systems and set alerts to keep the team informed of the latest data (Microsoft Power BI Documentation, 2023c).

Power BI also offers real-time data connectivity, allowing users to set up dashboards that display up-to-date information. This is particularly useful for monitoring KPIs and making timely decisions (Mounika Narang, 2023).

Furthermore, users can set up data alerts to receive notifications when specific data conditions are met, helping to monitor key metrics proactively. The ability to set up data-driven alerts and notifications ensures that stakeholders stay informed about changes in the data (Microsoft Power BI Documentation, 2023f).

The latter, Power BI Embedded, enables users to integrate Power BI reports and dashboards directly in applications, websites, or portals, extending the reach of the data insights. It allows developers to embed interactive Power BI content within their software products, enabling end users to access and interact with data visualisations seamlessly, without requiring a separate Power BI license (Microsoft Power BI Documentation, 2023k).

These are just examples of the most paramount capabilities and functions available in Power BI. The platform is constantly being updated. Therefore, the Microsoft Power BI documentation site is a great resource to find more and always up-to-date information and official documentation about the functions and capabilities of this software.

In summary, Power BI has emerged as a versatile, robust and pivotal tool and a game-changer in the realm of BI and data visualisation, providing organisations with the tools they need to unlock the value of their data. Its ability to seamlessly connect, transform, model, and visualise data generates insights into business performance and trends. With features like interactive reports, natural language queries, and AI integration, Power BI ensures that insights are generated and effectively communicated and acted upon. It empowers data-driven decision-making by providing stakeholders with real-time and accurate information, enabling data-driven choices that lead to improved performance and strategic direction. The tool's intuitive interface and automation features save time and reduce the effort required to transform raw data into meaningful reports, resulting in increased productivity and cost savings. Thus, its wide variety of features and capabilities make it an indispensable asset for businesses seeking to derive actionable insights, drive informed decision-making and gain competitive advantage. Power BI's role in guiding these decisions will undoubtedly become increasingly significant as data grows in complexity and volume. Power BI's capabilities are shaping the future of data-driven decision-making.

Chapter 3

Methodology

3.1 Research Questions and Objectives

As its main purpose, the current study implements two BI solutions using Power BI and seeks to answer two fundamental questions of utmost significance in the context of BI.

Foremost, the main objective is to understand the value and relevance of BI, to find out whether it fulfils its purpose and can generate the benefits detailed in the literature review. The core question at the heart of the present study is centred around the capability of BI to generate substantive information and knowledge that can distinctly and positively shape the trajectory of a company's decision-making process. The essence of this endeavour lies in discerning whether BI's potential extends beyond the mere transformation of data to actively influencing how a company's choices are made. The resultant effect of such influence holds the promise of fostering enhanced performance, potentially culminating in a markedly strengthened competitive advantage in the dynamic business landscape. In essence, the study's pursuit aims to unravel whether BI can steer an organisation towards wiser decisions, elevated performance, and a more commanding position in the competitive arena.

Simultaneously, the study sets its sights on a comprehensive evaluation of the inherent worth, value and latent potential held by Power BI, a preeminent player in the realm of BI tools. The secondary inquiry, then, revolves around assessing Power BI's efficacy in providing useful and powerful BI solutions and its potential suitability for broad adoption within corporate settings. In substance, it seeks to understand whether Power BI holds the qualities that make it a valuable asset as a BI tool and whether its capabilities lend themselves to being harnessed extensively and intensively across a spectrum of analysis within companies.

By scrutinising these intertwined aspects, the research sheds light on the intricate interplay between cutting-edge BI capabilities and their transformative impact on organisational decision-making dynamics. Furthermore, evaluating Power BI's prowess and compatibility as a flagship BI solution seeks to unravel the practical pathways through which it could potentially revolutionise the landscape of data-driven decision-making across corporate environments. Through these meticulous investigations, the study aspires to contribute to a deeper understanding of how BI and Power BI, in particular, can reshape the business landscape by empowering enterprises to harness data-driven insights for strategic advantage.

3.2 Research Methodology

Aiming to implement a BI solution at Proef, using Power BI, the ongoing investigation is an applied research project. Thus, it requires a well-structured methodology to ensure a systematic approach.

In this context, the overall strategy or method used to implement and achieve the research objectives is a synergistic fusion of action research and case study. Combining both of these research designs can be a powerful approach considering the purpose of this study, allowing one to actively engage with the organisation and gain in-depth insights into specific aspects of the implementation.

At the core of this methodology lies the action research framework. This study is an organisational development project focused on problem-solving and improving real-world situations, and it involves collaboration with stakeholders to bring about practical change throughout the Power BI implementation process, combining scientific knowledge with organisational knowledge and contributing to scientific knowledge in an empirical way (Avison, Lau, Myers, & Nielsen, 1999; Coghlan, 2007).

Action research involves a cyclical and iterative process of identifying a problem, implementing interventions, observing the outcomes, and making continuous improvements based on the results. For the present study, this dynamic approach begins with the identification, in collaboration with Proef's stakeholders, of BI challenges and opportunities within Proef Group. It continues with the creation of the dashboards in Power BI aligned with Proef's strategic goals. Then, the dashboards are closely monitored, and feedback from stakeholders is gathered, providing a nuanced understanding of the solution's efficacy and impact on Proef's decision-making processes, performance metrics, and operational and financial efficiency. Real-time data collection and feedback mechanisms facilitate agile and iterative adjustments, fostering an environment for continuous dashboard improvement allowing the end of the process to be a collaborative and continuous optimisation of the Power BI solution. This iterative process ensures that the solution evolves in response to Proef's evolving needs and addresses any challenges encountered, fostering a continuous cycle of growth and refinement (Avison et al., 1999; Coghlan, 2007).

Therefore, action research allows for active collaboration with Proef and work closely with its stakeholders throughout the Power BI implementation process, ensuring that the BI solution is tailored to the specific needs and requirements of the organisation and overcomes any encountered obstacles. By proactively involving Proef Group in this transformative journey, with a spirit of collaboration and continuous improvement, the aim is to empower the company with timely and data-driven insights that significantly enhance decision-making capabilities and overall performance.

A case study exploration further enriches the methodology in parallel with the action research framework.

The case study approach provides detailed insights into specific contexts and allows researchers to explore complex issues. By delving into a specific department (Department A) and a specific company (Company X) within Proef Group, this focused investigation provides rich qualitative data into the different organisational contexts, which consequently allows an in-depth exploration of the Power BI solution's impact and efficacy on the Group (Tellis, 1997).

Hence, the case study exploration enriches the research by providing a deep and granular understanding of Power BI's value and feasibility as a widely used tool tailored to the distinct needs of various business units within Proef Group. Through this lens, a multi-faceted perspective of the transformative potential of Power BI in shaping decision-making outcomes is gained, identifying both common success factors and unique challenges within each case (Tellis, 1997).

By combining action research and case studies, the present study benefits from the strengths of both designs. Action research allows actively intervening and improving the Power BI implementation while engaging with stakeholders, fostering a collaborative learning process. The case study provides detailed and context-specific insights (in-depth and rich qualitative data), allowing to understand the solution's impact within Proef. Thus, by merging dynamic and participatory implementation with in-depth exploration of specific units, this research empowers a holistic and insightful investigation and unravels BI's transformative capabilities and Power BI's potential as a valuable and widely adopted BI tool. Through this rigorous approach, Proef Group can leverage data-driven decision-making to cultivate a sustainable competitive advantage in the ever-evolving business landscape.

3.3 Data Protection and Ethical Integrity

In conducting this comprehensive study, it was recognised the paramount importance of upholding data protection and ethical principles. In light of these considerations, measures have been taken to safeguard the privacy and confidentiality of individuals and entities involved while ensuring the accuracy and authenticity of the information analysed.

A data modification process has been implemented to strike a balance between preserving privacy and maintaining the integrity of the research. This process involves encoding personal identifiers such as individual names, client denominations, department titles and company designations. This approach prevents identifying specific individuals, clients, departments, or companies while retaining the factual essence of the data. For this reason, the authentic titles of the department and company within the Proef Group, for which the dashboards are being designed, remain undisclosed. These entities have been referred to as "Department A" and "Company X" heretofore, and this nomenclature will also persist in the future.

It is imperative to emphasise that the values and statistics utilised in the study are entirely real and unaltered. The genuine numerical data have been retained to ensure the validity of the findings and conclusions. The modifications introduced solely pertain to identification, eliminating any potential risks associated with data breaches or inadvertent disclosures.

This meticulous data modification process aligns with data protection, privacy, and ethical research principles. By employing this approach, there is a committed to safeguarding the privacy of participants, upholding ethical research standards and ensuring reliable and accurate results. Firstly, the study guarantees the privacy of participants as it respects the rights and privacy of individuals, clients, departments, and companies who contributed to the data. The coded identifiers eliminate any chance of direct or indirect identification. Secondly, it upholds ethical research standards, because, by coding sensitive information, it reduces the potential for unintended consequences, ensuring that the research remains unbiased, fair, and free from any undue influence. Finally, the study ensures reliable and accurate results, since the statistical values and outcomes presented reflect the actual data collected, enhancing the credibility of the research and the robustness of the findings.

Lastly, it is crucial to highlight that Proef has consented to utilise its data with encoded personal identifiers and unchanged values. Thus, as the insights gleaned from the study are unveiled, there is a commitment to data protection and ethical research. This approach reinforces the credibility of the findings and highlights the dedication to responsible and conscientious research practices.

Chapter 4

Power BI Implementation

4.1 Data Sources

In the implementation of Power BI at Proef within the scope of this dissertation, an array of data sources is harnessed to ensure comprehensive and meaningful insights. These sources are meticulously chosen to capture the granular operational details and the overarching financial perspectives essential for a holistic understanding of organisational performance.

To begin with, the primary operational data sources emanate from the Proef's internal databases through SQL Servers, specifically, ProefSQL server and ProefBI server.

ProefSQL server plays a pivotal role as it is a repository for data collected from Planner, Clockify, OnePoint and the IT platform. Planner serves as the central platform for employees across various departments to efficiently manage their tasks. Within each company section of Planner, employees can create tasks, specifying details such as task name, category, and associated items. To complement this task management process, Clockify is used to track and record the time spent on each Planner task. Through Clockify, employees can meticulously log their work hours in each specific task. Specifically, the employees from the IT department utilise their own platform (IT Platform) to register their tasks and monitor the timings. Additionally, OnePoint serves as an internal website within Proef. This platform offers a range of functionalities, one of which allows the departments, which do not register the task on Planner and which are not IT, to register their tasks and timings. Thus, ProefSQL offers a structured and organised source of information about the tasks performed by each employee. This information is integral to the research as it tracks and analyses operational KPIs.

On the other hand, ProefBI server is a comprehensive repository encompassing all data from NAVISION, which is Proef's Enterprise Resource Planning (ERP) system. Hence, this server houses a wide range of data related to the company's activities, including revenue, expenses, clients, projects, and other critical financial, economic and operational data. By integrating this data, the ability to monitor operational and financial KPIs is gained.

Complementing the internal data, Excel spreadsheets hosted on SharePoint are also incorporated. The Excel spreadsheets from SharePoint are crucial components of the data collection process, as they contain valuable information related to various parametrisations, the BI transition plan, detailed action plans and departments' evaluations.

These data sources are carefully integrated and analysed to ensure the accuracy and validity of the findings presented in this dissertation. The combination of structured databases and

SharePoint spreadsheets allows for a comprehensive exploration of the Department A's and Company X's indicators, facilitating well-rounded and insightful dashboards.

4.2 Tables

Various tables from the above data sources are required to successfully create the two proposed Power BI dashboards.

Most of those tables are dimension tables that describe the business units, providing context and categorisation. The remainder are fact tables that gather the quantitative and measurable data from several business units to expose activities and business processes.

The tables utilised within this research are thoughtfully organised and detailed in the following table. Each table is clearly categorised as either a dimension table or a fact table, reflecting its role in the data architecture. Additionally, the data source to which each table belongs and the dashboard with which each table is associated are explicitly specified. The table names have been altered for simplification, not reflecting the original names from the data sources.

Following the table, two dedicated sub-sub-chapters that offer a more comprehensive exploration of the tables used in this study can be found. The first delves into the dimension tables and the second, on the other hand, focuses on the fact tables. Both provide a breakdown of each table's purpose and the specific insights it contributes to the analysis.

Table 4.1: Dimension and Fact Tables. Own elaboration

Table	Type of Table	Data Source	Dashboard
dim_Companies	Dimension	ProefBI Server	Dashboard I
dim_Areas	Dimension	ProefBI Server	Dashboard II
dim_Departments	Dimension	ProefBI Server	Dashboard II
dim_Teams	Dimension	ProefSQL Server	Dashboard I Dashboard II
dim_Employees	Dimension	ProefSQL Server	Dashboard I Dashboard II
dim_Clients	Dimension	ProefBI Server	Dashboard II
dim_TaskNames	Dimension	ProefSQL Server	Dashboard I Dashboard II
dim_TaskCategories	Dimension	ProefSQL Server	Dashboard I Dashboard II
fact_Tasks	Fact	ProefSQL Server	Dashboard I Dashboard II
dim_Reports	Dimension	ProefSQL Server	Dashboard I
dim_ReportRecipients	Dimension	Excel Spreadsheets from SharePoint	Dashboard I
dim_CompanyCriticality	Dimension	Excel Spreadsheets from SharePoint	Dashboard I

dim_ReportCriticality	Dimension	Excel Spreadsheets from SharePoint	Dashboard I
dim_RecipientCriticality	Dimension	Excel Spreadsheets from SharePoint	Dashboard I
dim_Delivery	Dimension	Excel Spreadsheets from SharePoint	Dashboard I
dim_AccountingClosing	Dimension	ProefBI Server	Dashboard I
fact_BIAutomations	Fact	Excel Spreadsheets from SharePoint	Dashboard I
dim_Jobs	Dimension	ProefBI Server	Dashboard I
fact_JobsAnalysed	Fact	ProefSQL Server	Dashboard I
dim_JobStatus	Dimension	ProefBI Server	Dashboard I
fact_JobStatusEvolution	Fact	ProefBI Server	Dashboard I
fact_Actions	Fact	Excel Spreadsheets from SharePoint	Dashboard I Dashboard II
dim_Accounts	Dimension	ProefBI Server	Dashboard II
fact_AccountingMovements	Fact	ProefBI Server	Dashboard II
dim_EvaluationCategories	Dimension	Excel Spreadsheets from SharePoint	Dashboard II
fact_DepartmentsEvaluation	Fact	Excel Spreadsheets from SharePoint	Dashboard II
dim_Date	Dimension	Calculated Table	Dashboard I Dashboard II

4.2.1 Dimension Tables

The dimension tables employed in the two BI solutions are pivotal in shaping the structure and effectiveness of data analysis and reporting. These dimension tables are dim_Companies, dim_Areas, dim_Departments, dim_Teams, dim_Employees, dim_Clients, dim_TaskNames, dim_TaskCategories, dim_Reports, dim_ReportRecipients, dim_CompanyCriticality, dim_ReportCriticality, dim_RecipientCriticality, dim_Delivery, dim_AccountingClosing, dim_Jobs, dim_JobStatus, dim_EvaluationCategories, dim_Accounts and dim_Date. They encompass a diverse range of essential attributes, each contributing to the comprehensive understanding of the organisation's data landscape.

First, the Companies dimension table, dim_Companies, provides a comprehensive list of all the organisations within Proef Group, enabling data segregation and analysis based on the distinct entities within the conglomerate.

The Areas dimension furnishes a categorical and aggregated breakdown of departments based on their respective focus areas, such as financial, logistics, business development, information systems and more, facilitating specialised analysis within Company X's diverse functions.

In a more fragmented and disaggregated way, dim_Departments also aids in organisational structuring, allowing the exploration of data from a departmental perspective, which is essential for resource allocation and performance assessment.

The Teams dimension table provides insights into team structures made up of employees from different departments who have actions to perform together. In Dashboard I, teams comprise at least one employee from Department A. In contrast, teams in Dashboard II include the employees of Company X. This dimension is instrumental in understanding team dynamics, allocation of resources, and team-specific performance metrics.

Enabling workforce analytics and also resource allocation, dim_Employees contains information about all employees within the organisation.

The Client dimension table stores information about Company X's customers. Analysing client data is crucial for sales and customer relationship management.

The Task Names table categorises and organises all tasks performed by the employees of Department A, capturing the task names from Planner in Dashboard I, and all tasks performed by all employees from Company X, by merging the names of the tasks from Planner, OnePoint and the IT Platform in Dashboard II (the merging process is detailed in the "ETL Process", which is explained in Sub-chapter 4.3). What makes this dimension invaluable is its ability to facilitate a dynamic task drill-down process, allowing to dive deep into each task's specifics. This capability empowers to extract precise information about individual tasks, progress, contributors, and associated details, offering unparalleled insights for informed decision-making and resource allocation within Department A and Company X.

Task Categories dimension contains the possible categories of the tasks performed by the employees and described in the dimension previously mentioned. Hence, they help categorise and track tasks and activities, enhancing task-specific and task-aggregated analysis and management. Similarly to dim_TaskNames, also dim_TaskCategories is obtained through the data from Planner in Dashboard I and the combination of Planner, OnePoint and the IT Platform data in Dashboard II.

The dimension dim_Reports catalogues information related to various reports generated within Department A. This vital dimension provides a structured repository for these reports, allowing for organised access, categorisation, and reference. Together with the fact_Tasks, this table is indispensable for managing reporting processes, tracking report delivery, and ensuring the availability of critical data to stakeholders.

The dimension dim_ReportRecipients is a list of all the recipients of the reports produced by Department A, as it is the case of project management, middle management, top management and administration.

Company Criticality, Report Criticality, and Recipient Criticality dimensions numerically categorise, with a minimum of 1 and a maximum of 10, the criticality levels of the companies for which reports are made, the type of reports, and the recipients to which the reports are sent, respectively. These dimensions have the ultimate purpose of categorising the importance of each report produced by Department A, consequently assisting in prioritisation management.

The dim_Delivery table is primarily responsible for housing the critical parametrisations necessary for measuring Department A's monthly report delivery process. This table serves as a comprehensive reference, offering precise insights into how the timely delivery of reports is orchestrated. Specifically, it outlines for each report and type of delivery (report sent and presentation) the reference day – whether it aligns with accounting closing or the end of the month – and further delineates the number of days added to this reference day. This is a strategic manoeuvre to calculate the due date for each report to measure whether reports are delivered each month punctually and whether crucial information reaches the intended recipients promptly and efficiently.

The dim_AccountingClosing collects, for each month, the objective and actual dates when all accounting movements for that respective month have been fully recorded, and no additional entries are expected. This table marks the closure of financial activities for each accounting period, signifying the point at which all necessary transactions have been accurately documented and the books for that month are finalised. For Dashboard I, it is essential to clearly delineate when the accounting periods close to measure the timing compliance of the reports produced by Department A.

In turn, dim_Jobs holds information about various jobs, that is, subprojects, projects, global projects and contracts undertaken by Proef Group, whereas dim_JobStatus provides the list of possible statuses for those jobs, and they can be open, started, executed, ended, closed or suspended.

The dimension dim_EvaluationCategories encompasses the categories under evaluation for each Company X department: adequacy, client support, innovation, quality and timing. When added to the evaluation fact table, it facilitates a more precise comprehension of each department's strengths and areas in need of improvement.

The Accounts dimension table stores the accounting headings, being crucial data to support financial reporting, budgeting, and analysis.

Finally, dim_Date is essential for temporal analysis, allowing users to explore data trends, patterns, and performance variations across different periods, segment data into periods (year, month, quarter, week, and more) and gain comparative insights (homologous period, Year-to-Date (YTD), and others). It is a calculated table whose creation will be explained in detail in the "Calculated Tables" (Sub-sub-chapter 4.5.1).

These dimension tables collectively contribute to the robustness of this dissertation's BI solutions, enabling users to navigate and explore data with precision, derive actionable insights, and make informed decisions essential for the organisation's strategic growth and operational excellence.

4.2.2 Fact Tables

Fact tables are the dynamic heart of the BI systems, where quantitative data converges, allowing to measure, analyse, and derive insights. It serves as a repository for transactional or event-driven data, storing metrics and measures closely tied to the business operations. In the Proef's BI solutions domain, meticulously crafted fact tables serve as the repositories of quantitative and transactional data, offering a robust foundation for in-depth analysis and reporting. These fact tables are fact_Tasks, fact_BIAutomations, fact_JobsAnalysed, fact_JobStatusEvolution, fact_Actions, fact_DepartmentsEvaluation, and fact_AccountingMovements.

The fact_Tasks table is pivotal for monitoring and analysing task-related data within the BI solutions. This foundational table consolidates critical information concerning the progression of tasks, encompassing key elements such as task duration, the employees responsible for their execution, and the associated task categories, among other crucial factors. This meticulous consolidation paves the way for an exhaustive examination of time allocation across various tasks and workflow efficiency, allowing task management and informing resource allocation decisions, ultimately contributing to enhancing productivity across the organisation.

Furthermore, the fact_Tasks table serves a dual purpose, making its presence felt in both Dashboard I and Dashboard II. However, it is worth noting that its composition differs slightly between the two dashboards. In Dashboard I, this table is directly accessed with data from Clockify, extracting tasks-related data of Department A. Conversely and similarly to dim_TaskNames and dim_TaskCategories, in Dashboard II, the Tasks table is a more comprehensive entity, constructed by merging data from multiple sources, including Clockify, OnePoint, and the IT platform in order to get the event-driven data related to the tasks performed by all employees of Company X. The process is thoroughly elucidated in the upcoming sub-chapter, which delves into the intricacies of the ETL process.

The BI automation table is dedicated to cataloguing information concerning the planned and the executed BI automations. Specifically, it delineates the precise scheduling of the transactions from Excel spreadsheets to automated BI reports tailored for each Department A report. Additionally, it captures the execution dates following the successful completion of these scheduled processes. As such, Dashboard I can help Department A optimise the BI transaction process.

The fact_JobsAnalysed consists of a comprehensive repository for an in-depth exploration of the analysed job-related data. Within this table, all pertinent information concerning subprojects, projects, global projects, and contracts that have undergone analysis by Department A every month are compiled and organised. It allows tracking and quantifying the jobs scrutinised, facilitating a nuanced understanding of the workload and priorities over time. This table gives better visibility into resource allocation, allowing operational improvements.

To enhance the previous fact table in getting the analysed jobs, fact_JobStatusEvolution is dedicated to monitoring the dynamic evolution of the subproject statuses within the organisation across time. It serves as a historical record, providing valuable insights into the progression and transformation of these statuses over various periods. Dashboard I aims to identify how many subprojects remain unclosed over time to pinpoint which respective projects, global projects, and contracts are also unclosed (have at least one subproject not closed). Considering that closed jobs are not considered in the analyses of the department, the analysis allows understanding how many and which jobs are analysed in detail.

The Actions fact table meticulously documents information about planned actions in meetings. It comprehensively encompasses all actions already performed and to be performed, the responsible teams tasked with their execution, the current status of each action, the commencement, end and target dates, as well as the priority level assigned to each action, among other essential data. As a result, this table serves as a robust tool for monitoring and fine-tuning workflows, all while ensuring adherence to established protocols and promoting overall operational efficiency. Besides being present in both dashboards, this fact table is obtained from different data sources and the process is explained in more detail in the next sub-chapter.

For performance evaluation at the departmental level, fact_DepartmentsEvaluation documents the outcomes of the surveys conducted each year, quantifying the satisfaction levels of the surveyed individuals regarding the various departments within each category questioned over time. By systematically capturing and analysing this data, a comprehensive understanding of how Company X's various departments are performing is gained. This insight empowers the organisation to make informed decisions regarding resource allocation, identify areas for improvement, and implement targeted strategies to enhance overall efficiency and effectiveness. The fact_DepartmentsEvaluation table is a cornerstone in pursuing excellence and operational optimisation by driving continuous improvement initiatives.

Concluding the exploration of fact tables, the Accounting Movements table serves as the repository for financial data intricately tied to accounting transactions within the organisation. This table meticulously quantifies the financial movements that occur, offering a comprehensive insight into the financial dynamics of the operations. This data is instrumental in supporting financial reporting, allowing the generation of crucial financial documents like the P&L and the Balance sheet with accuracy and precision, consequently empowering in-depth financial analysis and providing valuable insights into fiscal health and performance, thereby aiding in strategic financial decision-making.

All these fact tables collectively empower the two BI solutions to unlock the full potential of Proef's data. By offering structured and quantifiable data, they enable to conduct detailed analyses, uncover trends, make data-informed decisions, and optimise operations across various facets of the organisation. As such, these tables are the backbone of data-driven decision-making within the Proef's BI ecosystem.

4.3 ETL Process

The sub-chapter titled "Data Sources" explained the data sources employed, encompassing SQL Servers (ProefBI and ProefSQL) and SharePoint directories housing Excel spreadsheets. As a result, data extraction is carried out within Power BI, employing Power Query to extract the dimension and fact tables previously mentioned from those data sources.

After extracting the data, the focus is shifted to the subsequent phase of the ETL process, namely, the "Transform" phase.

This phase is a critical juncture where the raw data extracted from Proef's SQL Servers and SharePoint folders undergoes, through Power Query, comprehensive modifications to render it suitable for analysis and reporting within the Power BI environment. In this context, it is imperative to highlight the intricate data preparation process that underlies the research.

First, five distinct tables have been meticulously crafted by amalgamating data from various sources through joins.

Notably, the fact_Tasks table of the Dashboard II results from merging task data from multiple platforms, encompassing Clockify, Onepoint, and the IT platform. This amalgamation was orchestrated to establish a unified repository for task occurrences within the organisation. Simultaneously, the dim_TaskNames and dim_TaskCategories tables of the same dashboard have undergone a parallel consolidation process. They were thoughtfully integrated with their respective counterparts from Planner, Onepoint, and the IT platform, giving rise to comprehensive tables that comprehensively encapsulate task names and categories across the organisational landscape. However, due to differences in naming conventions across these platforms, certain column names must align consistently. Therefore, a standardisation effort was undertaken to ensure uniformity in column names as a prerequisite to the join operation. This standardisation process helped streamline data integration from these disparate sources, enabling a more seamless and coherent analysis of task-related information across the organisation. The same task-related fact table and dimension tables in Dashboard I are directly obtained from the tables extracted from Clockify and Planner through the ProefSQL server, respectively, since Department A only register tasks and times in the Planner and Clockify apps.

To create a cohesive view of the actions in Dashboard I, the fact_actions table has been generated by appending six tables, each originating from SharePoint but representing distinct Excel spreadsheets. Remarkably, these six tables shared an identical structure. Each of these tables corresponds to planned actions undertaken by different primary companies within the group. While the actions are purposefully aligned, they are managed separately for each company. It has been imperative to merge these tables into a single unified dataset to facilitate a comprehensive analysis and gain a holistic perspective on the planned and executed actions. The consolidation process has entailed applying a join operation, harmonising the data from the six tables into one cohesive entity. This approach has eliminated redundancy and provided a consolidated view of the actions, making it considerably easier to identify commonalities, trends, and insights across the various companies. By amalgamating these data sources, the organisation is better equipped to make informed decisions and optimise its strategic planning efforts. On opposite, the fact table which gathers the actions of Company X in Dashboard II is obtained directly from a single Excel spreadsheet, since the aim, in this dashboard, is to get the actions that are planned for a single company, Company X.

The fact_AccountingMovements table originated from appending the table from the ProefBI server that contains the budget accounting transactions with the one which includes the real accounting transactions. The alignment in column names, data types, and other structural attributes simplifies the integration, ensuring consistency and accuracy. The notable distinctions are the extra column "Budget Name" present in the budget table, which does not have any corresponding column in the real transactions tables and the inclusion of an additional column in both tables, aptly named "Description". This small but significant addition plays a vital role in distinguishing the origin of each transaction, whether it stems from the budget or real accounting records. This unified dataset, therefore, effortlessly combines planned and actual financial activities, facilitating comprehensive financial analysis and informed decision-making within the organisation.

With the foundational structure of all the tables in place, the next phase involves transitioning to transforming these tables.

The first step in the data transformation journey has involved utilising the "Remove Duplicates" function in all primary keys belonging to dimension tables of Dashboard I and Dashboard II to delete the possible existing duplicates and ensure that the keys are unitary.

Columns that do not contribute directly to the research objectives or analysis have been identified and eliminated in all tables. Tables are streamlined by trimming unnecessary columns, resulting in a more focused and manageable dataset. This enhances the clarity and relevance of the data and simplifies subsequent analysis, ensuring that the findings and conclusions are based on the most pertinent information. The judicious removal of extraneous columns exemplifies the commitment to data precision and conciseness, aligning with the overarching goal of delivering well-structured and insightful dashboards.

In both dashboards, all date-related columns have undergone a conversion to the date data type, ensuring uniformity and consistency in how dates are represented throughout the dataset. Additionally, all numeric columns have been transformed into either integer or decimal data types, with the choice based on the specific characteristics of each column. This data type standardisation contributes to data integrity and facilitates efficient data analysis and computation.

In order to reduce the rows' quantity and enable a faster and easier data load, filters have been applied to tables based on criteria defined in one or more columns. In Dashboard I, tables dim_Teams, dim_Employees, dim_TaskNames, dim_TaskCategories, and fact_Tasks have been filtered to contain only the rows corresponding to Department A. In a similar basis, tables dim_Areas, dim_Departments, dim_Teams, dim_Employees, dim_TaskNames, dim_TaskCategories, and fact_Tasks from Dashboard II have been filtered to include the rows related to Company X. Additionally, date filters have been applied on the fact tables (except fact_AccountingMovements) in order to retrieve the data from last three years and remove the rest, given that Proef is solely focused on examining the recent years. The fact_AccountingMovements remains unfiltered by date because the Balance sheet requires all registered transactions. However, this table and dim_Accounts have been filtered by the financial statements, in this case, the P&L and the Balance sheet, because they are the ones used for the Company X's dashboard. Furthermore, the dim_AccountingClosing table has been restricted by the task condition, specifically set to "Month-end closing". Ultimately, within the fact_DepartmentsEvaluation, there have been instances of missing values within the "Value" column, representing respondent satisfaction levels. To handle this data, rows with missing values have been excluded from the analysis.

In the dim_TaskName table, the task names have been structured in a format that includes their creation date followed by a hyphen and the actual task name. To refine this structure and enhance the analysis process, the column has undergone a transformation where the task names have been obtained by extracting the text after the delimiter (hyphen). The objective behind this transformation is to isolate and retain the task names exclusively, as the creation date is deemed unnecessary for analytical purposes.

Still, in the task name table, there are tasks that either possess no name, signifying missing values, or tasks designated with the name "N/A." or "-". To handle missing values and standardise the values within this table, both the missing values and the "N/A" and "-" names have been substituted with the label "Unspecified task". This alteration promotes consistency and clarity within the dataset.

The fact_Tasks table of Dashboard I has undergone a significant transformation by merging it with a lookup table containing supplementary task-related information, namely, the item names associated with each task. These item names are systematically aggregated within a separate dimension table. However, due to their relatively lower significance within the overall pertained analysis, a strategic decision has been made to avoid loading this dimension table. Instead, a more efficient approach has been adopted, and the item values have been integrated into the fact_Tasks table in order to be able to reference them in case a specific analysis requires their inclusion. This streamlined approach optimises data storage and ensures that the dataset remains nimble and adaptable, with the capacity to incorporate additional information when warranted by analytical requirements.

To safeguard data privacy and protection, derived columns employing the M language have been deployed for individuals and entities' name encoding. This step is crucial for concealing sensitive information within the dataset, as explained in Chapter 3.

Using the same language, additional columns have been created to enhance data connections. Thus, these transformations targeted to establish extra keys facilitating the linkage of various tables. Under this scope, the "Delivery ID" column amalgamates data from the "Report ID" and "Delivery Type" columns in both the dim_Delivery and fact_Tasks tables of Dashboard I. This clever amalgamation is a linchpin, enabling seamless connections between these tables. Similarly, the "Company_MonthYear_Key" column was crafted, aggregating data from the "Company ID" and "MonthYear" columns found in the dim_Accounting-

Closing and fact_Tasks tables of the Department A's dashboard. This composite key fortifies cross-table relationships, fostering comprehensive data analysis. Lastly, the "AreaDepartmentKey" column was instituted, drawing from the "DepartmentID" and corresponding "AreaID" columns in both the dim_Departments and fact_Tasks tables from Dashboard II. This transformation facilitates a holistic approach to data analysis, linking the tables in which the column was added.

Other significant transformation unfolds in the fact_BIAutomations table. Concretely, a new column named the "Date Type Index" has been generated. The primary objective behind this transformation is to ensure the systematic sorting of data within the "Date Type" column once the tables are loaded into Power BI. This predefined sorting order is paramount, aligning the data with the specific sequence relevant to the analysis.

The dim_Accounts table has undergone a series of transformative steps to enhance its utility for financial reporting and analysis. To begin, a pivotal transformation has involved the creation of the "P&L" column. This has been achieved by employing conditional logic to selectively retrieve in the mentioned new column the rows from the "Description" column corresponding to P&L accounts. Building on this foundational step, additional transformations have extended the table's capabilities. These transformations have given rise to a column including the P&L rows with other descriptions in order to get a more aggregated P&L, as well as an even more aggregated column named "Sales, Costs and Results". Furthermore, a dedicated "Balance" column has been introduced to encompass accounting accounts pertinent to the Balance sheet. Moreover, recognising the importance of preserving the order of financial statements, indexes have been thoughtfully generated for each new financial column. These indexes ensure the data can be sorted accurately, aligning with the sequence in which financial statements are typically presented. In the final leg of this table's transformations, introducing the "IsCalc" column has taken center stage. This column is a numeric marker assigned with unique values to the rows containing calculated values within the financial statements and which equals 0 in the remaining rows. It simplifies referencing and integrating these calculated rows into measures for the financial statements.

Within the fact_DepartmentsEvaluation table, a crucial change has been introduced through a process known as "unpivoting". This alteration has become necessary because the original source data, stored in an Excel sheet, is wide-format, presenting information with departments and years listed in rows, while the evaluated categories are arranged in columns. The data has undergone the unpivoting process to facilitate a more conducive format for aggregations and in-depth analysis. This transformation effectively has elongated the table, making it more amenable to comprehensive assessments and analytical operations.

Similarly, the fact_BIAutomations table of Excel from SharePoint presents a data structure where the automation types are distributed across columns. Consequently, for analogous reasons, as with fact_DepartmentsEvaluation, it has become necessary to subject the fact_BIAutomations table to the unpivoting process. Consequently, within the table, the automation types have become featured in the rows, in addition to all the other attributes already present within those rows. Thus, unpivoting this data has been undertaken to rectify the structure and transform it into a more analytically conducive format. By doing so, the data in fact_BIAutomations has been reorganised into a longitudinal format, enabling more efficient analysis, aggregation, and comparison of automation-related information.

After all these data transformations, the datasets are reshaped, cleaned, enriched, and structured, suitable for analysis and reporting.

Following the transformation phase, the transformed data is ready to be loaded into the Power BI data model. The “Load” phase is where data is organised into the fact tables and the dimension tables, forming the foundation for creating reports, dashboards, and other data visualisations.

Within the Appendix A, a more comprehensive analysis of the loaded dimension and fact tables can be found. Specifically, each table is accompanied by a corresponding table listing its existing attributes (columns) along with comprehensive descriptions and explanations for each attribute.

After successfully loading all tables, the view for analysis is optimised. To enhance usability and clarity, some columns within the dataset have been sorted based on specific criteria. This sorting process ensures that the data is presented in a logical and meaningful order, aiding financial analysts and decision-makers in their analysis. Additionally, certain columns that are not directly relevant to the analytical context have been hidden to streamline the view and focus on the most pertinent information. This typically includes key columns and other fields necessary for database operations but not essential for the intended analysis. By hiding these extraneous columns, the dataset becomes more concise and easier to navigate, allowing to concentrate on the key metrics and insights necessary for informed decision-making.

In conclusion, the ETL process within the Power BI implementation for the Proef Group is a meticulously orchestrated sequence of steps to transform raw data into actionable insights. It is the cornerstone upon which data-driven decision-making thrives within the organisation, ensuring that data is accurate, reliable, and readily available for analysis and reporting, ultimately supporting Proef's pursuit of excellence and strategic growth.

4.4 Dimensional Modelling

The relationships between tables in data modelling are crucial in understanding how data is structured and interconnected. A well-designed and robust dimensional model of the data is essential for creating insightful and actionable Power BI dashboards. Those models serve as the backbone of the data infrastructure, harmoniously combining dimension tables with fact tables to enable robust reporting, efficient data retrieval, analysis, visualisation, and informed decision-making across the organisation.

As such, a dimensional model was created for each of the two Power BI dashboards created in the context of this dissertation.

Figures 4.1 and 4.2 include the visual representations of the dimensional models within Power BI of both Dashboard I and Dashboard II, respectively, offering a clear and intuitive overview of their data architecture. This visual depiction aids in understanding the intricate relationships between fact tables (highlighted in green) and dimension tables.

As illustrated, both dashboards adopt the Galaxy, or also named, Galaxy schema as their architectural foundation. This schema is a versatile and interconnected structure that seamlessly integrates multiple fact tables and dimension tables. The Galaxy schema, renowned for its flexibility and scalability, is ideally suited for both dashboards, as they contain data from various business domains which must coexist harmoniously while maintaining the integrity of relationships.

Dashboard I contains one-to-one relationships between dimension tables, namely, dim_CompanyCriticality and dim_Company; dim_ReportCriticality and dim_Report; and

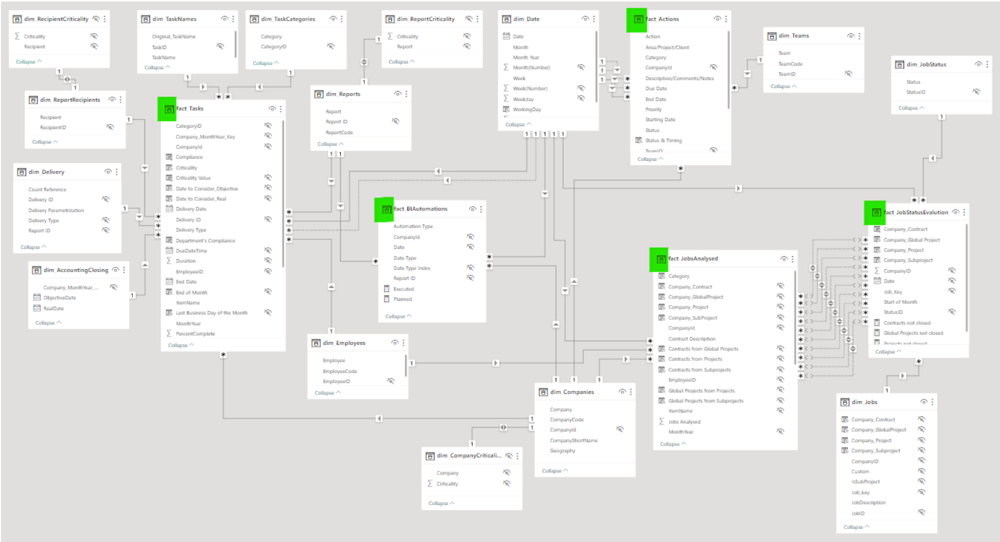


Figure 4.1: Dimensional Model of Dashboard I

dim_RecipientsCriticality and dim_Recipients. These relationships are predicated on the idea that the criticality values associated with each of the unique rows of the companies, reports and recipients are attributes from those dimensions that are gathered in other table.

The fact_Tasks table serves as a pivotal point in the database, forming one-to-many relationships with several essential dimension tables. These relationships are instrumental in connecting task-related data to a broader context. For instance, dim_TaskNames and dim_TaskCategories contribute to naming and categorising tasks, respectively, while links to dim_Employees provide valuable insights into the employees responsible for task execution. Similarly, connections to dim_Companies provide insights into tasks associated with different companies. By establishing links with dim_Reports, the table can associate tasks with specific reports, facilitating tracking and analysis of the reports. While ties to dim_ReportsRecipients shed light on the recipients of the reports linked to tasks. Furthermore, the relationships with dim_Delivery and dim_AccountingClosing allow for a comprehensive view of task delivery details, and related accounting information. Finally, the connection to dim_Date helps in analysing tasks within specific timeframes. These diverse relationships create a rich network of data that empowers comprehensive analysis and reporting within the database.

The fact_BIAutomation table establishes one-to-many relationships with three critical dimension tables: dim_Companies, dim_Date, and dim_Reports. These relationships encompass all the dimensions present within the fact table, enabling a comprehensive and interconnected view of the data. By connecting with dim_Companies, the table provides insights into the various companies involved in BI automation processes, facilitating analysis across different entities. Simultaneously, its relationship with dim_Date allows for temporal analysis, enabling the evaluation of automation activities over time. Lastly, the association with dim_Reports allows for a detailed examination of how automation processes relate to specific reports, enhancing the understanding of data-driven insights and their impact on business operations. This network of relationships empowers in-depth analysis and reporting within the database, facilitating informed decision-making and a holistic perspective on the BI reports implementation.

The database structure comprises other two vital fact tables, namely fact_JobsStatusEvalution and fact_JobsAnalysed, each linked to different dimension tables, forming a complex yet insightful data ecosystem. Firstly, fact_JobsStatusEvalution establishes one-to-many relationships with dim_Jobs, dim_JobStatus and dim_Dates. These relationships enable the table to provide valuable insights into the evaluation of job statuses within the context of specific jobs and dates. Moving on to fact_JobsAnalysed, it is intricately connected to three dimension tables: dim_Companies, dim_Employees, and dim_Date. These one-to-many relationships offer a comprehensive view of job analysis, incorporating factors such as company affiliations, employee involvement, and temporal aspects. This enables the examination of the performance of the Department A in analysing jobs from various angles, considering factors like company-specific jobs, and temporal trends. Moreover, what adds an extra layer of depth to the database structure is the unactive many-to-many relationships that interconnect these two fact tables. These unactive relationships create a dynamic link between job status evaluations and job analyses. Their purpose becomes evident when complex calculations are required to understand which subprojects, projects, global projects, and contracts remain unclosed and have been analysed. In such scenarios, the appropriate relation is activated within the calculation of the measure, allowing for a flexible and dynamic approach to data analysis. In essence, this intricate network of relationships within the database allows for a sophisticated analysis of job statuses, evaluations, and analyses. It aims to empower valuable KPIs calculations to uncover nuanced insights, and consequently make informed decisions, and gain a holistic understanding of how job-related analysis are performed over time within the department.

The fact_Actions table also establishes crucial one-to-many relationships with three significant dimension tables which play a pivotal role in providing context and insights into the actions recorded within the database. With dim_Companies, the relationship offers a detailed perspective on actions associated with various companies, enabling comprehensive analysis across different business entities. This connection proves invaluable for understanding the impact of actions on different organisational units. Similarly, the linkage to dim_Teams provides insights into actions carried out by different teams or groups within the organisation. This dimension facilitates the assessment of team-specific performance and contributions to the overall workflow. The relationship with dim_Dates is particularly multifaceted. Firstly, it establishes an active relationship between the column "Date" in dim_Dates and the "Starting date" column in the fact_Actions table. This active relationship enables straightforward and direct analysis of actions concerning their start dates. Furthermore, dim_Dates also engages in two unactive one-to-many relationships. The first links the "Date" column in dim_Dates with the "End date" column in the fact table, providing a historical context for actions based on their end dates. The second unactive relationship connects the "Date" column in dim_Dates with the "Due date" column in the fact_actions, offering insights into the timeliness and adherence to schedules for these actions. This feature allows for more flexible analysis and reporting, as it makes it possible to choose when and how to leverage these relationships based on specific analytical needs. In this context, these unactive relationships are activated in measures using the "USERELATIONSHIP" function when required. These intricate relationships create a web of data connections, allowing for comprehensive analysis of actions within the database. By considering factors such as company affiliations, team dynamics, and various date-related aspects, this framework empowers informed decision-making and a holistic understanding of actions and their impact on dim_Companies, dim_Teams e dim_Dates.

Lastly, it is important to note that dim_Companies and dim_Date are common dimensions shared across all the fact tables (except from fact_JobStatusEvalution in the case of dim_Companies, which is just an auxiliary table for the main fact_JobsAnalysed). This strategic design choice becomes especially evident in the "Visualisation" (Sub-chapter 4.6), explored further. The presence of companies and dates as global slicers throughout the entire dashboard allow for the seamless filtering of all analyses. This means that users can effortlessly tailor their views and insights across various analytical perspectives by selecting specific companies and/or specific dates, enhancing the dashboard's flexibility and user-friendliness.

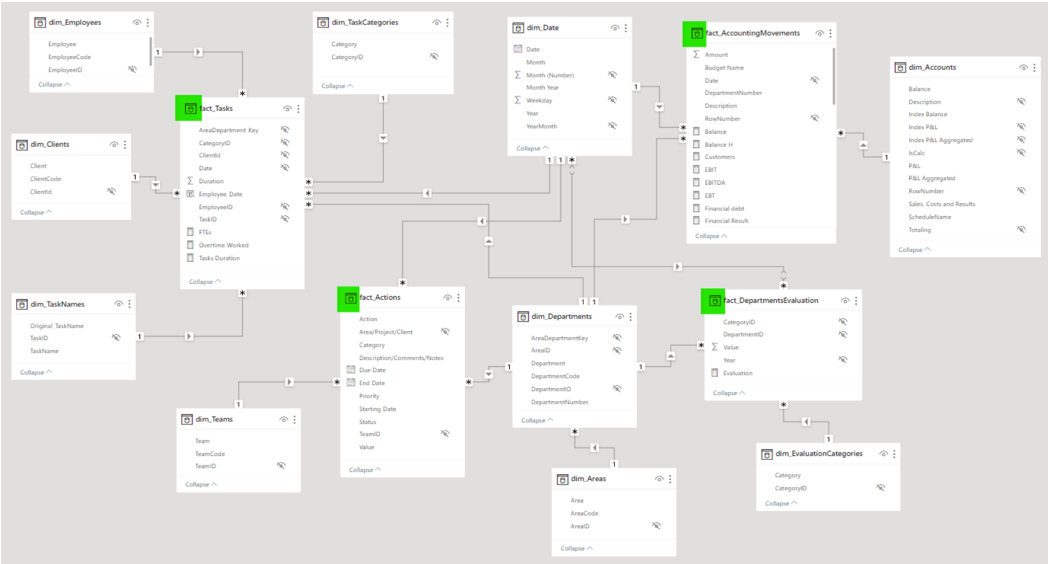


Figure 4.2: Dimensional Model of Dashboard II

Dashboard II contains a one-to-many relationship between two dimension tables, namely, dim_Areas and dim_Departments, the first being a sub-dimension. This relationship is predicated on the idea that an area serves as an aggregated categorisation encompassing multiple departments. In other words, multiple departments can belong to a single area, illustrating the one-to-many relationship.

Moving forward, one of the central components of this data schema, the Tasks fact table, serves as a hub, connecting various aspects of Company X's tasks. As already mentioned before, this table offers insights into the duration of the tasks performed each day. So it also offers insights into the tasks themselves, such as their names and categories, the employees responsible for executing them, the departments to which they belong, and the clients for whom these tasks are performed. As such, it establishes one-to-many relationships with several dimension tables, that is, dim_TaskNames, dim_TaskCategories, dim_Employees, dim_Departments, dim_Clients, and dim_Date. The connection between the foreign keys present in the Tasks fact table and the primary keys within these dimensions defines these relationships.

Next, the fact_Actions table catalogues planned and executed actions to be or already undertaken by teams, on specific dates, affecting various departments. Just like the Tasks fact table, it also maintains one-to-many relationships with the dimension tables that categorise those actions, in this case, dim_Teams, dim_Date, and dim_Departments tables. These connections ensure that the actions can be attributed to and filtered by teams, departments, and specific dates.

The fact_AccountingMovements table records daily accounting transactions in each financial statement account and associated to each department of Company X. Therefore, it maintains one-to-many relationships with the dim_Accounts, dim_Date and dim_Departments, allowing for the precise tracking of accounting activities associated with specific accounts on specific days and on specific departments.

Shifting focus to the fact_DepartmentsEvaluation table, one-to-many relationships are established with the dimension tables corresponding to the categories being analysed in inquiries and the departments evaluated, that is, dim_EvaluationCategories and dim_Departments, respectively. However, this fact table's distinctive feature lies in its connections with the dim_Date dimension through a many-to-many relationship. This is primarily because departmental evaluations occur on an annual basis. Consequently, a year may appear multiple times in the fact table (for each evaluation in a given year) and in the dimension (for each date within that year). Despite the many-to-many relationship, the cross-filter direction has been set as "single" from dim_Date to fact_DepartmentsEvaluation to filter the fact table based on the dimension table selection, ensuring clarity in data retrieval.

Finally, similar to how dim_Companies and dim_Dates function in the dimensional model of Dashboard I, dim_Departments and dim_Dates in Dashboard II are also connected to all the fact tables. This integration ensures that the final dashboard includes general slicers, allowing departments and dates to be filtered seamlessly. This versatile feature empowers the selection of specific departments and specific dates, enhancing the dashboard's usability and adaptability across various analytical contexts and periods.

In both dashboards, the one-to-many relationships facilitate data exploration, filtering, aggregation, easy and efficient querying, slicing, dicing, and drilling down, allowing Proef's stakeholders and decision-makers to gain valuable insights into both their operational efficiency and financial performance, make data-driven decisions, and ultimately drive business success. Whether tracking task and reports assignments, BI automation, jobs, actions, department evaluations, or accounting movements, the one-to-many relationships ensure that the right context is readily available to make informed decisions and drive business success.

The relationship structure is a cornerstone of effective data modelling, ensuring that the data remains organised, accessible, and insightful for both dashboards. The Galaxy schemas empower to perform complex cross-domain analyses, allowing to uncover hidden insights and correlations across the various datasets. By sharing dimension tables across fact tables, these schemas ensure consistent data context, reducing redundancy, and enhancing efficiency in reporting and analysis. Additionally, as Proef's data landscape evolves, the Galaxy schemas will be able to effortlessly accommodate additional fact and dimension tables, ensuring its long-term viability.

In summary, adopting the Galaxy schema in Power BI showcases the commitment to effective data management and analytics. This architectural choice underscores the schema's importance in achieving Proef's goals of data-driven decision-making, optimising operational efficiency, and maximising financial performance insights. With the Galaxy schema as the structural backbone, Proef is well-equipped to navigate the complexities of its data landscape and extract actionable intelligence for sustained success.

4.5 Calculated Tables, Columns and Measures

In the context of this dissertation's Power BI implementations, using calculated tables, columns, and measures is essential for harnessing the full potential of the data and driving insightful analysis. These components serve as a cornerstone of the data modelling and analysis efforts, enabling the extraction of meaningful findings and drawing well-informed conclusions. For this reason, the calculated tables, columns, and measures created in Power BI are explained in detail in the next sub-sub-chapters.

4.5.1 Calculated Tables

Calculated tables are custom tables created within the Power BI dataset. These tables are not part of the original data source but are constructed by defining specific formulas or expressions. Calculated tables are pivotal in organising, aggregating, and simplifying the data for analysis. They are particularly useful for scenarios where there is a need to create supplementary reference tables or perform complex calculations on the data.

In this dissertation, each dashboard creates a single calculated table, specifically the dim_Date table. The DAX formula of the table in each of the dashboards is described in Table B.1 in Appendix B.

This table encompasses a comprehensive list of all the days spanning from the first day (i.e. 1st of January) of the minimum year found across all the fact tables to the last day (i.e. December 31th) of the maximum year within the fact tables for each respective dashboard. It is instrumental in creating summarised views of the data, generating hierarchical date tables to facilitate time-based analysis, or aggregating data to a higher level of granularity. For this, it includes columns "Year", "Month", "MonthYear" and "Week" and also "Month (Number)", "YearMonth", and "Week(Number)", having these last three the purpose of representing the index for the sorting of the "Month", "MonthYear" and "Week" columns.

These tables are essential for simplifying data exploration and providing precomputed data that aligns with the analysis objectives.

4.5.2 Calculated Columns

Calculated columns are custom columns introduced within existing tables by specifying expressions or formulas using DAX. These columns enrich the datasets with computed values crucial for the analysis.

In this research, calculated columns become an integral part of the data model on both dashboards. Thus, they are explained next and detailed, with their corresponding DAX formulas, in Table B.2 in Appendix B.

In Dashboard I, the dim_Date table includes a calculated column named "WorkingDay". As the name suggests, the purpose of this column is to classify each day as a working day or not. It assigns a value of "True" if the day is a weekday and "False" if it falls on a weekend. This calculated column serves as a valuable tool for distinguishing between days when typical work activities are expected to occur and when non-working conditions apply. It plays a pivotal role in reporting scenarios where the differentiation between working and non-working days is essential for accurate assessments and planning within the organisational context.

“Criticality Value” and “Criticality” represent two calculated columns within the fact_Tasks table. Their primary purpose is to determine the priority level, whether it is low, medium, or high, associated with the reports. These calculated columns play a pivotal role in assessing the significance and urgency of the reports delivered, offering valuable insights into their respective importance within the departmental context. By categorising criticality levels, these tables contribute to a structured and informed approach to managing and prioritising tasks and reports within the department, ensuring that attention and resources are directed appropriately based on their criticality status.

The delivery of reports submitted by employees in Department A follows a specific target delivery date, which is calculated based on parameters recorded in the dim_Delivery table. According to this table, the delivery date is determined by considering the last business day of the month or the accounting closing date, to which a specified number of business days, as indicated in the parameter table, is added. When the reference point is the accounting closing date, it is possible to calculate either the general report delivery target date or the Department A-specific report delivery target date, using the objective or the real dates of the dim_AccountingClosing table, respectively. As such, to assess compliance with these report delivery deadlines, various calculated columns are created in the fact_Tasks. The “Compliance” calculated column aims to describe, for tasks indicating report and delivery, whether they were delivered on time or not. It uses ‘1’ to indicate on-time deliveries and ‘0’ for late deliveries, considering the objective accounting closing date or the last business day of the month as the reference point. On the other hand, when considering the actual accounting closing date or, again, the last business day of the month, compliance with the delivery deadline is assessed by the “Department’s Compliance” calculated column, which also gather 0s and 1s. Calculating these two columns relies on other calculated columns such as “End of Month”, “Last Business Day of the Month”, “Date to Consider_Objective”, “Date to Consider_Real”, “Report Due Date”, “Report Due Date _ realaccounting” and even the aforementioned “WorkingDay” calculated column from the dim_Date table. These columns assist in determining the target report delivery dates, considering the parameters specified in the dim_Delivery table. As a result, compliance columns are generated by comparing these calculated target delivery dates with the actual delivery dates recorded in the “Delivery Date” column, which was already present in the source table. This comprehensive system allows for a precise evaluation of report delivery timelines and performance within Department A.

Dashboard I has several calculated columns within the job tables, as observed in the Table B.2. These columns aim to create keys to establish relations between dim_Jobs, fact_JobEvolutionStatus and fact_JobsAnalysed tables. Additionally, some auxiliary calculated columns are created with the crucial purpose of assisting in the calculation of which jobs are both unclosed and have been analysed by Department A’s employees. This aids in determining the quantity of subprojects, projects, global projects, and contracts analysed within each specific period, helping the jobs calculations that will follow in the next sub-chapter.

Finally, within the fact_Actions table, two calculated columns have been introduced to enhance data analysis: “Timing Compliance” and “Status & Timing”. The “Timing Compliance” column calculates, for each completed or cancelled action, whether it was executed within the specified timeframe, thus providing insights into deadline adherence. On the other hand, the “Status & Timing” column categorically represents the state of each action, whether it’s open, completed, or cancelled, followed by its timing status, which is either “on time” or “out of time”. This categorisation simplifies the classification of actions based on their status and whether they were executed within the set timeframe, offering a more structured and insightful view of action management within the department.

In Dashboard II, a critical calculated column named "Employee_Date" takes center stage as the sole column computational element. This calculated column is meticulously crafted by aggregating data from the "EmployeeID" and "Date" columns within the fact_Tasks table.

The "Employee_Date" column serves as a pivotal preparatory step in the analytical process. It effectively differentiates values for each day worked by individual employees, contributing to a deeper understanding of workforce productivity and efficiency.

The primary objective behind the creation of this column is to facilitate the forthcoming calculations, which will be subjected to in-depth analysis in the subsequent sub-chapter.

4.5.3 Measures

In these Power BI implementations, measures are dynamic calculations central to the analysis of Department A's operational performance and Company X's operational and financial performance. They provide aggregated results, crucial for creating KPIs and quantitative assessments. Measures bridge the gap between data and information, quantifying trends and supporting evidence-based conclusions in the data-driven decision-making process. They are created using DAX in both Dashboard I and Dashboard II.

Table B.4 in Appendix B presents the comprehensive list of measures dedicated to Dashboard I and their DAX formulas, being distributed by their categorisation by dashboard analysis. These measures are meticulously designed to capture and quantify the operational indicators critical for the first analytical dashboard. They represent key performance metrics that shed light on Department A's operational effectiveness and efficiency.

Within the context of "Reports Availability" within the department, specific KPIs are utilised to gauge the effectiveness and timeliness of report deliveries. These KPIs encompass the reports' count, adherence to general timing standards, and compliance with Department A's specific timing requirements. These metrics are pivotal in assessing the department's performance and ensuring that reports are delivered in a timely and organised manner.

Additionally, the "Executed" and "Planned" measures are critical calculations used to quantify the cumulative number of reports slated for automation in the BI system and the cumulative actual number of reports that have been successfully automated, respectively. These measures offer valuable insights into the progress of automation initiatives and the department's ability to achieve its automation targets. They are integral to assessing the department's operational efficiency and effectiveness in automating reports to enhance workflow efficiency and data-driven decision-making.

Regarding "Jobs Monitoring", the measures implemented heavily rely on the calculated columns mentioned above to individually capture the number of subprojects, projects, global projects, and contracts analysed by department members. Additionally, there are measures that calculate the total count of open subprojects, projects, global projects, and contracts, enabling the subsequent calculation of the percentage of subprojects, projects, global projects, and contracts analysed in relation to the total number that remain unclosed and available for analysis. This strategic approach not only facilitates efficient resource allocation but also empowers decision-makers with valuable information to prioritise and optimise work processes within the department, ultimately enhancing productivity and workflow management.

Furthermore, in the analysis of the "Actions Monitoring", key metrics are calculated to assess the status and effectiveness of these actions. This analysis categorises actions into three distinct groups - "Actions On Time", "Actions Out of Time", and "Closed and Cancelled Actions". The first are the actions that are still open and within their designated timeframes. They reflect tasks that are currently on track and being managed according to the established schedules. "Actions Out of Time" encompasses actions that remain open but have exceeded their prescribed deadlines. These actions are running behind schedule and require attention to get back on track. "Close and Cancelled Actions" are actions that have already been completed successfully or have been cancelled due to specific reasons. They represent actions that are no longer active and have reached a resolution, either by fulfilment or decision to abandon. Additionally, the analysis computes the percentage of compliance with action timing for those actions that have been closed. This metric provides valuable insights into how well the organisation adheres to timelines and commitments, shedding light on the efficiency of action execution within Department A. It offers a comprehensive overview of the progress and outcomes of these actions, helping stakeholders make informed decisions and optimise their management processes.

Table B.5 in Appendix B provides an exhaustive list of measures tailored specifically for Dashboard II, ordered by the analysis to which they belong. These measures are crafted to address the unique analytical needs of the second dashboard, that is, the economic and financial measures and the operational KPIs of Company X. Therefore, they offer a clear view of the financial health and sustainability of the company and the main potential points of operational improvement.

In the provided table, "Task allocation" involves three key metrics. The first metric focuses on computing the total duration of the tasks. The second one calculates overtime worked, which entails the number of hours worked beyond the scheduled hours. This accounts for any instance where an employee works more than 7.5 hours per day, following Proef's standard schedule, any day of the week, and includes all hours recorded on weekends. Lastly, the Full-Time Equivalents (FTEs) metric determines the number of personnel equivalent to the total hours worked, assuming each person worked 7.5 hours daily.

The "Financial Analyses" stands out as the most comprehensive analysis within this framework, boasting an extensive array of measures. It encompasses a multifaceted approach to financial analysis, addressing various critical aspects. Firstly, it includes measures tailored to the accounting rows which are calculations from the other rows found within the financial statements. This level of granularity allows for precise insights into the financial data. Moreover, the Financial perspective dives deeper into the financial statements, specifically the P&L and Balance Sheet. Each line item in these statements is meticulously dissected and obtained through the use of the "SWITCH" expression. This method facilitates detailed scrutiny of the financial data on a row-by-row basis. Furthermore, the Financial perspective extends its reach into historical data. It computes the values of the two financial statements from the homologous period, providing essential context and allowing for comparison. Additionally, it displays the forecasted values of the P&L for the selected period, enhancing again comparison. For the P&L, a noteworthy feature is the utilisation of additional distinct and more complex DAX expressions. These expressions are designed to streamline the aggregation process, resulting in a more concise P&L with fewer financial statement rows. This simplification aids in extracting key insights from the financial data efficiently. The analysis of this financial statement also delves into monthly or YTD figures for the P&L actual, historical and forecated values. This perspective on YTD data offers a real-time view of financial performance throughout the year. In addition to these key components, the “Financial Analyses” calculates the differences between real YTD values and historical YTD values, referred to as “R-H YTD”. Similarly, it computes the differences between real YTD values and forecasted YTD values, known as “R-F YTD”. These delta measures shed light on deviations between actual performance and historical or projected benchmarks. To provide a more comprehensive perspective, the analysis also calculates the corresponding percentages for these differences, represented as “R/H YTD” and “R/F YTD”. These percentages offer valuable insights into the magnitude of variations, aiding in a deeper understanding of financial performance. Therefore, the “Financial Analyses” is a robust and multifaceted analysis that encompasses a wide range of measures, enabling a thorough examination of financial data from various angles, all aimed at providing valuable insights for informed decision-making.

It’s also worth noting that the “Actions Monitoring” analysis doesn’t include any measures since it primarily consists of a straightforward listing.

Lastly, the “Departments’ Evaluation” analysis has only one single measure. This measure serves the purpose of computing the average of the evaluations conducted for the various departments in the various categories assessed.

All measures have been formatted in the appropriate numerical style, with the suitable number of decimal places to facilitate the analysis. This selection process was undertaken to enhance visibility and clarity in the dashboards, ensuring that the data is presented in the most effective and comprehensible manner.

Overall, measures are the quantitative backbone of the Power BI implementations, enabling the transformation of data into actionable insights. Utilising DAX, these measures are created to serve as the KPIs for the two distinct dashboards.

In summary, the incorporation of calculated tables, columns, and measures into the Power BI implementations for this dissertation is instrumental in transforming raw data into actionable insights. These components enable to structure, enhance, and analyse the data effectively, ultimately contributing to the success and rigor of the analysis purposes. By harnessing the capabilities of Power BI’s calculated features, the exploration, understanding, and communication of the findings are empowered with precision and clarity.

4.6 Visualisations

After the successful integration of data into the DW and the calculation of KPIs, the culmination of this solution lies in the development of dashboards. Dashboards serve as a vital tool, offering users an effortless, expeditious, and intuitive means to access and visualise information. They play an indispensable role in data analysis, facilitating decision-making processes.

The architecture and composition of dashboards, encompassing elements such as charts, maps, tables, and other visual components, wield substantial influence over how users perceive and interpret data. Consequently, the development of dashboards demands a thoughtful approach, ensuring the seamless communication of insights and the effective facilitation of data analysis. Through these well-constructed dashboards, Proef can harness its data’s true potential, empowering stakeholders to make informed decisions and drive meaningful outcomes.

In this context, both Dashboard I and Dashboard II are structured consistently, adhering to Proef's corporate identity with Proef colours and logo positioned in the top-left corner. At the top of each dashboard, slicers provide user-friendly controls for data filtering, enhancing the accessibility of vital insights.

Dashboard I comprises a total of 5 pages, beginning with an overarching overview page that offers a high-level perspective. This overview is a gateway to four additional detailed pages, each dedicated to one of the four key analysis topics introduced on the overview page. This organisation enables users to delve deeper into specific areas of interest while maintaining a clear navigational flow.

In the same dashboard, the company and date slicers are consistently present across all five pages. These slicers are intelligently synchronised, ensuring user interactions with one slicer seamlessly impact the other. This synchronisation simplifies the user experience, allowing for swift and efficient data exploration and analysis.

On the other hand, Dashboard II follows a more consolidated approach, consisting of a single page. This streamlined design aligns with the dashboard's primary objective of providing a comprehensive view of operational and financial measures specific to Company X. Given its content's holistic nature, there is no requirement for additional detailing pages.

4.6.1 Dashboard I - Overview

The Overview page depicted in Figure 4.3 serves as the central hub of Dashboard I, encompassing four distinct analyses critical to Department A's operations: "Reports Availability", "BI Reports Implementation", "Jobs Monitoring", and "Actions Monitoring". These analyses offer a comprehensive snapshot of the department's KPIs and facilitate quick insights into critical aspects.

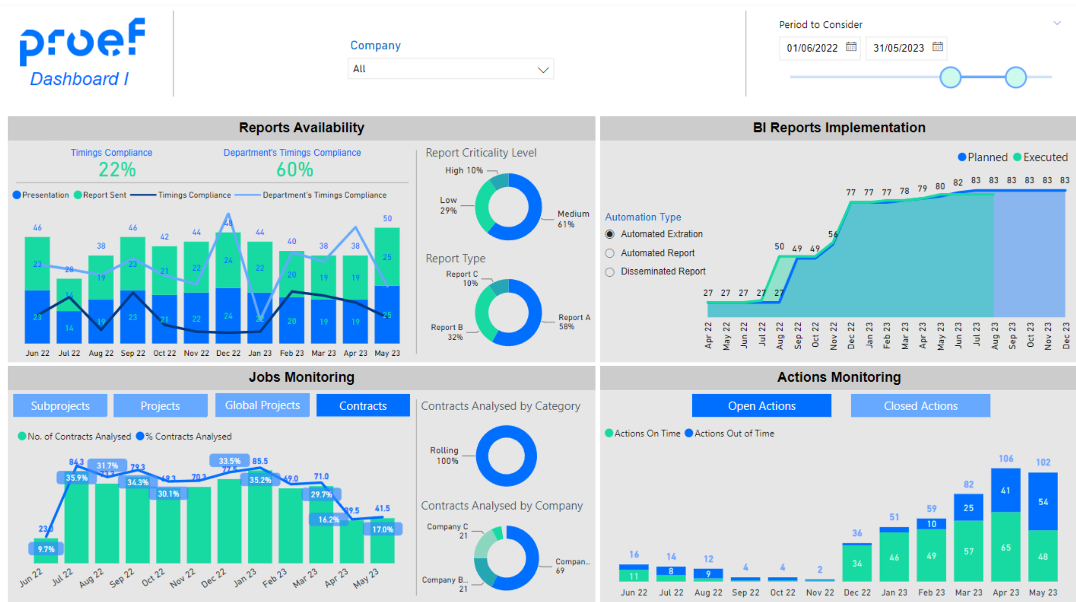


Figure 4.3: Overview Page of Dashboard I

A notable feature of the Overview page is its user-friendly design, enabling seamless navigation to more detailed information. Users can effortlessly transition to the dedicated detail pages by simply clicking on the titles of each analysis. This intuitive functionality empowers users to easily explore specific aspects of interest, providing a dynamic and interactive experience within the dashboard.

One of the key aspects of this page is its ability to facilitate a temporal analysis for each of the metrics, utilising graphical representations with months and years distributed along the x-axis.

In addition, the graphics also allow for a drill-down to obtain a weekly view instead of the monthly view, as seen in Figure C.1 of Apendix C. This capability to "drill-down" in graphical representations is a valuable feature in data analysis and reporting tools. It enables to explore data at different levels of granularity, providing a more detailed and nuanced understanding of the information at hand. Users have the option to delve deeper into the data by drilling down, which means they can access a more fine-grained, weekly perspective. This feature is particularly useful when there is a need to analyse trends or fluctuations within a specific month and understand the data on a weekly basis. It allows for a more comprehensive examination of the information and can be instrumental in making informed decisions or identifying patterns that might not be apparent at a higher level of aggregation.

The first analysis provides a clear insight into the quantity of reports delivered by the department each month, whether through report submissions or presentations. This analysis effectively highlights whether all reports are being delivered as expected or if there are any discrepancies. Additionally, it includes an assessment of both the general and department-specific timing compliance, shedding light on whether reports are being delivered on time and whether measures need to be taken to enhance timing compliance. Furthermore, the top donut chart allows for an evaluation of the criticality of the delivered reports, presenting the percentage of the total of each priority level. By clicking on one of the priority categories within the chart, the dynamic capabilities of Power BI enable the remaining elements to be filtered based on priority (as illustrated in Figure C.2). This enables observing whether the quantities delivered vary similarly depending on the priority and whether timing compliance improves. Similarly, filtering by report type in the donut chart below is possible to identify which reports may require the most improvement. Similarly, the reverse holds true: by clicking on a bar in the bar chart, the donut charts are also filtered. This two-way interaction between different types of charts is a powerful feature in data visualisation and analysis, enhancing the user's ability to explore and dissect data from various angles and perspectives, promoting a deeper understanding of the underlying information. Such interactive features are invaluable in modern data visualisation tools, as they empower users to make data-driven decisions with ease and precision.

The "BI Reports Implementation" analysis provides insights into the cumulative number of reports transitioning to BI planned for each period and the cumulative number of reports implemented during those periods. The chosen graph type, an area chart, is particularly effective as it clearly illustrates whether the implementation is keeping pace with the planned reports, falling behind schedule, or exceeding expectations. Furthermore, this analysis can be filtered by the type of automation, either automated extraction, automated report, or disseminated report, allowing for a more detailed assessment of each report type.

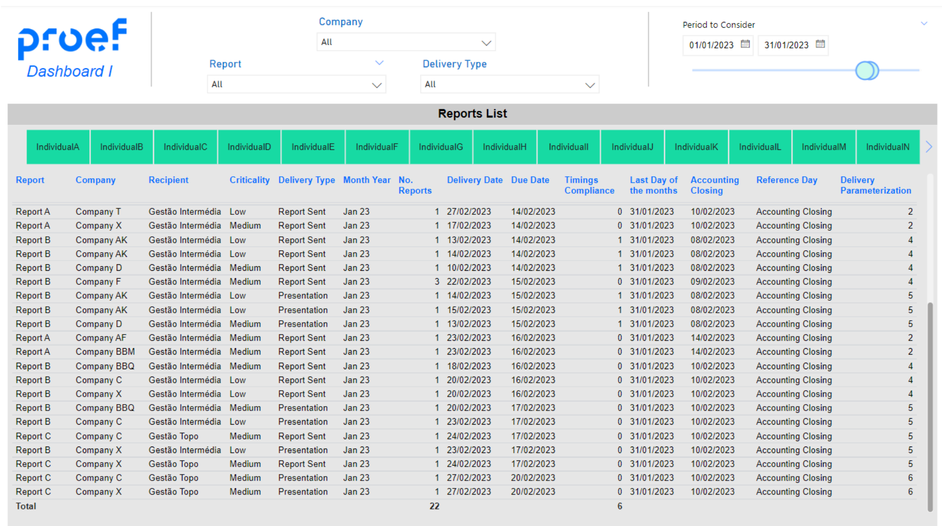
The "Jobs Monitoring" section includes buttons for viewing subprojects, projects, global projects, or contracts. For each of these views, the dashboard displays the number of jobs (depending on the selected button) analysed over time and the percentage that these analysed jobs represent to the total number of unclosed jobs that could fall within the analysis scope. Additionally, there are two donut charts, one for type of analysis categories and another for companies associated with the analysed jobs. Similar to the donut charts in the "Report Availability" section, these charts can be filtered to enable more detailed analyses. This analysis provides insights into the team's workload, helping to determine whether more or less time should be dedicated to these analyses.

The final analysis highlights the quantity of open actions, with a breakdown for each month indicating how many are within the deadline and how many are overdue. Moreover, the "Close Actions" button allows users to switch to the view of completed actions, whether they were executed or cancelled (as demonstrated in Figure C.3 of Appendix C). It provides insight into the percentage of actions completed within the specified timeframes for each month. This analysis is crucial for identifying the type of actions that have surpassed deadlines and require more attention in future. It also helps track the evolution of actions, indicating whether deadlines have been consistently met or not, facilitating decision-making and necessary interventions.

Lastly, it's worth noting that all analyses on this page include tooltips for quick access to detailed information related to each graph. These tooltips provide comprehensive details about delivered reports, planned and executed BI reports, analysed jobs, and actions, depending on which graph the cursor hovers over, in the specific period in which the cursor hovers over, along with relevant additional details, as illustrated in Figures C.4, C.5, C.6, and C.7, respectively.

4.6.2 Dashboard I - Reports Availability

The "Reports Availability" page provides a comprehensive list of all reports delivered during the selected period and some important characteristics, with the option to filter the results by company, specific report, delivery type, and employee. Figure 4.4 demonstrates this page layout.



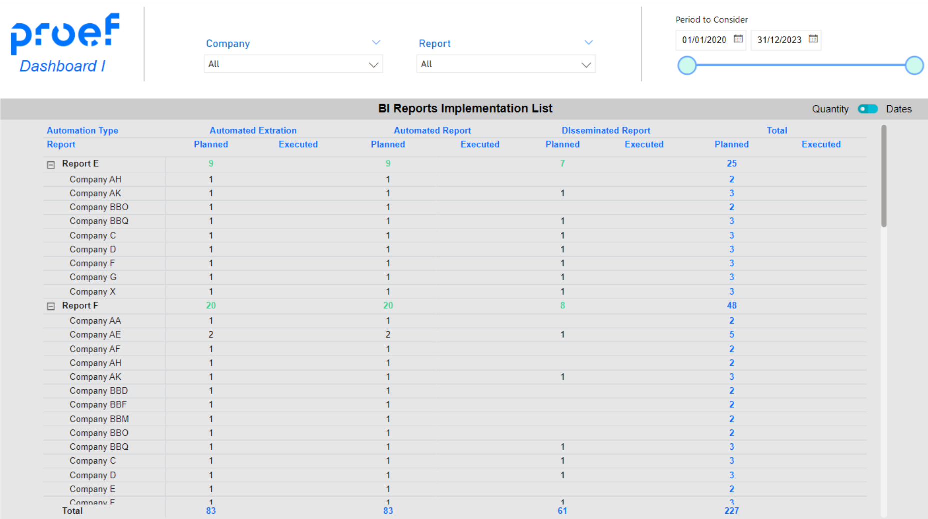
Report	Company	Recipient	Criticality	Delivery Type	Month Year	No. Reports	Delivery Date	Due Date	Timings Compliance	Last Day of the months	Accounting Closing	Reference Day	Delivery Parameterization
Report A	Company T	Gestão Intermédia	Low	Report Sent	Jan 23	1	27/02/2023	14/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	2
Report A	Company X	Gestão Intermédia	Medium	Report Sent	Jan 23	1	17/02/2023	14/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	2
Report B	Company AK	Gestão Intermédia	Low	Report Sent	Jan 23	1	13/02/2023	14/02/2023	1	31/01/2023	08/02/2023	Accounting Closing	4
Report B	Company AK	Gestão Intermédia	Low	Report Sent	Jan 23	1	14/02/2023	14/02/2023	1	31/01/2023	08/02/2023	Accounting Closing	4
Report B	Company D	Gestão Intermédia	Medium	Report Sent	Jan 23	1	10/02/2023	14/02/2023	1	31/01/2023	08/02/2023	Accounting Closing	4
Report B	Company F	Gestão Intermédia	Medium	Report Sent	Jan 23	3	22/02/2023	15/02/2023	0	31/01/2023	09/02/2023	Accounting Closing	4
Report B	Company AK	Gestão Intermédia	Low	Presentation	Jan 23	1	14/02/2023	15/02/2023	1	31/01/2023	08/02/2023	Accounting Closing	5
Report B	Company AK	Gestão Intermédia	Low	Presentation	Jan 23	1	15/02/2023	15/02/2023	1	31/01/2023	08/02/2023	Accounting Closing	5
Report B	Company D	Gestão Intermédia	Medium	Presentation	Jan 23	1	13/02/2023	15/02/2023	1	31/01/2023	08/02/2023	Accounting Closing	5
Report A	Company AF	Gestão Intermédia	Medium	Report Sent	Jan 23	1	23/02/2023	16/02/2023	0	31/01/2023	14/02/2023	Accounting Closing	2
Report A	Company BBM	Gestão Intermédia	Medium	Report Sent	Jan 23	1	23/02/2023	16/02/2023	0	31/01/2023	14/02/2023	Accounting Closing	2
Report B	Company BBQ	Gestão Intermédia	Medium	Report Sent	Jan 23	1	18/02/2023	16/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	4
Report B	Company C	Gestão Intermédia	Low	Report Sent	Jan 23	1	20/02/2023	16/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	4
Report B	Company X	Gestão Intermédia	Low	Report Sent	Jan 23	1	20/02/2023	16/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	4
Report B	Company BBQ	Gestão Intermédia	Medium	Presentation	Jan 23	1	20/02/2023	17/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	5
Report B	Company C	Gestão Intermédia	Low	Presentation	Jan 23	1	23/02/2023	17/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	5
Report C	Company C	Gestão Topo	Medium	Report Sent	Jan 23	1	24/02/2023	17/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	5
Report B	Company X	Gestão Intermédia	Low	Presentation	Jan 23	1	23/02/2023	17/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	5
Report C	Company X	Gestão Topo	Medium	Report Sent	Jan 23	1	24/02/2023	17/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	5
Report C	Company C	Gestão Topo	Medium	Presentation	Jan 23	1	27/02/2023	20/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	6
Report C	Company X	Gestão Topo	Medium	Presentation	Jan 23	1	27/02/2023	20/02/2023	0	31/01/2023	10/02/2023	Accounting Closing	6
Total						22			6				

Figure 4.4: Reports Availability Page of Dashboard I

This page is a valuable resource for users seeking detailed information about the reports available within their chosen parameters, enhancing their ability to access relevant data efficiently and effectively. Whether users are interested in a specific report, category, or employee delivery performance, this page offers a user-friendly interface to access the desired information, fostering data-driven decision-making and analysis.

4.6.3 Dashboard I - BI Reports Implementation

As depicted in Figure 4.5, the "BI Reports Implementation" page features a matrix displaying the reports for BI automation and their respective companies. It indicates, for each type of automation, whether reports are planned or not and whether they have been executed, denoted by a '1' for affirmative and '0' for negative. In addition to this view, an identical structure is available with dates, as seen in Figure C.8.



Automation Type	Automated Extration		Automated Report		DIsseminated Report		Total	
Report	Planned	Executed	Planned	Executed	Planned	Executed	Planned	Executed
⊟ Report E	9		9		7		25	
Company AH	1		1				2	
Company AK	1		1		1		3	
Company BBO	1		1				2	
Company BBQ	1		1		1		3	
Company C	1		1		1		3	
Company D	1		1		1		3	
Company F	1		1		1		3	
Company G	1		1		1		3	
Company X	1		1		1		3	
⊟ Report F	20		20		8		48	
Company AA	1		1				2	
Company AE	2		2		1		5	
Company AF	1		1				2	
Company AH	1		1				2	
Company AK	1		1		1		3	
Company BBD	1		1				2	
Company BBF	1		1				2	
Company BBM	1		1				2	
Company BBO	1		1				2	
Company BBQ	1		1		1		3	
Company C	1		1		1		3	
Company D	1		1		1		3	
Company E	1		1				2	
Company F	1		1		1		3	
Total	83		83		61		227	

Figure 4.5: BI Reports Implementation Page of Dashboard I

The first view is a valuable tool for quantifying reports, while the second provides a detailed breakdown of the associated dates, both with the possibility of roll-up (Figures C.9 and C.10) views. These dual perspectives offer users a comprehensive understanding of the status and timing of report planning and execution, facilitating both high-level assessment and in-depth data analysis.

4.6.4 Dashboard I - Jobs Monitoring

The "Jobs Monitoring" page features a comprehensive table that provides detailed insights into the jobs analysed by Department A, as denoted by Figure 4.6.

The table includes information on the number of analyses conducted for each job and the corresponding number of contracts, global projects, and subprojects to which each job is linked. Users can apply filters based on various criteria, such as company, jobs, and employee, allowing for customised data exploration. This level of granularity and flexibility empowers users to understand the workload, jobs distribution, and individual contributions within the department, enhancing data-driven decision-making and job management.

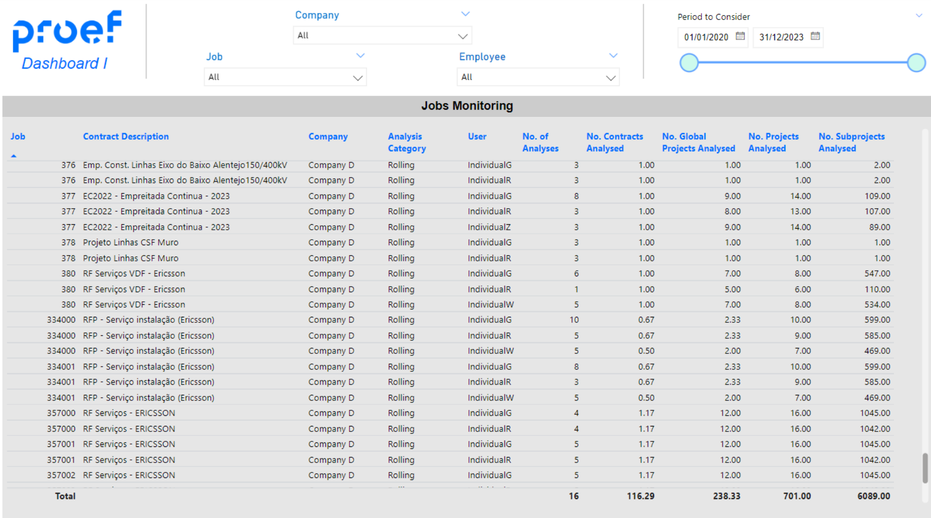


Figure 4.6: Jobs Monitoring Page of Dashboard I

4.6.5 Dashboard I - Actions Monitoring

The final analysis within Dashboard I, titled "Actions Monitoring" and exhibited in Figure 4.7, includes a comprehensive list of all actions associated with the department, providing detailed information on each action, including its status. Additionally, this analysis incorporates two donut charts that visually represent key metrics. The first donut chart illustrates the quantity of actions and the corresponding percentage of the total within each "Status & Timing" category, providing a clear breakdown of their distribution. The second donut chart provides the same insights into the distribution of actions across various action categories.

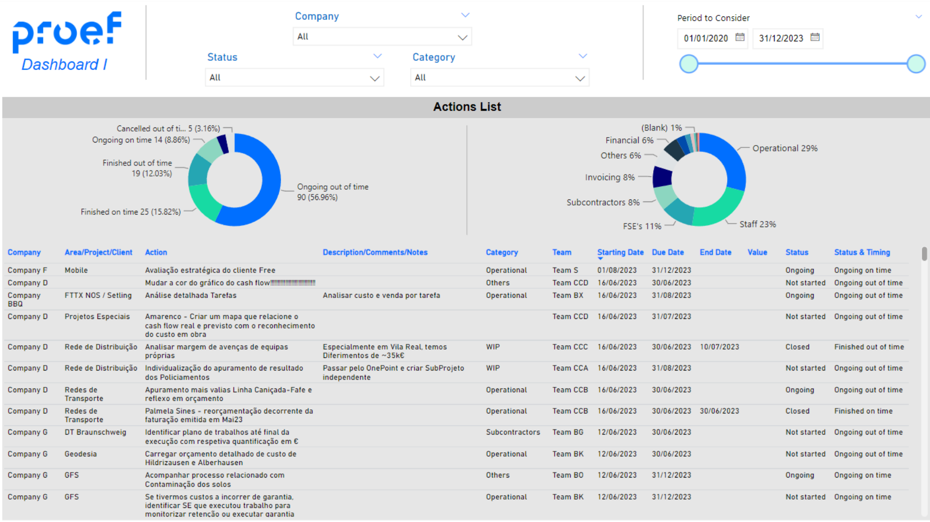


Figure 4.7: Actions Monitoring Page of Dahsboard I

These visuals enhance the ability to assess the department's action portfolio, monitor progress, and prioritise actions based on their status, timing, and category. This holistic view gives decision-makers valuable insights for effective action management and departmental performance evaluation.

4.6.6 Dashboard II

Dashboard II provides an extensive overview of Company X, offering a comprehensive and broad perspective on both operational and financial aspects. Thus and as seen in Figure 4.8, it encompasses operational analyses, including "Task Allocation", "Actions Monitoring" and "Departments' Evaluation", aimed at providing insights into the company's day-to-day operations and performance tracking. Additionally, the dashboard includes the "Financial Analyses", featuring a P&L, allowing stakeholders to assess the company's financial health and performance over time, and a Balance sheet, providing a snapshot of the company's financial position at a specific point in time.

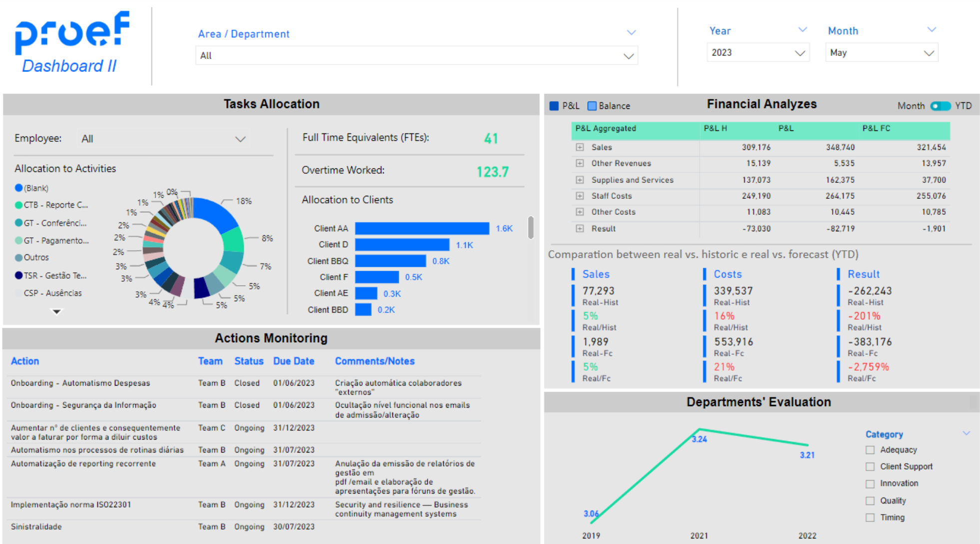


Figure 4.8: Overview Page of Dashboard II

In "Task Allocation" analysis, the pie chart illustrates the percentage distribution of the duration of each task category, while the bar chart displays the duration of tasks performed for each client. The FTEs indicate the number of people that the worked time would correspond to if each worked 7.5 hours daily (the daily working hours at Proef). Overtime worked indicates the number of extra hours worked. The primary aim of this comprehensive analysis is to provide invaluable insights into the allocation of tasks, time management, and resource utilisation within the organisation. By examining the distribution of tasks across categories, client-specific task duration, and workforce equivalencies, this analysis offers a holistic view of operational efficiency and productivity. Furthermore, it enables fine-grained filtering by area, department, and even individual employees, empowering stakeholders to make data-driven decisions to enhance organisational performance. An example of the employee filter is given in Figure C.13 of Appendix C.

"Actions Monitoring" is a comprehensive tool used by Company X to manage and monitor its actions effectively. This list catalogues all the actions undertaken by the organisation, providing essential details such as the responsible team, the current status of the action, and the targeted execution date. These elements work in harmony to prioritise tasks, ensuring that the most critical actions are addressed promptly. Moreover, this analysis includes space for comments and notes, which can prove invaluable for gaining a deeper understanding of each action. These annotations offer context, insights, and additional information that may be crucial for successful execution and efficient decision-making within the company. In essence, the "Actions Monitoring" serves as a central hub for the organisation to track, prioritise, and enhance its actions, ultimately contributing to improved operational efficiency and goal attainment.

The "Financial Analyses" encompasses critical financial statements in three distinct views activated by buttons, namely the P&L, presented on a monthly (Figure 4.8) or YTD basis (Figure C.11), as well as the Balance sheet (Figure C.13). The P&L initiates with a concise and aggregated overview, featuring key categories such as "Sales", "Other Revenues", "Supplies and Services", "Staff Costs", "Other Costs", and "Result". This streamlined presentation facilitates quick assessments. However, for a more detailed understanding, the analysis can be further drill-downed to reveal the specific values within each accounting category of the P&L (as Figure C.12 of Appendix C depicts). The streamlined presentation of the P&L allows for quick assessments, but the option to delve deeper into specific accounting categories enhances the precision of analysis. Whether in an aggregated form or in a disaggregated form, the P&L matrix offers three types of values: historical, current, and predicted. This holds true for both the monthly perspective, where values corresponding to the selected month are displayed, and the YTD perspective, where values represent the cumulative sum from the beginning of the year (typically January of the selected year) up to the chosen month of the same year. The inclusion of historical, current, and forecasted values, both on a monthly and YTD basis, offers a dynamic and informative view of the company's financial health. The Balance sheet, in contrast, doesn't adopt a monthly or YTD view because it always considers values from the inception of the company up to the selected month and year. Within the Balance sheet matrix, current and historical values are presented, allowing for a temporal comparison between the selected month and the homologous month. Finally, this comprehensive analysis also includes cards that provide comparison between real versus historical values and real versus forecasted values for sales, net costs, and the overall result. In this analysis, it is considered the YTD of the real, historical and forecasted values and the differences are then presented both in absolute terms and as percentages. Positive variations are highlighted in green, while negative variations are marked in red, providing a quick visual indication in the percentages of the impact on the company's performance. This additional cards featuring comparisons of actual results against historical and forecasted data for the mentioned financial metrics, along with color-coded indicators, facilitate rapid decision-making. Overall, this comprehensive financial analysis not only empowers stakeholders with detailed insights into the company's financial performance but also serves as a strategic tool for informed decision-making, helping drive the organisation toward improved financial planning and enhanced overall performance.

Lastly, the "Departments' Evaluation" aims to provide a clear view of the company's performance when no filters are applied, and, more specifically, within each area or even individual departments when filters are employed. This analysis also offers the flexibility to specify the category or categories of interest, including adequacy, client support, innovation, quality, and timing, for in-depth examination (an example is present in Figure C.13). In doing so, it ensures that stakeholders can readily assess the overall organisational performance and, when desired, zoom in on particular areas or departments, all while focusing on the specific categories that matter most for a comprehensive understanding of the company's achievements. This approach enables a thorough examination of both the strengths and weaknesses within each department or area, empowering decision-makers to take proactive measures for improvement in the areas showing vulnerabilities. It also encourages the continuation of exemplary performance in the strongest categories of each area or department. By analysing through the lens of different categories, Company X can develop targeted strategies to bolster areas in need of enhancement and incentivise the perpetuation of best practices in the strongest aspects of every department or area. This holistic evaluation not only fosters a culture of continuous improvement but also helps drive overall organisational success.

This combination of operational and financial insights equips stakeholders with the information needed to make informed decisions and drive Company X toward its strategic goals.

4.7 Validation and Publication

Throughout the process of developing the Power BI dashboards, they were regularly shared with a diverse group of stakeholders from Proef. The primary objective of these presentations was to solicit valuable feedback from individuals with different perspectives and roles within the organisation.

The aim of involving a wide range of stakeholders is to ensure that the dashboards met the diverse needs and expectations of the organisation. Each presentation offered an opportunity for stakeholders to provide their insights, suggestions, and concerns about the dashboards' design, functionality, and data representation.

One of the key strengths of this iterative approach was its responsiveness to feedback. As feedback was collected and analysed, continuous adjustments were made to the dashboards. These adjustments encompassed various aspects, such as modifying visualisations for better clarity, refining data calculations, and enhancing the user interface for improved usability.

Over time, this collaborative feedback-driven process led to a significant evolution of the Power BI dashboards. They became more refined, informative, and tailored to the specific needs of Proef.

In essence, the commitment to gathering and incorporating stakeholder feedback led to the creation of dashboards that truly served the organisation's objectives. It exemplified a dynamic and adaptive approach to dashboard development, ensuring that the final product is not just a static representation of data but a valuable tool that supported data-driven decision-making within Proef.

Furthermore, the assurance of data validity and accuracy constitutes a paramount aspect of the dashboards' development process. Rigorous verification procedures were meticulously conducted to guarantee the reliability of the insights and information conveyed by both dashboards.

Data validity encompasses the precision and correctness of the data itself, ensuring that it faithfully represents the real-world phenomena it seeks to depict. This validation process entailed cross-referencing data sources, scrutinising data entry and transformation procedures, and implementing robust data quality checks.

Accuracy, conversely, pertains to the closeness of the data to the actual values it represents. To ascertain the accuracy, extensive data reconciliation was performed, comparing the dashboard data with trusted sources, historical records, and expert knowledge. Any discrepancies were diligently addressed and rectified.

The commitment to data validity and accuracy underscores the dedication to providing stakeholders with trustworthy insights. These verification measures not only enhance the reliability of the dashboards but also fortify the credibility of the decisions and actions informed by the data, ultimately contributing to sound, data-driven decision-making within the organisation.

Having the data validated and accurate and to facilitate accessibility and real-time updates, these two dashboards were published on the Power BI Service and shared with relevant stakeholders. Daily automated refreshes were implemented to guarantee that the data remains up-to-date and reflects the most current information.

Dashboard I has been intentionally designed to be accessible to all employees within Department A, with absolutely no restrictions imposed. This strategic decision underscores the organisation's commitment to providing an open and inclusive environment for data-driven decision-making. By extending unrestricted access to Dashboard I, every employee within Department A has the opportunity to harness the power of data and gain valuable insights that can inform their daily tasks and contribute to the department's overall success. This approach promotes a culture of transparency, trust, and collaboration, where each team member can actively participate in data analysis, discussions, and decision-making processes, fostering an empowered and informed workforce.

On the other hand, Dashboard II takes a different approach by incorporating a role-based access control mechanism tailored to each stakeholder's specific needs. This role-based approach involves the creation of specific roles that filter data, permitting access exclusively to data associated with a particular department. This strategic implementation ensures that every user can access only the information relevant to their respective department, enhancing data security and privacy. By creating distinct roles, data is meticulously filtered, granting access solely to the data associated with an individual's department. This precise role allocation fortifies data security and preserves confidentiality, allowing each department's employees to concentrate on their unique data and analytics requirements. This approach exemplifies a commitment to both data protection and delivering highly targeted and relevant insights to each stakeholder.

Access to both dashboards was provided without implementing any specific security measures or row-level filtering to restrict access for the company's administrators. This open-access approach means that administrators can view and interact with all data within the dashboards.

Chapter 5

Conclusion

5.1 Final Remarks

This dissertation embarked on a comprehensive exploration of the transformative potential of BI, with a specific focus on the utility and effectiveness of Power BI as a valuable tool for generating actionable information and knowledge. Thus, the overarching goal was twofold: to ascertain BI's capacity to profoundly influence company decisions, resulting in improved performance and a heightened competitive edge, and to evaluate Power BI's suitability as a prominent BI solution for widespread adoption by companies.

Concretely, it focused on the development and implementation of two Power BI dashboards for Proef to provide the organisation with powerful tools that facilitated informed decision-making, process optimisation, and data-driven insights. Therefore, the endeavour aimed to bridge the gap between data and actionable insights.

First, discussions were held with relevant Proef stakeholders to understand Proef's specific reporting needs. It became evident that there was a requirement for an operational dashboard for Department A, as there was currently no performance analysis for this department. Additionally, there was a need for a financial and operational analysis for Company X, for which financial information was manually obtained only once a month and it lacked any comprehensive operational analysis across the entire company.

To achieve this, the necessary data was incorporated into Power Query from Power BI through internal data sources such as SQL servers and shared Excel files on SharePoint. The obtained tables were carefully analysed, and their purposes for the analyses were defined to ensure that the data transformation in the ETL process was appropriate. Still, using Power Query, the data underwent transformations to address inconsistencies and enrich it to be better prepared for generating insights. Next, the tables were loaded, and a data model in a Galaxy schema was created through various relationships between the tables in both dashboards. Calculated tables, columns, and measures were created to obtain the required values for analysis, enhancing the data's potential.

Following this, visualisations were developed with careful consideration for alignment with Proef's needs and user-friendliness. These visualisations were designed to represent the desired analyses accurately, enabling decisions to be made to improve operational and financial performance for both Department A and Company X.

Specifically, Dashboard I encompasses four distinct analyses: "Reports Availability", "BI Reports Implementation", "Jobs Monitoring", and "Action Monitoring. Similarly, Dashboard II also comprises four distinct analyses: "Tasks Allocation", "Actions Monitoring," "Financial Analyses," and "Departments' Evaluation". Together, these eight analyses across Dashboard I and Dashboard II provide a comprehensive toolkit for stakeholders to access vital information, monitor critical processes, and make informed decisions that contribute to the overall performance and efficiency of the organisation.

Throughout the development process, the dashboards were validated and presented multiple times to stakeholders to allow for adjustments and continuous improvement. This iterative approach ensured that the dashboards were effectively aligned with the company's objectives. In the end, the dashboards were shared through the Power BI service, with the appropriate securities implemented.

In addition to aiding Proef in automating BI, the purpose of creating these two dashboards is to showcase BI's versatility within an organisation. Specifically, these dashboards aim to provide both operational and financial insights and they also demonstrate BI's ability to handle either detailed or aggregated data, serving individual departments and entire companies. Overall, the developed BI solutions have proven to be highly successful, showcasing the remarkable capabilities of Power BI in creating advanced, visually appealing, and useful solutions tailored to Proef's needs. These solutions have empowered the organisation to draw significant and valuable conclusions, enhancing the decision-making process.

BI stands as a potent catalyst for informed decision-making. By facilitating data-driven insights, it empowers organisations to respond adeptly to dynamic market conditions, optimise resources, and chart strategic courses for success. The deployment of Power BI within this study exemplified how a well-designed BI solution can transform data into a valuable asset, enabling decision-makers to navigate complex challenges with confidence. In this realm, Power BI emerged as a formidable BI tool, with its user-friendly interface, robust data modelling capabilities, and versatile reporting and visualisation options. Its intuitive features and accessibility make it an ideal choice for organisations seeking to harness the potential of BI without extensive technical expertise. This suggests that Power BI has the potential to be widely and intensively adopted across various industries and sectors. In essence, this research sheds light on the symbiotic relationship between BI and Power BI, revealing how the effective utilisation of the latter can amplify the transformative potential of the former. By providing the tools to convert raw data into actionable insights, Power BI empowers organisations to thrive in a data-centric business landscape.

In conclusion, this dissertation underscores that BI can provide essential knowledge for enhancing decision-making within a company, making it a crucial asset. Moreover, it confirms that Power BI is an excellent tool in this context. The following contributions further emphasise the significance of BI within an organisation and the advantages of utilising Power BI.

5.2 Study Contributions

The key contributions and insights gained through this dissertation are multifaceted and highly valuable.

First, this project offers a valuable contribution to the literature in the field of BI as it serves as a real-world case study of BI systems implementation within an organisation. Furthermore, it constitutes a noteworthy contribution to the Power BI domain, given its exclusive utilisation throughout the entire process.

More specifically, this dissertation has a significant contribution to Proef, yielding several benefits.

With the creation of the two dashboards, information pertaining to Department A and Company X is now consolidated into a single dashboard for each entity. This consolidation ensures that all stakeholders have access to the same, standardised, and consistent information, fostering a unified and consistent view of the truth. As a result, fragmentation of data is significantly reduced.

All the information presented in these dashboards has undergone thorough validation, guaranteeing the provision of precise and reliable insights. This singular view of the truth ensures that decision-making is based on standardised and uniform data across the department or company, promoting greater alignment in actions and choices.

With the dashboards in place, the company can closely monitor its performance in various areas. Any deviations from expected targets or trends are readily identified, allowing for proactive interventions to optimise performance. This real-time monitoring capability helps the company maintain competitiveness and react promptly to emerging challenges and opportunities.

The improved visibility into operational data provided by Power BI has allowed the company to optimise resource allocation and cost management. By identifying areas of inefficiency and waste, the company can make targeted cost reductions while ensuring that resources are allocated to initiatives that generate the most significant returns.

The Power BI dashboards have transformed the company's strategic planning process. Decision-makers can now base their strategies on concrete data insights rather than intuition alone. This data-backed approach to strategy formulation enhances the likelihood of successful outcomes and minimises risks associated with uncertain decision-making.

Furthermore, the dashboards offer daily data updates, granting stakeholders swift access to information at any time without the need for extra effort in data collection and processing. This time-saving approach allows stakeholders to focus on their core responsibilities, ultimately leading to cost reductions and increased productivity.

Due to its automated nature, this process not only reduces time requirements but also minimizes the likelihood of errors. Consequently, tasks are executed more rapidly, efficiently, and with fewer mistakes, resulting in an elevated level of service and productivity.

The information within the dashboards is well-structured, intuitive, user-friendly, and visually appealing, enabling a comprehensive understanding of the data by all interested parties. Moreover, the dashboards provide more extensive and higher-quality information compared to the previous system, thanks to Power BI's capability to handle larger databases and perform advanced and precise calculations.

Additionally, the analysis benefits from enhanced interactivity of various visual elements and greater flexibility and dynamism in data exploration through Power BI's interactive features, such as drill-down, roll-up, and filters, among others.

The dashboards have been shared on the Power BI service, enabling Proef's stakeholders to collaborate and share information seamlessly. Therefore, a cross-functional collaboration is obtained by providing a shared, centralised platform for data analysis and reporting. Different departments and teams can collaborate more effectively, aligning their efforts with the company's overall goals and objectives.

Most importantly, these dashboards have significantly improved the company's ability to make data-driven decisions. By providing intuitive, real-time access to critical business data and KPIs, the dashboards empower decision-makers with actionable insights. This newfound data transparency and accessibility enable the company to respond swiftly and make informed strategic choices. This have a positive impact on organisational performance, manifested in improved decision-making processes and better alignment of decision-makers with the business strategy. End-users have embraced these dashboards as integral tools in their day-to-day activities, using them strategically to monitor performance and guide decision-making. An example is the Director of Department A who utilises the new dashboard in every departmental meeting with his team.

Overall, the study's contributions to the company through the implementation of Power BI dashboards are profound, touching upon improved decision-making, efficiency, performance monitoring, strategy formulation, cost management, collaboration, and adaptability. These contributions collectively enhance the company's competitiveness and position it for sustained growth and success in today's data-driven business landscape.

The findings from this study are likely applicable to Power BI implementations in various companies, irrespective of their scale. Consequently, this dissertation stands as a valuable asset that can potentially guide other businesses in navigating similar undertakings.

5.3 Limitations and Future Work

In the context of this dissertation, it is crucial to acknowledge certain limitations encountered during the research and identify potential avenues for future work.

Firstly, the scope of the dissertation was constrained by the available timeframe. Implementing Power BI solutions is time-consuming, and the research had to focus on specific aspects, potentially leaving out other relevant analysis. Future work could involve a more comprehensive analysis, incorporating additional data sources and a broader scope of analysis.

Moreover, besides the very positive feedback on the ease of use of Power BI, the usability and accessibility of the dashboards is a limitation for the stakeholders which are not proficient in digital devices and, specifically, in data analysis tools. Future research could explore ways to enhance the user experience, including providing user training.

Furthermore, while the current research focused on specific metrics and KPIs, future work could delve deeper into advanced analytics and ML integration within Power BI for predictive and prescriptive analytics, further enriching decision-making capabilities.

Lastly, a valuable avenue for research could involve conducting a comparative analysis of various BI, data analytics and visualisation software tools rather than focusing solely on Power BI. This comparative approach would provide a more comprehensive understanding of different tools' strengths, weaknesses, and suitability for specific analytical and business needs. The comparative analysis could encompass a range of data analytics software options, such as Tableau, QlikView, and other emerging tools in the market.

In conclusion, while the dissertation involving Power BI implementations has provided valuable insights, acknowledging its limitations and proposing future work is essential to advance the field. Future research could focus on more comprehensive analysis, usability, advanced analytics and BI tools comparison, ultimately contributing to more robust and comprehensive data-driven decision-making processes.

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Appendix A

Tables

A.1 Dimension Tables

Table A.1: Dimension dim_Companies of Dashboard I. Own elaboration

Column	Description
CompanyId	Company identifier
CompanyShort-Name	Short name attributed to the company
Geography	Geography in which the company operates
Company	Company name
CompanyCode	Company code for data protection and privacy reasons in this dissertation

Table A.2: Dimension dim_Areas of Dashboard II. Own elaboration

Column	Description
AreaID	Area identifier
Area	Area name
AreaCode	Area code for data protection and privacy reasons in this dissertation

Table A.3: Dimension dim_Departments of Dashboard II. Own elaboration

Column	Description
DepartmentID	Department identifier
Department-Number	Department internal number
Department	Department name

DepartmentCode	Department code for data protection and privacy reasons in this dissertation
AreaID	Area identifier
AreaDepartmen-tKey	Combination of area and department identifier

Table A.4: Dimension dim_Teams of Dashboard I and Dashboard II. Own elaboration

Column	Description
TeamID	Team identifier
Team	Team name
TeamCode	Team code for data protection and privacy reasons in this dissertation

Table A.5: Dimension dim_Employees of Dashboard I and Dashboard II. Own elaboration

Column	Description
EmployeeID	Employee identifier
Employee	Employee name
unic_employeeid	Employee second identifier
EmployeeCode	Employee code for data protection and privacy reasons in this dissertation

Table A.6: Dimension dim_Clients of Dashboard II. Own elaboration

Column	Description
ClientId	Client identifier
Client	Client name
ClientCode	Client code for data protection and privacy reasons in this dissertation

Table A.7: Dimension dim_TaskNames of Dashboard I and Dashboard II. Own elaboration

Column	Description
TaskName	Task name
TaskID	Task identifier

Original_ TaskName	Task original name (prior to the ETL transformations)

Table A.8: Dimension dim_TaskCategories of Dashboard I and Dashboard II. Own elaboration

Column	Description
CategoryID	Category identifier
Category	Category name

Table A.9: Dimension dim_Reports of Dashboard I. Own elaboration

Column	Description
ReportID	Report identifier
Report	Report name
ReportCode	Report code for data protection and privacy reasons in this dissertation

Table A.10: Dimension dim_ReportRecipients of Dashboard I. Own elaboration

Column	Description
RecipientID	Recipient identifier
Recipient	Recipient name

Table A.11: Dimension dim_CompanyCriticality of Dashboard I. Own elaboration

Column	Description
Company	Company name
Criticality	Criticality of the company (number between 1 and 10)

Table A.12: Dimension dim_ReportCriticality of Dashboard I. Own elaboration

Column	Description
Report	Report name

Criticality	Criticality of the report (number between 1 and 10)

Table A.13: Dimension dim_RecipientCriticality of Dashboard I. Own elaboration

Column	Description
Recipient	Recipient name
Criticality	Criticality of the recipient (number between 1 and 10)

Table A.14: Dimension dim_Delivery of Dashboard I. Own elaboration

Column	Description
Report ID	Report identifier
Delivery Type	Description of the delivery type
Delivery ID	Delivery identifier
Reference Day	Day of reference to calculate the objective delivery date
Days to Add	Number of days to add to the reference date to obtain the objective delivery date

Table A.15: Dimension dim_AccountingClosing of Dashboard I. Own elaboration

Column	Description
Company_MonthYear_Key	Combination of Company and MonthYear identifier
Objective Date	Due date of the month accounting closing
Real Date	Real date of the month accounting closing

Table A.16: Dimension dim_Jobs of Dashboard I. Own elaboration

Column	Description
JobID	Job identifier
Job_key	Combination of job and company identifier
JobDescription	Job description
CompanyID	Company identifier
IsSubproject	Binary variable indicating if the job is a subproject (1) or not (0)

Table A.17: Dimension dim_JobStatus of Dashboard I. Own elaboration

Column	Description
StatusID	Status identifier
Status	Status description

Table A.18: Dimension dim_Accounts of Dashboard II. Own elaboration

Column	Description
ScheduleName	Description of the financial statement
Description	Description of the accounting row from the financial statement
Totaling	Accounts to consider for the calculations
RowNumber	Accounting row identifier
IsCalc	0 if the accounting row does not require calculations, unic value if it does
P&L Aggregated	Aggregated description of the P&L accounting row
P&L	Description of the P&L accounting row
Sales, Costs and Results	Aggregated descriptions for the accounting row by sales, costs or results
Index P&L Aggregated	Index of the column "P&L Aggregated"
Index P&L	Index of the column "P&L"
Balance	Description of the Balance accounting row
Index Balance	Index of the column "Balance"

Table A.19: Dimension dim_EvaluationCategories of Dashboard II. Own elaboration

Column	Description
CategoryID	Evaluation category identifier
Category	Evaluation category description

A.2 Fact Tables

Table A.20: Fact fact_Tasks of Dashboard I. Own elaboration

Column	Description
TaskID	Task identifier

CategoryID	Category identifier
EmployeeID	Employee identifier
CompanyId	Company identifier
ItemName	Item name of the task
Start Date	Start date of the task
End Date	End date of the task
Duration	Duration time of the task
DueDateTime	Objective end date of the task
PercentageComplete	Percentage of completion of the task from 0 to 100
ReportID	Report identifier
RecipientID	Recipient identifier
Delivery Date	Report delivery date
Delivery Type	Report delivery type
DeliveryID	Delivery identifier
MonthYear	Month and Year corresponding to the report
Start of Month	Start of the month of the corresponding date of the report
Company_MonthYear_Key	Combination of Company and MonthYear identifier

Table A.21: Fact fact_Tasks of Dashboard II. Own elaboration

Column	Description
TaskID	Task identifier
CategoryID	Category identifier
EmployeeID	Employee identifier
ClientId	Client identifier
Date	Date of the task execution
Duration	Time duration of the task
AreaDepartment_Key	Combination of Company and MonthYear identifier

Table A.22: Fact fact_BIAutomations of Dashboard I. Own elaboration

Column	Description
Date	BI reports implementation date
ReportID	Report identifier
CompanyId	Company identifier
Automation Type	Description of the automation type
Date Type	Description of the date type (planned or executed date)

Date Type Index	Index of the column "Date Type"

Table A.23: Fact fact_JobsAnalysed of Dashboard I. Own elaboration

Column	Description
Jobs Analysed	Analysed job identifier
MonthYear	Month and Year of the analysis
Start of Month	Start of the month of the analysis
CompanyId	Company identifier
Contract Description	Description of the contract corresponding to the Analysed job
Category	Description of the job analysis category
EmployeeID	Employee identifier

Table A.24: Fact fact_JobStatusEvolution of Dashboard I. Own elaboration

Column	Description
Date	Job status date
Job_Key	Combination of company and job identifier
CompanyID	Company identifier
StatusID	Status identifier
Start of Month	Start of the month considering the job status date

Table A.25: Fact fact_Actions of Dashboard I and Dashboard II. Own elaboration

Column	Description
Area/Project/ Client	Area, project or client description in Dashboard I and department description in Dahsboard II
Actions	Action name
Description/ Comments/ Notes	Eventual description, comment or note that may be consider necessary
CompanyId	Company identifier
TeamID	Team identifier
Status	Current status of the action
Starting Date	Start date of the action
Due Date	objective end date of the action
End Date	End date of the action

Priority	Priority of the action
Category	Action category name
Value	Monetary value that the action is expected to generate

Table A.26: Fact fact_AccountingMovements of Dashboard II. Own elaboration

Column	Description
Date	Date of the financial transactions
RowNumber	Accounting row identifier
Department-Number	Department second identifier
Description	"Budget" if the financial transaction are from the Budget
Budget Name	Name of the budget
Amount	Amount of the financial transaction

Table A.27: Fact fact_DepartmentsEvaluation of Dashboard II. Own elaboration

Column	Description
DepartmentID	Department identifier
Year	Year in which the department is being evaluated
CategoryID	Category identifier
Value	Departments' valuation value

Appendix B

Calculated Tables, Columns and Measures

B.1 Calculated Tables

Table B.1: Calculated Tables. Own elaboration

Dashboard	Calc. Table	DAX Formula
Dashboard I	dim_Date	ADDCOLUMNS (CALENDAR (DATE (YEAR (MIN (MIN (MIN ('fact_BIAutomations'[Date]), MIN (fact_JobsAnalysed[Start of Month])), MIN (MIN ('fact_Actions'[Starting Date]), MIN (fact_Tasks[Start Date])))), 1, 1), DATE (YEAR (MAX (MAX (MAX ('fact_BIAutomations'[Date]), MAX (fact_JobsAnalysed[Start of Month])), MAX (MAX ('fact_Actions'[Due Date]), MAX (fact_Tasks[End Date])))), 12, 31)), "Year", YEAR ([Date]), "Month", FORMAT ([Date],"MMM"), "Month(Number)", MONTH ([Date]), "Weekday", WEEKDAY ([Date]), "YearMonth", FORMAT ([Date], "YYMM"), "Month Year", FORMAT ([Date], "MMM YY"), "Week", "W" & WEEKNUM ([Date]), "Week(Number)", WEEKNUM([Date]))
Dashboard II	dim_Date	ADDCOLUMNS (CALENDAR (DATE (MIN (YEAR (MIN (MIN (MIN (fact_Tasks[Date]), MIN ('fact_Actions'[Starting Date])), MIN (fact_AccountingMovements[Date]]))), MIN (fact_DepartmentsEvaluation[Year])), 1, 1), DATE (MAX (YEAR (MAX (MAX (MAX (fact_Tasks[Date]), MAX ('fact_Actions'[Starting Date])), MAX (fact_AccountingMovements[Date]]))), MAX (fact_DepartmentsEvaluation[Year])), 1, 1), "Year", YEAR ([Date]), "Month", FORMAT ([Date],"MMM"), "Month(Number)", MONTH ([Date]), "Weekday", WEEKDAY ([Date]), "YearMonth", FORMAT ([Date], "YYMM"), "Month Year", FORMAT ([Date], "MMM YY"))

B.2 Calculated Columns

Table B.2: Calculated Columns of Dashboard I. Own elaboration

Table	Calc. Column	DAX Formula
dim_Date	WorkingDay	'dim_Date'[Weekday] <> 1 && 'dim_Date'[Weekday] <> 7
fact_Tasks	Criticality Value	IF (ISBLANK (RELATED ('dim_ReportCriticality'[Criticality])) = FALSE(), DIVIDE (RELATED ('dim_RecipientCriticality'[Criticality]) + RELATED (dim_CompanyCriticality[Criticality]) + RELATED ('dim_ReportCriticality'[Criticality]), 3), BLANK())

	Criticality	IF (ISBLANK (fact_Tasks[Criticality Value]), BLANK() , IF (fact_Tasks[Criticality Value] < 6.5, “Low”, IF (fact_Tasks[Criticality Value] < 8, “Medium”, “High”)))
	Compliance	IF (RELATED (dim_Reports[Report]) <> BLANK() && fact_Tasks[Delivery Type] <> BLANK() && fact_Tasks[MonthYear] <> BLANK(), IF (fact_Tasks[Report Due Date] - fact_Tasks[Delivery Date] >= 0, 1, 0))
	Department’s Compliance	IF (RELATED (dim_Reports[Report]) <> BLANK() && fact_Tasks[Delivery Type] <> BLANK() && fact_Tasks[MonthYear] <> BLANK(), IF (fact_Tasks[Report Due Date _ realaccounting]-fact_Tasks[Delivery Date] >= 0, 1, 0))
	End of Month	EOMONTH (fact_Tasks[Start of Month], 0)
	Last Business Day of the Month	IF (WEEKDAY (fact_Tasks[End of Month]) <> 1 && WEEKDAY (fact_Tasks[End of Month]) <> 7, fact_Tasks[End of Month], IF (WEEKDAY (fact_Tasks[End of Month] - 1) <> 1 && WEEKDAY (fact_Tasks[End of Month] - 1) <> 7, fact_Tasks[End of Month] - 1, IF (WEEKDAY (fact_Tasks[End of Month] - 2) <> 1 && WEEKDAY (fact_Tasks[End of Month] - 2) <> 7, fact_Tasks[End of Month] - 2)))
	Date to Consider_ Objective	IF (RELATED (‘dim_Delivery’[Count Reference]) = “End of Month”, fact_Tasks[Last Business Day of the Month], IF (RELATED (‘dim_Delivery’[Count Reference]) = “Accounting Closing”, RELATED (‘dim_AccountingClosing’[ObjectiveDate])))
	Date to Consider_Real	IF (RELATED (‘dim_Delivery’[Count Reference]) = “End of Month”, fact_Tasks[Last Business Day of the Month], IF (RELATED (‘dim_Delivery’[Count Reference]) = “Accounting Closing”, RELATED (dim_AccountingClosing[RealDate])))
	Report Due Date	VAR CurrentDate = fact_Tasks[Date to Consider_Objective] VAR NumberofDaysToAdd = RELATED (‘dim_Delivery’[Delivery Parametrization]) VAR NextWorkingDates = FILTER (ALL (‘dim_Date’), ‘dim_Date’[Date] > CurrentDate && ‘dim_Date’[WorkingDay]) VAR NextPretendedDays = TOPN (NumberofDaysToAdd, NextWorkingDates, ‘dim_Date’[Date], ASC) VAR Result = IF (ISBLANK (fact_Tasks[Date to Consider_Objective]) = FALSE() , IF (ISBLANK (MAXX (NextPretendedDays, ‘dim_Date’[Date])) = FALSE, MAXX (NextPretendedDays, ‘dim_Date’[Date]), fact_Tasks[Date to Consider_Objective]), BLANK ()) RETURN Result
	Report Due Date _ realaccounting	VAR CurrentDate = fact_Tasks[Date to Consider_Real] VAR NumberofDaysToAdd = RELATED (‘dim_Delivery’[Delivery Parametrization]) VAR NextWorkingDates = FILTER (ALL (‘dim_Date’), ‘dim_Date’[Date] > CurrentDate && ‘dim_Date’[WorkingDay]) VAR NextPretendedDays = TOPN (NumberofDaysToAdd, NextWorkingDates, ‘dim_Date’[Date], ASC) VAR Result = IF (ISBLANK (fact_Tasks[Date to Consider_Real]) = FALSE() , IF (ISBLANK (MAXX (NextPretendedDays, ‘dim_Date’[Date])) = FALSE, MAXX (NextPretendedDays, ‘dim_Date’[Date]), fact_Tasks[Date to Consider_Real]), BLANK ()) RETURN Result
dim_Jobs	Company_ Subproject	IF (LEN (‘dim_Jobs’[JobID]) = 12, ‘dim_Jobs’[CompanyID] & ‘dim_Jobs’[JobID])
	Company_ Project	IF (LEN (‘dim_Jobs’[JobID]) >= 9, ‘dim_Jobs’[CompanyID] & LEFT (‘dim_Jobs’[JobID], 9))
	Company_ GlobalProject	IF (LEN (‘dim_Jobs’[JobID]) >= 6, ‘dim_Jobs’[CompanyID] & LEFT (‘dim_Jobs’[JobID], 6))
	Company_ Contract	‘dim_Jobs’[CompanyID] & LEFT (‘dim_Jobs’[JobID], 3)
fact_JobStatusEvalution	Company_ Subproject	fact_JobStatusEvalution[CompanyID] & RELATED (‘dim_Jobs’[JobID])

	Company_ Project	fact_JobStatusEvalution[CompanyID] & LEFT (RELATED (‘dim_Jobs’[JobID]), 9)
	Company_ Global Project	fact_JobStatusEvalution[CompanyID] & LEFT (RELATED (‘dim_Jobs’[JobID]), 6)
	Company_ Contract	fact_JobStatusEvalution[CompanyID] & LEFT (RELATED (‘dim_Jobs’[JobID]), 3)
fact_Jobs-Analysed	Category	IF (‘fact_JobsAnalysed’[Projects Analysed] <> BLANK(), “Rolling”, BLANK())
	Company_ SubProject	IF (LEN (‘fact_JobsAnalysed’[Projects Analysed]) = 12, ‘fact_JobsAnalysed’[CompanyId] & ‘fact_JobsAnalysed’[Projects Analysed], BLANK())
	Company_ Project	IF (LEN (‘fact_JobsAnalysed’[Projects Analysed]) = 9, ‘fact_JobsAnalysed’[CompanyId] & ‘fact_JobsAnalysed’[Projects Analysed], BLANK())
	Company_ GlobalProject	IF (LEN (‘fact_JobsAnalysed’[Projects Analysed]) = 6, ‘fact_JobsAnalysed’[CompanyId] & ‘fact_JobsAnalysed’[Projects Analysed], BLANK())
	Company_ Contract	IF (LEN (‘fact_JobsAnalysed’[Projects Analysed]) = 3, ‘fact_JobsAnalysed’[CompanyId] & ‘fact_JobsAnalysed’[Projects Analysed], BLANK())
	Projects from Subprojects	IF (‘fact_JobsAnalysed’[Company_SubProject] <> BLANK(), ‘fact_JobsAnalysed’[CompanyId] & LEFT (‘fact_JobsAnalysed’[Projects Analysed], 9))
	Global Projects from Subprojects	IF (‘fact_JobsAnalysed’[Company_SubProject] <> BLANK(), ‘fact_JobsAnalysed’[CompanyId] & LEFT (‘fact_JobsAnalysed’[Projects Analysed], 6))
	Global Projects from Projects	IF (‘fact_JobsAnalysed’[Company_Project] <> BLANK(), ‘fact_JobsAnalysed’[CompanyId] & LEFT (‘fact_JobsAnalysed’[Projects Analysed], 6))
	Contracts from Subprojects	IF (‘fact_JobsAnalysed’[Company_SubProject] <> BLANK(), ‘fact_JobsAnalysed’[CompanyId] & LEFT (‘fact_JobsAnalysed’[Projects Analysed], 3))
	Contracts from Projects	IF (‘fact_JobsAnalysed’[Company_Project] <> BLANK(), ‘fact_JobsAnalysed’[CompanyId] & LEFT (‘fact_JobsAnalysed’[Projects Analysed], 3))
	Contracts from Global Projects	IF (‘fact_JobsAnalysed’[Company_GlobalProject] <> BLANK(), ‘fact_JobsAnalysed’[CompanyId] & LEFT (‘fact_JobsAnalysed’[Projects Analysed], 3), BLANK())
fact_Actions	Timing Compliance	IF (‘fact_Actions’[End Date] <> BLANK(), IF (‘fact_Actions’[End Date] <= ‘fact_Actions’[Due Date], 1, 0), BLANK())
	Status & Timing	IF (‘fact_Actions’[End Date] <> BLANK(), IF (‘fact_Actions’[Status] = “Closed”, IF (‘fact_Actions’[End Date] <= ‘fact_Actions’[Due Date], “Finished on time”, “Finished out of time”), IF (‘fact_Actions’[Status] = “Cancelled”, IF (‘fact_Actions’[End Date] <= ‘fact_Actions’[Due Date], “Cancelled on time”, “Cancelled out of time”))), IF (‘fact_Actions’[Due Date] <= TODAY(), “Ongoing out of time”, “Ongoing on time”))

Table B.3: Calculated Columns of Dashboard II. Own elaboration

Table	Calc. Column	DAX Formula
fact_Tasks	Employee_Date	fact_Tasks[EmployeeID] & “_” & fact_Tasks[Date]

B.3 Measures

Table B.4: Measures of Dashboard I. Own elaboration

Analysis	Measure	DAX Formula
Reports Availability	Number of Reports	CALCULATE (DISTINCTCOUNT (fact_Tasks[TaskID]), fact_Tasks[ReportID] <> BLANK(), fact_Tasks[Delivery Type] <> BLANK())
	Timings Compliance	SUMX (DISTINCT (fact_Tasks[TaskID]), FIRSTNONBLANK (fact_Tasks[Compliance], 0)) / DISTINCTCOUNT (fact_Tasks[TaskID])
	Departments' Timings Compliance	SUMX (DISTINCT (fact_Tasks[TaskID]), FIRSTNONBLANK (fact_Tasks[Department's Compliance], 0)) / DISTINCTCOUNT (fact_Tasks[TaskID])
Bi Reports Implementation	Planned	CALCULATE (COUNTROWS (‘fact_BIAutomations’), ‘fact_BIAutomations’[Date Type] = “Planning Date”, ‘dim_Date’[Date] <= MAX (‘dim_Date’[Date]))
	Executed	IF (MAX (‘dim_Date’[Date]) <= TODAY(), CALCULATE (COUNTROWS (‘fact_BIAutomations’), ‘fact_BIAutomations’[Date Type] = “Execution Date”, ‘dim_Date’[Date] <= MAX (‘dim_Date’[Date])))
Jobs Monitoring	No. Subprojects Analysed	CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (‘fact_JobsAnalysed’[Company_SubProject])) + CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Subproject]), RELATEDTABLE (fact_JobStatusEvalution), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6), USERELATIONSHIP (‘fact_JobsAnalysed’[Company_Contract], fact_JobStatusEvalution[Company_Contract])) + CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Subproject]), RELATEDTABLE (fact_JobStatusEvalution), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6), USERELATIONSHIP (‘fact_JobsAnalysed’[Company_GlobalProject], fact_JobStatusEvalution[Company_Global Project])) + CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Subproject]), RELATEDTABLE (fact_JobStatusEvalution), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6), USERELATIONSHIP (‘fact_JobsAnalysed’[Company_Project], fact_JobStatusEvalution[Company_Project])), ‘fact_JobsAnalysed’[Projects Analysed] <> BLANK())
	No. Projects Analysed	CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (‘fact_JobsAnalysed’[Company_Project])) + CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Project]), RELATEDTABLE (fact_JobStatusEvalution), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6), USERELATIONSHIP (‘fact_JobsAnalysed’[Company_Contract], fact_JobStatusEvalution[Company_Contract])) + CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Project]), RELATEDTABLE (fact_JobStatusEvalution), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6), USERELATIONSHIP (‘fact_JobsAnalysed’[Company_GlobalProject], fact_JobStatusEvalution[Company_Global Project])) + DIVIDE (1, CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Subproject]), RELATEDTABLE (fact_JobStatusEvalution)), USERELATIONSHIP (‘fact_JobsAnalysed’[Projects from Subprojects], fact_JobStatusEvalution[Company_Project]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6)), ‘fact_JobsAnalysed’[Projects Analysed] <> BLANK())

No. Global Projects Analysed	CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (‘fact_JobsAnalysed’[Company_GlobalProject])) + CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Global Project]), RELATEDTABLE (fact_JobStatusEvalution), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6), USERELATIONSHIP (‘fact_JobsAnalysed’[Company_Contract], fact_JobStatusEvalution[Company_Contract])) + DIVIDE (1, CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Project]), RELATEDTABLE (fact_JobStatusEvalution)), USERELATIONSHIP (‘fact_JobsAnalysed’[Global Projects from Projects], fact_JobStatusEvalution[Company_Global Project]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6)) + DIVIDE (1, CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Subproject]), RELATEDTABLE (fact_JobStatusEvalution)), USERELATIONSHIP (‘fact_JobsAnalysed’[Global Projects from Subprojects], fact_JobStatusEvalution[Company_Global Project]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6)), ‘fact_JobsAnalysed’[Projects Analysed] <> BLANK())
No. Contracts Analysed	CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (‘fact_JobsAnalysed’[Company_Contract])) + DIVIDE (1, CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Global Project]), RELATEDTABLE (fact_JobStatusEvalution)), USERELATIONSHIP (‘fact_JobsAnalysed’[Contracts from Global Projects], fact_JobStatusEvalution[Company_Contract]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6)) + DIVIDE (1, CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Project]), RELATEDTABLE (fact_JobStatusEvalution)), USERELATIONSHIP (‘fact_JobsAnalysed’[Contracts from Projects], fact_JobStatusEvalution[Company_Contract]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6)) + DIVIDE (1, CALCULATE (CALCULATE (DISTINCTCOUNTNOBLANK (fact_JobStatusEvalution[Company_Subproject]), RELATEDTABLE (fact_JobStatusEvalution)), USERELATIONSHIP (‘fact_JobsAnalysed’[Contracts from Subprojects], fact_JobStatusEvalution[Company_Contract]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6)), ‘fact_JobsAnalysed’[Projects Analysed] <> BLANK())
Subprojects not closed	CALCULATE (DISTINCTCOUNT (fact_JobStatusEvalution[Job_Key]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6, fact_JobStatusEvalution[Company_Contract] <> 999, fact_JobStatusEvalution[Date] = MAX (fact_JobStatusEvalution[Date]))
Projects not closed	CALCULATE (DISTINCTCOUNT (fact_JobStatusEvalution[Company_Project]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6, fact_JobStatusEvalution[Date] = MAX (fact_JobStatusEvalution[Date]), fact_JobStatusEvalution[Company_Contract] <> 999)
Global Projects not closed	CALCULATE (DISTINCTCOUNT (fact_JobStatusEvalution[Company_Global Project]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6, fact_JobStatusEvalution[Date] = MAX (fact_JobStatusEvalution[Date]), fact_JobStatusEvalution[Company_Contract] <> 999)
Contracts not closed	CALCULATE (DISTINCTCOUNT (fact_JobStatusEvalution[Company_Contract]), fact_JobStatusEvalution[StatusID] <> 5, fact_JobStatusEvalution[StatusID] <> 6, fact_JobStatusEvalution[Date] = MAX (fact_JobStatusEvalution[Date]), fact_JobStatusEvalution[Company_Contract] <> 999)
% Subprojects Analysed	[No. Subprojects Analysed] / [Subprojects not closed]
% Projects Analysed	[No. Projects Analysed] / [Projects not closed]
% Global Projects Analysed	[No. Global Projects Analysed] / [Global Projects not closed]
% Contracts Analysed	[No. Contracts Analysed] / [Contracts not closed]

	Number of analyses	DISTINCTCOUNTNOBLANK (‘fact_JobsAnalysed’[Start of Month])
Actions Monitoring	Actions On Time	IF (MAX (‘dim_Date’[Date]) <= TODAY(), CALCULATE (COUNTBLANK (‘fact_Actions’[End Date]) + CALCULATE (COUNT (‘fact_Actions’[Action]), ‘fact_Actions’[End Date] > MAX (‘dim_Date’[Date])), ‘fact_Actions’[Due Date] >= MAX (‘dim_Date’[Date]), ‘dim_Date’[Date] < MAX (‘dim_Date’[Date])))
	Actions Out of Time	IF (MIN (‘dim_Date’[Date]) <= TODAY(), CALCULATE (COUNTBLANK (‘fact_Actions’[End Date]) + CALCULATE (COUNT (‘fact_Actions’[Action]), ‘fact_Actions’[End Date] > MAX (‘dim_Date’[Date])), ‘fact_Actions’[Due Date] < MAX (‘dim_Date’[Date]), ‘dim_Date’[Date] < MAX (‘dim_Date’[Date])))
	Closed and Cancelled Actions	CALCULATE (COUNT (fact_Actions[Action]), USERELATIONSHIP (dim_Date[Date], fact_Actions[End Date]), fact_Actions[End Date] <> BLANK())
	Actions Timings Compliance	CALCULATE (SUM (‘fact_Actions’[Timing Compliance]) / COUNT (‘fact_Actions’[Action]), USERELATIONSHIP (‘dim_Date’[Date], ‘fact_Actions’[End Date]))

Table B.5: Measures of Dashboard II. Own elaboration

Analysis	Measure	DAX Formula
Tasks Allocation	Tasks Duration	SUM (fact_Tasks[Duration])
	Overtime	IF (SUM (fact_Tasks[Duration]) - CALCULATE (DISTINCTCOUNTNOBLANK (fact_Tasks[Employee_Date]), dim_Date[Weekday] <> 1 && dim_Date[Weekday] <> 7) * 7.5 >= 0, SUM (fact_Tasks[Duration]) - CALCULATE (DISTINCTCOUNTNOBLANK (fact_Tasks[Employee_Date]), dim_Date[Weekday] <> 1 && dim_Date[Weekday] <> 7) * 7.5, 0)
	Overtime Worked	SUMX (VALUES (dim_Employees[Employee]), [Overtime])
	FTEs	DIVIDE ([Tasks Duration] * DISTINCTCOUNTNOBLANK (fact_Tasks[EmployeeID]), CALCULATE (DISTINCTCOUNTNOBLANK (fact_Tasks[Employee_Date]), dim_Date[Weekday] <> 1 && dim_Date[Weekday] <> 7) * 7.5)
Financial Analyses	P&L	CALCULATE (SWITCH (SELECTEDVALUE (dim_Accounts[IsCalc]), 0, CALCULATE (SUM (fact_AccountingMovements[Amount])), 1, [Other services], 2, [Suplies and services], 3, [Other op costs], 4, [EBT], 5, [Subcontracts], 6, [SpecialisedWorks])), fact_AccountingMovements[Description] = “”)
	P&L H	CALCULATE ([P&L], SAMEPERIODLASTYEAR (‘dim_Date’[Date]))
	P&L FC	CALCULATE (SWITCH (SELECTEDVALUE (dim_Accounts[IsCalc]), 0, CALCULATE (SUM (fact_AccountingMovements[Amount])), 1, [Other services], 2, [Suplies and services], 3, [Other op costs], 4, [EBT], 5, [Subcontracts], 6, [SpecialisedWorks]), fact_AccountingMovements[Description] = “Budget”, fact_AccountingMovements[Budget Name] = “FC”& MAX (‘dim_Date’[Year]))
	P&L YTD	TOTALYTD ([P&L], ‘dim_Date’[Date])
	P&L H YTD	CALCULATE ([P&L YTD], SAMEPERIODLASTYEAR (‘dim_Date’[Date]))
	P&L FC YTD	TOTALYTD ([P&L FC], ‘dim_Date’[Date])

	YTD	VAR scope1 = ISINSCOPE (dim_Accounts[P&L]) VAR scope2 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Supplies and Services” VAR scope3 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Other Costs” VAR scope4 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Other Revenues” RETURN IF (scope1, P&L YTD], IF (scope2, CALCULATE ([P&L YTD], dim_Accounts[IsCalc] = 6, ALL (dim_Accounts)), IF (scope3, CALCU-LATE ([P&L YTD], dim_Accounts[P&L] = “Subcontracts”) + CALCULATE ([P&L YTD], dim_Accounts[P&L] = “Other operating costs”) + CALCU-LATE ([P&L YTD], dim_Accounts[P&L] = “Materials”) + CALCULATE ([P&L YTD], dim_Accounts[P&L] = “Financial expenses”) + CALCULATE ([P&L YTD], dim_Accounts[P&L] = “Taxes”) + CALCULATE ([P&L YTD], dim_Accounts[P&L] = “Depreciation”), IF (scope4, CALCULATE ([P&L YTD], dim_Accounts[P&L] = “Other revenues”) + CALCULATE ([P&L YTD], dim_Accounts[P&L] = “Subsidies”) + CALCULATE ([P&L YTD], dim_Ac-counts[P&L] = “Financial Income”), [P&L YTD]))))
	YTD H	VAR scope1 = ISINSCOPE (dim_Accounts[P&L]) VAR scope2 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Supplies and Services” VAR scope3 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Other Costs” VAR scope4 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Other Revenues” RETURN IF (scope1, [P&L H YTD], IF (scope2, CALCULATE ([P&L H YTD], dim_Accounts[IsCalc] = 6, ALL (dim_Accounts)), IF (scope3, CAL-CULATE ([P&L H YTD], dim_Accounts[P&L] = “Subcontracts”) + CALCU-LATE ([P&L H YTD], dim_Accounts[P&L] = “Other operating costs”) + CAL-CULATE ([P&L H YTD], dim_Accounts[P&L] = “Materials”) + CALCULATE ([P&L H YTD], dim_Accounts[P&L] = “Financial expenses”) + CALCULATE ([P&L H YTD], dim_Accounts[P&L] = “Taxes”) + CALCULATE ([P&L H YTD], dim_Accounts[P&L] = “Depreciation”), IF (scope4, CALCULATE ([P&L H YTD], dim_Accounts[P&L] = “Other revenues”) + CALCULATE ([P&L H YTD], dim_Accounts[P&L] = “Subsidies”) + CALCULATE ([P&L H YTD], dim_Accounts[P&L] = “Financial Income”), [P&L H YTD]))))
	YTD FC	VAR scope1 = ISINSCOPE (dim_Accounts[P&L]) VAR scope2 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Supplies and Services” VAR scope3 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Other Costs” VAR scope4 = ISINSCOPE (dim_Accounts[P&L Aggregated]) && VALUES (dim_Accounts[P&L Aggregated]) = “Other Revenues” RETURN IF (scope1, [P&L FC YTD], IF (scope2, CALCULATE ([P&L FC YTD], dim_Accounts[IsCalc] = 6, ALL (dim_Accounts)), IF (scope3, CALCU-LATE ([P&L FC YTD], dim_Accounts[P&L] = “Subcontracts”“) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L]=“Other operating costs”) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Materials”) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Financial expenses”) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Taxes”) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Depreciation”), IF (scope4, CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Other revenues”) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Subsidies”) + CALCULATE ([P&L FC YTD], dim_Accounts[P&L] = “Financial Income”), [P&L FC YTD]))))
	R-F YTD	[YTD] - [YTD FC]
	R-H YTD	[YTD] - [YTD H]
	R/F YTD	IF ([YTD FC] < 0, - DIVIDE ([R-H YTD], [YTD FC]), DIVIDE ([R-H YTD], [YTD FC]))
	R/H YTD	IF ([YTD H] < 0, - DIVIDE ([R-H YTD], [YTD H]), DIVIDE ([R-H YTD], [YTD H]))
	Other services	CALCULATE ((CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = “TT001”) - [Subcontracts] - [Specialised-Works] - CALCULATE (sum (fact_AccountingMovements[Amount]), dim_Ac-counts[RowNumber] in “L0003”, “L0004”, “L0005”, “L0006”, “L0007”, “L0008”, “L0009”, “L0010”, “L0011”, “L0012”, “L0013”, “MAT”)), ALL (dim_Accounts))

Supplies and services	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] in "L0003", "L0004", "L0005", "L0006", "L0007", "L0008", "L0009", "L0010", "L0011", "L0012", "L0013") + [SpecialisedWorks] + [Other services], ALL (dim_Accounts))
Other op costs	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "TT002") - CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "L0017"), ALL (dim_Accounts))
EBT	CALCULATE ([EBIT] + [Financial Result], ALL(dim_Accounts))
EBIT	CALCULATE ([EBITDA] - CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "L0020"), ALL (dim_Accounts))
EBITDA	CALCULATE ([Turnover] - CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] in "L0001", "P0004", "L0016", "L0017") - [Subcontracts] - [Suplies and services] - [Other op costs] + CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] in "P0005", "P0006"), ALL (dim_Accounts))
Turnover	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] in "P0001", "P0002", "P0003"), ALL (dim_Accounts))
Financial Result	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "P0007") - CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "L0019"), ALL (dim_Accounts))
Subcontracts	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] in "SUB", "POL"), ALL (dim_Accounts))
Specialised-Works	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "TESP") -CALCULATE (SUM (fact_AccountingMovements[Amount]), dim_Accounts[RowNumber] = "POL"), ALL (dim_Accounts))
Balance	CALCULATE (SWITCH (SELECTEDVALUE (dim_Accounts[IsCalc]), 0, SUM (fact_AccountingMovements[Amount]), 7, [Other Investments], 8, [Total Non-Current Assets], 9, [Customers], 10, [Total Current Assets], 11, [Total Assets], 12, [Net results of the financial year], 13, [Total Equity], 14, [Total Non-Current Liabilities], 15, [Trade payables], 16, [Financial debt], 17, [Total Current Liabilities], 18, [Total Liabilities], 19, [Total Equity and Liabilities]), 'dim_Date'[Date]<= MAX (dim_Date[Date]))
Balance H	CALCULATE ([Balance], SAMEPERIODLASTYEAR (dim_Date[Date]))
Other Investments	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_A0001") - CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_ANC004"), ALL (dim_Accounts))
Total Non-Current Assets	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] in "KTM BAL EN_ANC001", "KTM BAL EN_ANC002", "KTM BAL EN_ANC003", "KTM BAL EN_ANC004", "KTM BAL EN_ANC006", "KTM BAL EN_ANC007", "KTM BAL EN_ANC008", "KTM BAL EN_ANC009"), ALL (dim_Accounts)) + [Other Investments]
Customers	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_A0002") - CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_PC002"), ALL (dim_Accounts))
Total Current Assets	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] in "KTM BAL EN_AC001", "KTM BAL EN_AC002", "KTM BAL EN_AC004", "KTM BAL EN_AC005", "KTM BAL EN_AC006", "KTM BAL EN_AC007", "KTM BAL EN'_AC008", "KTM BAL EN_AC009", "KTM BAL EN_AC010", "KTM BAL EN_AC011", "KTM BAL EN_AC012") + [Customers], ALL (dim_Accounts))
Total Assets	[Total Current Assets] + [Total Non-Current Assets]

	Net results of the financial year	CALCULATE (- CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_P0003") - CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_L0001"), ALL (dim_Accounts))
	Total Equity	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] in "KTM BAL EN_CP001", "KTM BAL EN_CP002", "KTM BAL EN_CP003", "KTM BAL EN_CP004", "KTM BAL EN_CP005", "KTM BAL EN_CP006") - [Net results of the financial year], ALL (dim_Accounts))
	Total Non-Current Liabilities	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] in "KTM BAL EN_PNC001", "KTM BAL EN_PNC002", "KTM BAL EN_PNC003", "KTM BAL EN_PNC004", "KTM BAL EN_PNC005"), ALL (dim_Accounts))
	Trade payables	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_A0003") - CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_AC004"), ALL (dim_Accounts))
	Financial debt	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_A0004") - CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] = "KTM BAL EN_PNC002"), ALL (dim_Accounts))
	Total Current Liabilities	CALCULATE (CALCULATE (SUM (fact_AccountingMovements[Amount]), fact_AccountingMovements[rownumber] in "KTM BAL EN_PC002", "KTM BAL EN_PC003", "KTM BAL EN_PC004", "KTM BAL EN_PC006", "KTM BAL EN_PC007", "KTM BAL EN_PC008", "KTM BAL EN_PC009", "KTM BAL EN_PC010") + [Trade payables] + [Financial debt], ALL (dim_Accounts))
	Total Liabilities	[Total Current Liabilities] + [Total Non-Current Liabilities]
	Total Equity and Liabilities	[Total Equity] + [Total Liabilities]
Departments' Evaluation	Evaluation	AVERAGE ('fact_DepartmentsEvaluation'[Value])

Appendix C

Dashboard Visualisations

C.0.1 Dashboard I

Figure C.1: Overview Page of Dashboard I - Weekly drill-down view

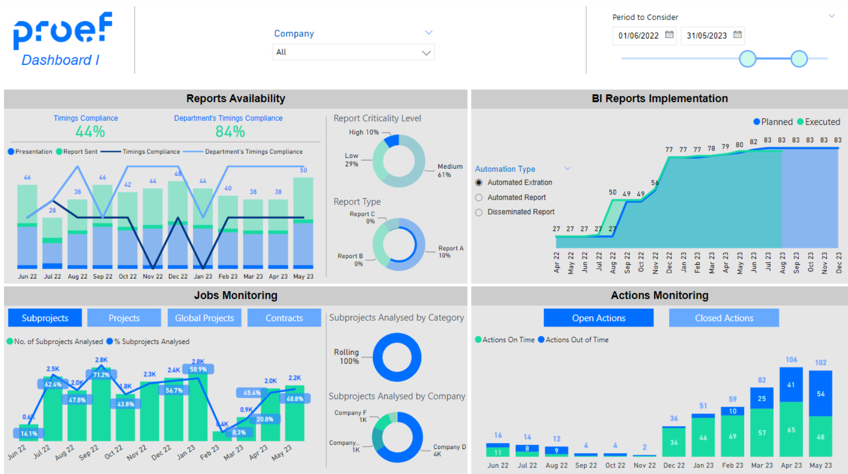


Figure C.2: Overview Page of Dashboard I - High criticality selection on the donut chart

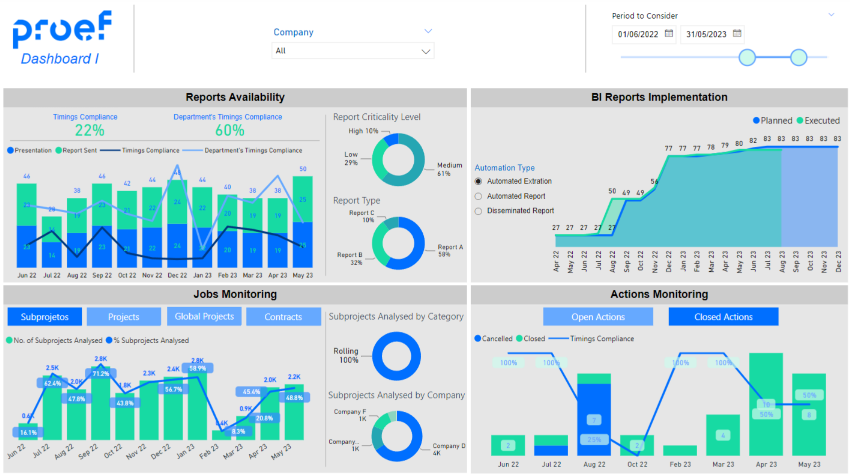


Figure C.3: Overview Page of Dashboard I - Closed Actions View

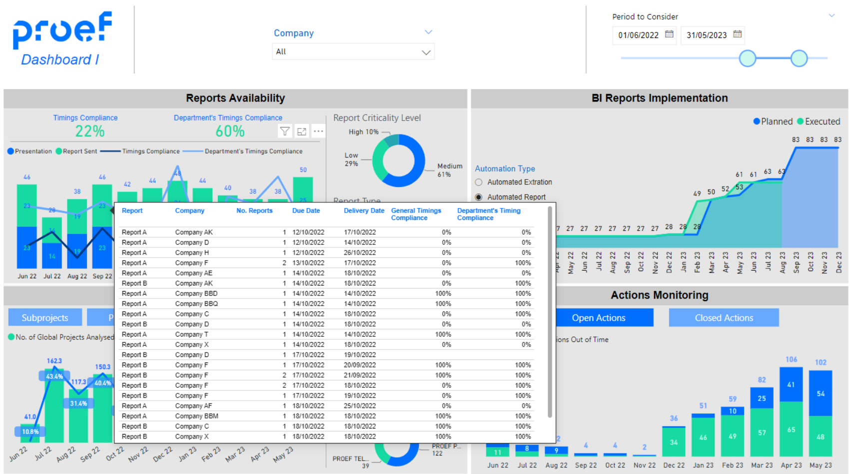


Figure C.4: Overview Page of Dashboard I - Tooltip from Reports Availability

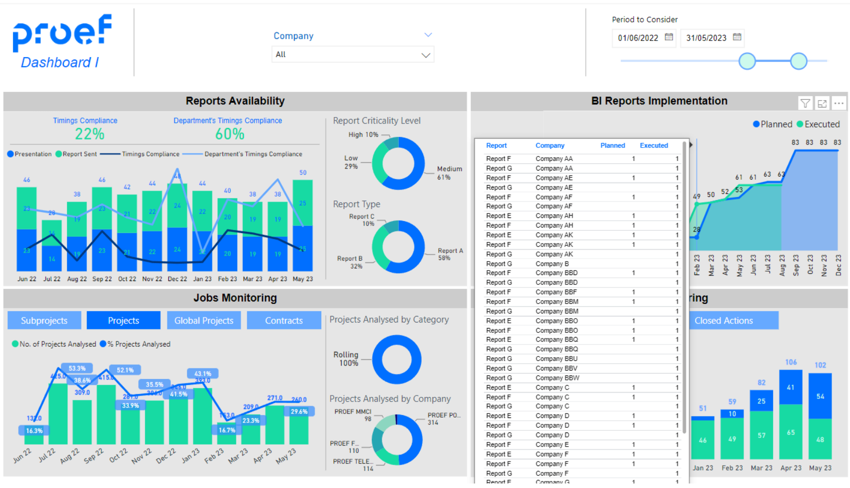


Figure C.5: Overview Page of Dashboard I - Tooltip from BI Reports Implementation

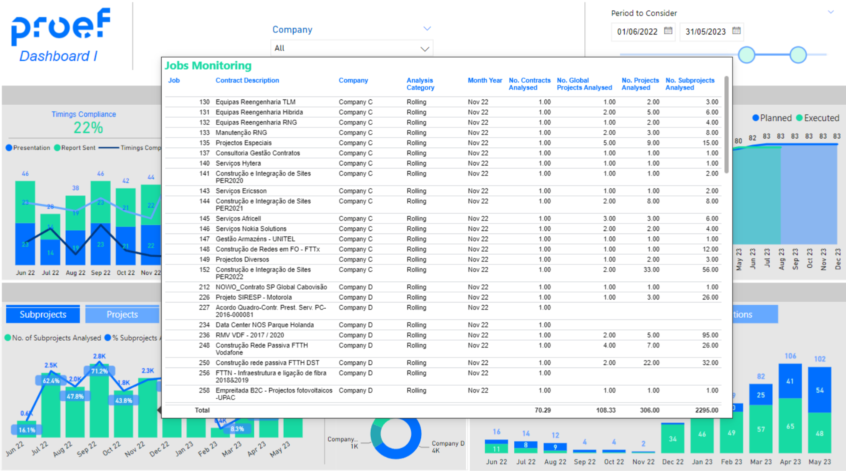


Figure C.6: Overview Page of Dashboard I - Tooltip from Jobs Monitoring

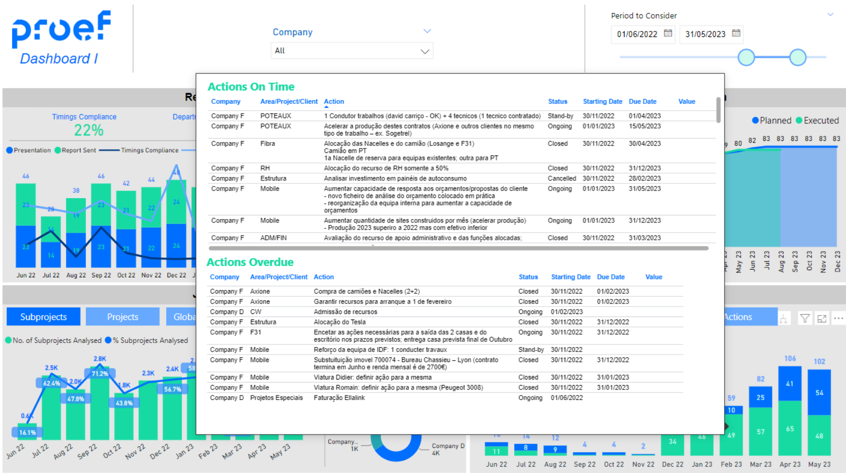


Figure C.7: Overview Page of Dashboard I - Tooltip from Actions Monitoring

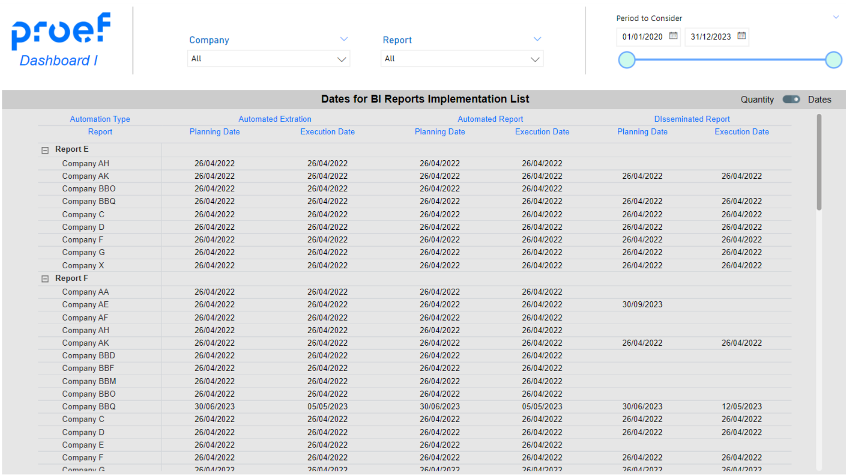
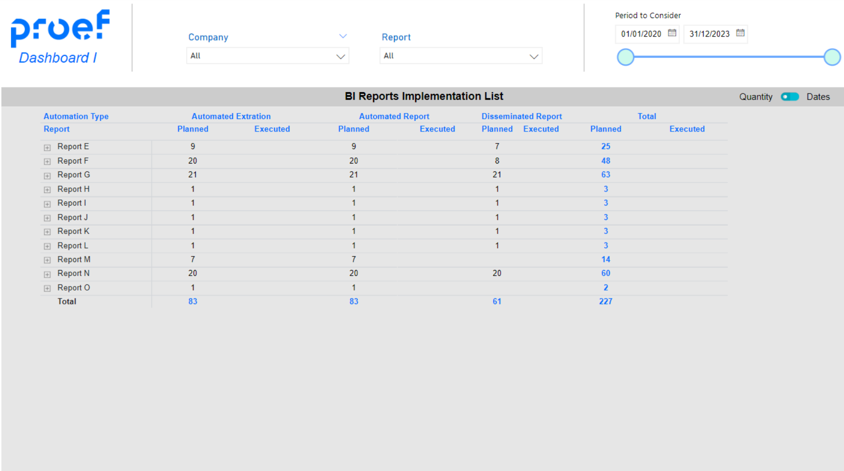
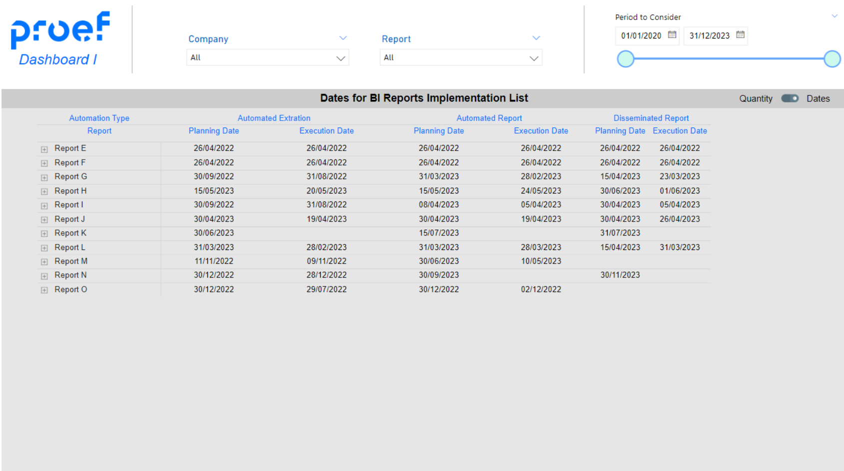


Figure C.8: BI Reports Implementation Page of Dashboard I - Dates View



Automation Type	Automated Extration		Automated Report		Disseminated Report		Total	
Report	Planned	Executed	Planned	Executed	Planned	Executed	Planned	Executed
Report E	9		9		7		25	
Report F	20		20		8		48	
Report G	21		21		21		63	
Report H	1		1		1		3	
Report I	1		1		1		3	
Report J	1		1		1		3	
Report K	1		1		1		3	
Report L	1		1		1		3	
Report M	7		7				14	
Report N	20		20		20		60	
Report O	1		1				2	
Total	83		83		61		227	

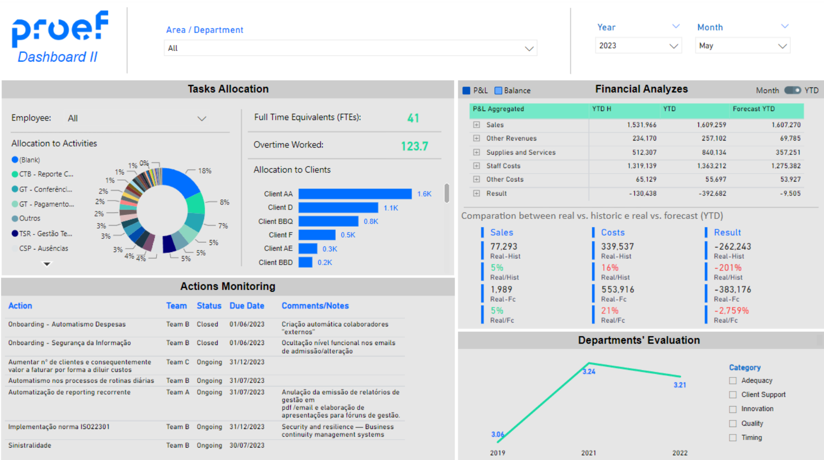
Figure C.9: BI Reports Implementation Page of Dashboard I - Roll-up View of Quantity



Automation Type	Automated Extration		Automated Report		Disseminated Report	
Report	Planning Date	Execution Date	Planning Date	Execution Date	Planning Date	Execution Date
Report E	26/04/2022	26/04/2022	26/04/2022	26/04/2022	26/04/2022	26/04/2022
Report F	26/04/2022	26/04/2022	26/04/2022	26/04/2022	26/04/2022	26/04/2022
Report G	30/09/2022	31/08/2022	31/03/2023	28/02/2023	15/04/2023	23/03/2023
Report H	15/05/2023	20/05/2023	15/05/2023	24/05/2023	30/06/2023	01/06/2023
Report I	30/09/2022	31/08/2022	08/04/2023	05/04/2023	30/04/2023	05/04/2023
Report J	30/04/2023	19/04/2023	30/04/2023	19/04/2023	30/04/2023	26/04/2023
Report K	30/06/2023		15/07/2023		31/07/2023	
Report L	31/03/2023	28/02/2023	31/03/2023	28/03/2023	15/04/2023	31/03/2023
Report M	11/11/2022	09/11/2022	30/06/2023	10/05/2023		
Report N	30/12/2022	28/12/2022	30/09/2023		30/11/2023	
Report O	30/12/2022	29/07/2022	30/12/2022	02/12/2022		

Figure C.10: BI Reports Implementation Page of Dashboard I - Roll-up View of Dates

C.0.2 Dashboard II



Action	Team	Status	Due Date	Comments/Notes
Onboarding - Automatismo Despesas	Team B	Closed	01/06/2023	Criação automática colaboradores "externos"
Onboarding - Segurança da Informação	Team B	Closed	01/06/2023	Ocultação nível funcional nos emails de admissão/alteração
Aumentar nº de clientes e consequentemente valor a faturar por forma a diluir custos	Team C	Ongoing	31/12/2023	
Automatismo nos processos de rotinas diárias	Team B	Ongoing	31/07/2023	
Automatização de reporting recorrente	Team A	Ongoing	31/07/2023	Anulação da emissão de relatórios de gestão em pdf /email e elaboração de apresentações para fóruns de gestão.
Implementação norma ISO22301	Team B	Ongoing	31/12/2023	Security and resilience — Business continuity management systems
Sinistralidade	Team B	Ongoing	30/07/2023	

P&L Aggregated	YTD H	YTD	Forecast YTD
Sales	1,531,966	1,609,259	1,607,270
Other Revenues	234,170	257,102	69,785
Supplies and Services	512,307	840,134	357,251
Staff Costs	1,319,139	1,363,212	1,275,382
Other Costs	65,129	55,697	53,927
Result	-130,438	-392,682	-9,505

Figure C.11: Overview Page of Dashboard II - P&L YTD View

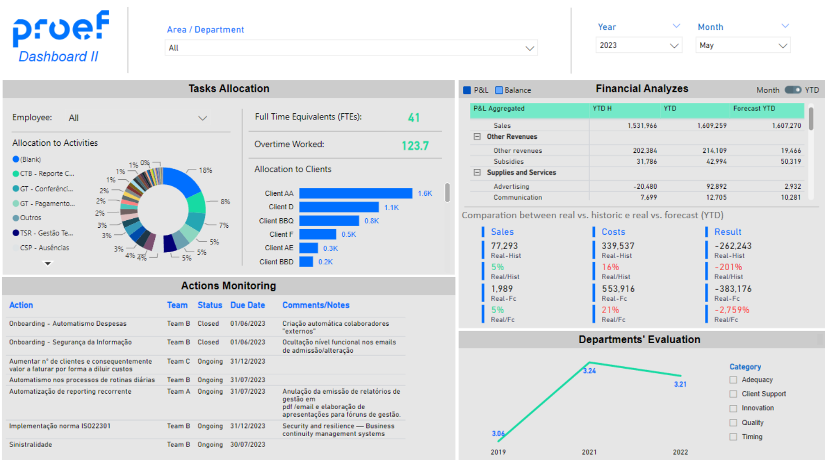


Figure C.12: Overview Page of Dashboard II - P&L YTD Disaggregated View

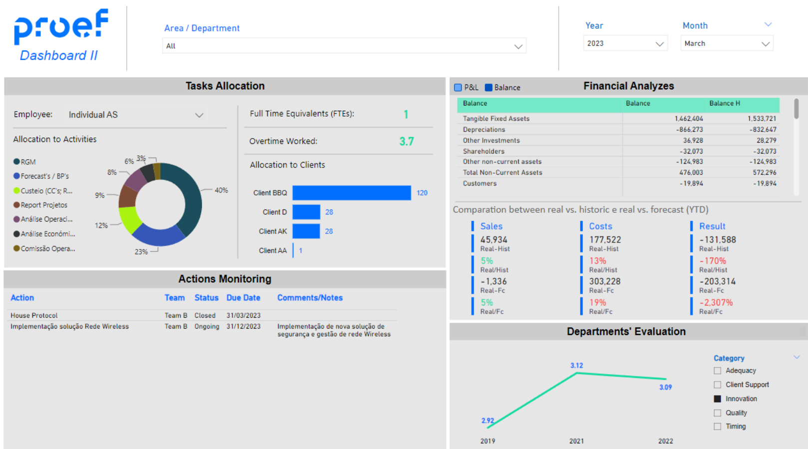


Figure C.13: Overview Page of Dashboard II - Employee and Departments' Evaluation Category filtered with Balance View