Universidade de Aveiro
2022

JOÃO PEDRO AROUCA DE CASTRO

Transformação Digital: Integração de Ferramentas BI com CRM e Dados de Vendas

Digital Transformation: BI Tools Integration with CRM and Sales Data

Universidade de Aveiro
2022

JOÃO PEDRO
AROUCA DE
CASTRO

Transformação Digital: Integração de Ferramentas BI com CRM e Dados de Vendas

Digital Transformation: BI Tools Integration with CRM and Sales Data

Dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Mestre em Engenharia e Gestão Industrial, realizada sob a orientação científica do Doutor Carlos Manuel dos Santos Ferreira, Professor Associado c/ Agregação do Departamento de Economia, Gestão, Engenharia Industrial e Turismo da Universidade de Aveiro.

o júri / the jury

presidente / president

Prof. Doutora Leonor da Conceição Teixeira
Professora Associada da Universidade de Aveiro

vogais / examiners committee

Prof. Doutor Samuel de Sousa Silva
Professor Auxiliar em Regime Laboral da Universidade de Aveiro

Prof. Doutor Carlos Manuel dos Santos Ferreira
Professor Associado com Agregação da Universidade de Aveiro

agradecimentos / acknowledgements

Aos meus pais, pela motivação e confiança constantes que me transmitiram, não só ao longo da realização da minha dissertação de mestrado, mas também durante todo o meu percurso académico. À Lara, pelo incansável apoio, estando lá para me felicitar nos dias bons e para me encorajar nos dias maus. Aos meus amigos, por estarem sempre lá para me ouvir e aconselhar e pela disponibilidade que sempre demonstraram. À Amorim Cork e a todos os profissionais que se cruzaram comigo durante o meu percurso e, de alguma forma, me auxiliaram na realização deste trabalho, em especial ao meu coorientador, o Engenheiro Mário Silva, que foi incansável ao longo de todo o processo. Agradeço-lhe todo o conhecimento que me transmitiu e a liberdade que me deu para fazer as minhas próprias escolhas, transmitindo-me sempre a maior das confianças. Ao meu orientador, Professor Doutor Carlos Ferreira, pela disponibilidade e contribuição que deu a este trabalho. Agradeço-lhes a motivação e o facto de se tratarem de um exemplo, para mim, enquanto futuro profissional.

Palavras Chave Business Intelligence, ETL, PowerBI, Reporting, CRM, ERP.

Resumo

Nos últimos anos, os avanços tecnológicos e a crescente quantidade de dados gerados levaram as empresas a adotar novos e melhores procedimentos de gestão, apoiados por software empresarial com capacidade de fazer frente a esta nova realidade. É aqui que entram as ferramentas de Business Intelligence (BI), com o objetivo de proporcionar às empresas a capacidade de extrair informação útil dos dados disponíveis, permitindo que se posicionem no mercado alvo com uma maior compreensão dos desafios e do que pode ser feito para alcançar melhores resultados. BI engloba métodos de recolha, tratamento, limpeza e armazenamento de dados e a implementação de ferramentas analíticas. Neste seguimento, como parte de um projeto abrangente de Transformação Digital (TD), a Amorim, e em particular a unidade de negócios Amorim Cork SGPS (AC-SGPS), tem notado um aumento constante no fluxo e volume de dados, associado a uma necessidade crescente de tirar o máximo partido dos mesmos. Consequentemente, um dos principais objetivos do grupo Amorim passa pelo investimento em ferramentas de BI que tornem a análise de dados mais fácil e intuitiva. Neste contexto, o foco do meu projeto de estágio passou pela integração de dados de uma ferramenta CRM e do sistema ERP, atualmente implementados, com Power BI (PBI), a fim de simplificar e melhorar a análise da informação existente. O projeto foi dividido em dois casos de estudo - departamentos de Serviço de Apoio ao Cliente e departamentos Comerciais de duas empresas do grupo Amorim -, onde a implementação do PBI foi realizada separadamente. Para cada caso, começou-se por realizar uma análise da estrutura de dados da empresa, tendo-se seguido uma recolha de requisitos iniciais dos stakeholders, culminando com o seu desenvolvimento e implementação. Durante todo o processo de desenvolvimento, foi dada prioridade à participação constante dos stakeholders para que, numa fase pós-implementação, pudessem fazer o melhor uso possível das ferramentas BI. Posteriormente foi realizado um inquérito aos utilizadores como forma de recolher e analisar os resultados e averiguar o valor acrescentado às empresas abrangidas. De um ponto de vista geral, segundo os membros dos departamentos, o novo acesso à informação é claramente superior aos métodos utilizados até então, tornando-a mais fácil de encontrar e consequentemente contribuindo para um método de trabalho mais independente e produtivo. Foi também salientada a importância da implementação deste tipo de ferramenta na monitorização e correção de processos a partir de uma perspetiva factual e quantificável dos dados, ao mesmo tempo que apoia o processo de tomada de decisão. Por conseguinte, prevê-se que o projeto venha a contribuir, por um lado para uma redução dos custos, resultante de uma maior produtividade e de um processo de tomada de decisão mais rápido e eficaz, e por outro lado para um aumento das receitas e dos lucros, como resultado de uma maior retenção e atracão de clientes, a par de uma maior satisfação e motivação dos utilizadores. Estas contribuições, no seu conjunto, estão intrinsecamente ligadas ao sucesso da estratégia empresarial e dos objetivos a longo prazo definidos no projeto multidepartamental de TD da AC-SGPS.

Keywords Business Intelligence, ETL, PowerBI, Reporting, CRM, ERP.

Abstract

In recent years, technological advancements and the escalating volume of data generated have encouraged companies to adopt new and improved management procedures, supported by business software able to accommodate this new reality. Business Intelligence (BI) tools serve this purpose, with the goal of providing businesses with the ability to extract useful information from available data, enabling them to position themselves in the target market with a greater understanding of the challenges and what can be done to achieve better results. BI involves the collection, processing, cleansing, and storage of data, as well as the implementation of analytical tools. Following this, as part of a comprehensive Digital Transformation (DT) project, Amorim, in particular the Amorim Cork SGPS (AC-SGPS) business unit, has observed a constant increase in the data flow and volume, as well as a growing need to maximize data utility. Consequently, one of the Amorim's primary objectives is to invest in BI tools that support and simplify data analysis. In this context, the primary objective of my internship project was to integrate data from a CRM tool and the currently implemented ERP system into PowerBI (PBI) in order to facilitate the analysis of existing data. The project was divided into two case studies - Customer Service departments and Commercial departments of two Amorim group companies - where the PBI was implemented independently. Each case began with an analysis of the department's data structure, followed by the collection of initial requirements from stakeholders, and concluded with the development and implementation of the solution. Special attention was deposited on the continuous participation of stakeholders throughout the development process so that they could make optimal use of the BI tools after implementation. Subsequently, a survey was conducted with the end users in order to collect and analyze the results and inquire the added value to the covered companies. According to the members of the departments, the new access to information is clearly superior to the methods previously used, as it makes the information easier to locate and contributes to a more independent and productive method of working. In addition, the significance of implementing this type of tool for monitoring and correcting processes from a factual and quantifiable data perspective while supporting the decision-making process was emphasized. Consequently, it is anticipated that the project will contribute, on the one hand, to a reduction in costs, as a result of increased productivity and a faster and more effective decision-making process, and, on the other hand, to an increase in revenues and profits, as a result of increased customer retention and attraction, as well as greater user satisfaction and motivation. Together, these contributions are intrinsically linked to the success of AC-SGPS's multi-departmental DT project's business strategy and long-term objectives.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Context and Motivation

Digital Transformation (DT) has emerged as a significant trend in the research and practice of strategic information systems. At a high level, DT refers to the significant changes that digital technologies are causing in society and industry. Although there are several definitions for this term, according to the literature review article by *Vial* (2019), DT is described as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" [1]. From a business perspective, this implies effecting changes in essential operations, leading companies to face significant technical challenges that can hinder the implementation of digital transformations. To manage these complex processes, companies must adopt new and better management procedures, supported by emerging enterprise software that can address new issues, namely the growing amount of data [2]. In recent years, a much larger amount of data than usual has been created, managed and stored by companies, requiring them to increasingly seek practical and effective solutions for the maintenance, management and correct analysis of their data, in order to optimize their business decisions as much as possible and enable the prediction of results and scenarios.

One of the solutions to deal with the ever-increasing data volume is through new storage methods in the Cloud and technologies for processing large amounts of data, which have made it possible to keep up with this growth, allowing its management to be much more effective. Nonetheless, in addition to the need for data storage and management, the opportunity to perform more complex business data analyses has begun to emerge. This is where Business Intelligence (BI) tools come in, with the goal of providing companies the ability to create information from the available data, thereby enabling them to position themselves on the target market with a greater understanding of the challenges and what can be done to achieve

better results.

According to a study, 75% of business executives do not have a high level of confidence in their data, whereas 80% believe that disruptive technologies will alter the competitive landscape and a large majority, approximately 72%, consider that efficient utilization of data supports the decision-making process [3]. While there is consensus that good data quality can be critical to many parts of an organization's future success, only 23% of organizations have a consistent overall enterprise-wide data management strategy [3]. The majority, 46%, are presently implementing this strategy in key areas, whilst the remainder are piloting or planning future investments [3]. The Amorim group can be included in this 46%. The Portuguese multinational is the world's largest cork processing group, and one of its many ongoing projects is the implementation of a multi-departmental DT project. My internship theme was derived from this project, where I had the opportunity to develop and implement tools applied to customer and sales data using the BI software adopted by the group, Power BI (PBI).

1.2 The Project at Amorim Cork

The Amorim group, as previously stated, is the biggest cork transformation group in the world, contributing significantly to the market, economics, innovation, and sustainability of the whole cork sector. Founded in 1870 by António Alves Amorim, the group has gained relevance around the globe, with clients on practically every continent and annual revenues of around 800 million euros. As a group whose focus is "to add value to cork, in a competitive, differentiated and innovative way, in perfect harmony with Nature", Amorim has been investing in the improvement and development of the various business sectors where it operates [4]. Currently, the group has five business units that range from the exploration and extraction of raw materials to the processing and production of cork stoppers, thermal, acoustic and anti-vibration insulation, as well as cork flooring and decorative cork wall coverings. Amorim Cork SGPS (AC-SGPS) is one of the five existing business units responsible for the production, supply, and distribution of cork stoppers, and comprises more than thirty companies. These include Amorim Cork SA (AC-SA), a producer of cork stoppers for a variety of wines, Amorim Top Series (ATS), a producer of exclusive capsulated cork stoppers for the world's most prestigious spirits brands, and Amorim Champcork (ACHK), a producer of cork stoppers for sparkling wines and champagnes. With sales of approximately 5.5 billion cork stoppers per year, AC-SGPS accounts for approximately 70% of the Amorim group's total sales [5]. This business unit has approximately 19,000 active customers worldwide, which contributes to its sense of responsibility and dedication in its pursuit of innovation and the sustainability of this raw material. Among numerous other initiatives, Amorim has been implementing a variety of DT projects across all of its business units in an effort to achieve competitive advantages, more profitable revenues, and greater efficiency [6].

Concerning the AC-SGPS, and more specifically the AC-SA and ATS, one of the primary focuses of the DT initiative relates to the rising volume of data and the increasing need to find solutions that facilitate a better understanding and application of this data. In particular, the

data flow has increased due to the recent implementation of two new business management software: SAP, an Enterprise Resource Planning (ERP) software implemented in the middle of 2019; and Microsoft Dynamics 365 (MSD CRM), a Customer Relationship Management (CRM) software implemented in the latter half of 2021. As a result, it became necessary to design and develop a BI solution that would enable the centralization of data in order to overcome problems associated with the lack of data analysis mechanisms. This problem inspired the topic of my internship project, which aimed to implement BI tools in the Customer Service (CS) department and Sales department of ATS, and in the CS department and Sales department of AC-SA. Despite the fact that the project was developed and implemented for two distinct companies (AC-SA and ATS), the same method was utilized for departments with the same objective (CS and Sales). It is also important to mention that the project was carried out under the supervision of the Management Control (MC) department of AC-SA, of which I was a member during the internship.

The departments in question had similar problems relating to the need to create and provide a tool that would centralize data and allow reliable data analysis. This implementation was intended not only to facilitate and optimize the departmental working methods, but also to add value to the companies by enhancing the work efficiency of the departments. From a development standpoint, it was intended to reduce the time required to search for information, eliminate the possibility of information loss, and improve the analysis performed through the tool in the PBI. Despite the similarity of the problem in both departments, as previously mentioned, the development process had to be adapted and customised for each of them (CS and Sales departments), depending on the type of data sources and how they are related.

Although this is not the first BI project implemented in both companies associated with data collected by the ERP, it was the first regarding data collected after the implementation of MSD CRM. Therefore, once the MSD CRM came in, the companies were storing data but did not have easy access to it. As a result, there was no solution that enabled a dynamic view of the information, sufficiently secure access, and simultaneous analysis of multiple data sources. This situation led to CS directors and collaborators not being able to focus on key incidents while Sales directors and collaborators were unable to prioritize key business opportunities.

1.3 Project Objectives

The objective of this work is to develop and implement a customized central data analysis solution for the CS department and Sales department, of both AC-SA and ATS companies, using PBI as a BI tool. This project aims to automate the process of collecting and processing data and provide tools for analysis, giving the user the ability to extract the full value of the information owned and that previously was not properly available. More specifically, for the CS department it is intended to use data inserted by the collaborators themselves in MSD CRM and help make the whole customer support process as personalized as possible through a data-driven approach. In the case of the Sales department, the objective was to provide the sales representatives with tools to analyze the business opportunities they created in MSD CRM and then relate it to the *Order to Cash* (O2C) model, which includes all SAP sales data.

In other words, the objective is to establish a connection between potential sales data created in MSD CRM and actual sales data invoiced in SAP.

After integrating this set of tools, it is anticipated that four primary goals will be accomplished:

- Centralize the information in a single platform;
- Improve and facilitate access to data by departmental directors and their teams;
- Optimize the decision making process;
- Support the directors in monitoring their teams.

1.4 Structure of the Document

The structure of the document is composed of six more chapters in addition to this one. The second chapter, *Theoretical Background*, consists in an overview of the relevant theoretical concepts to understand the project under consideration. This work's relevant methodologies are presented in the third chapter, *Methodologies*. The fourth chapter, *Business Integration Project at Amorim*, presents the companies data architecture and describes the specific needs of the departments in which the project will be developed, as well as the proposed solutions. All phases of the project's development and implementation are described in the fifth chapter, *Development and Implementation of Business Intelligence Tools*. On chapter six, *Results and discussion*, the results, and subsequent discussion of the work implemented, are presented, based on a series of questionnaires distributed to the teams involved. Finally, in the seventh chapter, *Conclusion and Future Work*, the general conclusions drawn and proposals for future work are presented, while highlighting the project's limitations.

Chapter 2

Theoretical Background

Data is expanding at an exponential rate and is increasingly considered "one of the most valuable assets a business can have and potentially has a tremendous impact on its long-term success", according to Forbes magazine [7]. This is precisely why organizations are realizing they need methods to track the data they possess, comprehend where it is stored, regulate who has access to it, and implement analytical tools to extract value from it.

Encompassing all the methods previously mentioned, the BI concept emerges. According to CIO, a magazine recognized for producing award-winning content and resources for IT leaders, "Business intelligence (BI) leverages software and services to transform data into actionable insights that inform an organization's business decisions" [8].

This chapter identifies the main objectives of a BI solution as well as a set of technologies that enable a good implementation, such as the software and databases responsible for collecting data, the data storage infrastructures, databases designed to be queried and analyzed, and Power BI, one of the main BI tools on the market, which I worked with during the development of the project.

2.1 Business Intelligence: definition and technologies

BI can be traced back to the study of Decision Support Systems (DSS), which is the discipline of information systems (IS) that focuses on improving management decision-making in order to assist knowledge workers, such as executives, managers, and analysts, in making better and more timely decisions [9] [10]. In the early 1990s, as a response to managers' demands for more efficient and effective enterprise data analysis in order to achieve a better understanding of their organization's state and enhance decision-making [11], Howard Dressner, a Gartner Group analyst at the time, created the concept of *business intelligence* considered by many experts as a successor to DSS. Whereas BI is increasingly used, particularly in the business world, to define not a single decision-making methodology but, according to

the US market research institute Forrester, "a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information" [12], DSS applications are often "purpose-built for supporting specific decisions" [13].

The figure 2.1 depicts a generic BI information system approach, whose primary function is to provide users with a multitude of intelligence outputs. This particular BI architecture was inspired on the infrastructure that Amorim deployed to support all phases of the BI process. In general, such a BI architecture is designed to integrate a variety of *data sources*, including both internal (ERP, CRM, and other systems) and external sources. Subsequently, BI operations are typically conducted incrementally as new data emerges, so efficient and scalable data loading and updating capabilities are required. These back-end technologies, used to prepare data for BI, are known as *Extract-Transform-Load* (ETL) tools. Afterwards, the data on which enterprise BI operations are performed are often loaded and stored in a repository known as a *Data Warehouse* (DW), which is managed by one or more [10] DW servers. In turn, DW servers can be supplemented by *mid-tier servers* - online analytical processing (OLAP) servers - which provide a multidimensional view of the data for eventual integration into front-end applications or direct user access [14]. A *front-end* application is the layer or element that the user can use, view, and interact with through buttons, images, interactive elements, navigation menus, and text when the data is ready to be analyzed in the form of reports, dashboards, and other visual output [15].

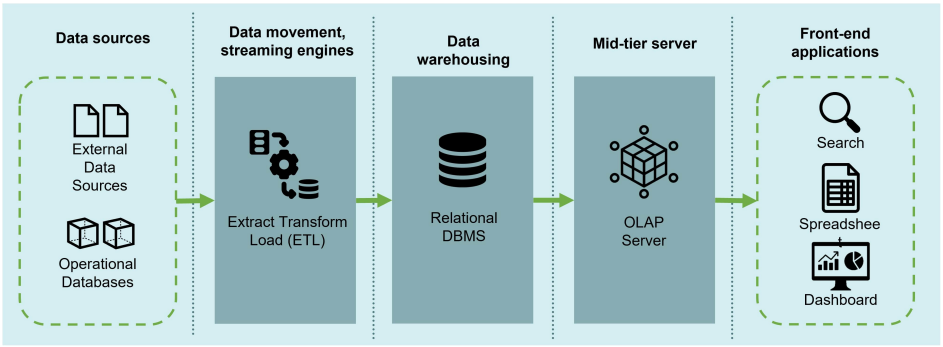


Figure 2.1: Business Intelligence Architecture.

2.1.1 Data Sources

A data source is a location from which data is collected. Data sources can be internal, if the information is gathered and stored within an organization, or external, if the data is generated outside of the organization. It is important to specify that for the developed project only internal data sources were used. The internally collected data is mostly maintained in databases referred to as Online Transaction Processing (OLTP). OLTP is the backbone of a business information system and consists of a Database Management System (DBMS) - the software that manages and controls access to a database, which is a collection of related data - where data is stored and processed in real time [16]. These transactional (or operational) systems contain large amounts of transactions that record the day-to-day operations of businesses, providing large quantities of raw data that are difficult to analyze.

Examples of such systems are related to the management of various business activities such as production, logistics, sales, and even customer service processes. Enterprise Resource Planning (ERP) and Consumer Relationship Management (CRM) correspond to a group of transactional software programs, both used in this project, and which together encompass the aforementioned transactional processes, in addition to many others.

ERP

ERP refers to a type of enterprise software system that allows an organization to automate and integrate most of its business operations, while simultaneously enabling the sharing of common data and practices across the enterprise. The ultimate goal of an ERP system is to ensure that by automating processes, data is entered just once [17] in order to reduce bureaucracy and redundancy of operations [18].

ERP is implemented in companies, particularly in large organizations, to address a wide range of business issues and provide the organization with an integrated infrastructure. By bringing together information about the activity and status of various divisions, ERP can integrate all information flows, allowing a company to share general data, procedures and business practices, enabling real-time access to information [19]. In addition, it ensures that different departments can communicate with each other, sharing information more easily with the rest of the company so that it can be used successfully.

By integrating and automating business processes, redundancies are eliminated, accuracy is improved, and productivity is increased, allowing departments with interdependent processes to coordinate their efforts to achieve faster and more effective results. From the early 1990s, when ERP systems emerged, to the present day, definitions may vary slightly according to different authors, but in general they are very similar and centered on the concept of process integration and automation.

A few years after the ERP concept appeared, there was an explosion in the implementation of this methodology, and SAP (System, Applications and Products in Data Processing) has been the market leader in this field ever since. SAP was founded in Germany in 1972 and began developing the first accounting packages and other modules for an ERP system [19]. This consists of a collection of modular applications designed to drive end-to-end business activities across all industries, offering a wide and complex variety of tasks in finance, human resources, manufacturing, procurement, product development, marketing, sales, service, supply chain management and IT management.

Therefore, SAP ECC (also known as SAP ERP), which stands for SAP ERP Central Component, is the company's flagship product and the system that most organizations have and are familiar with, as it contains modules such as finance, human resources, sales, and logistics, designed to run on a third-party database [20].

Later in 2012, the SAP HANA (High Performance ANalytic Appliance) was released, which marked SAP's move to cloud-based products. SAP HANA is defined as an in-memory database designed to dramatically accelerate SAP applications and the business processes they support, resulting in increased productivity, real-time visibility, and better use of analytics,

allowing companies to react to market conditions based on up-to-date data. For this reason, SAP redesigned SAP ECC from the ground up to leverage SAP HANA performance and innovative data models. Released in 2015, S/4 HANA constitutes the latest version of SAP ERP software and is designed to run exclusively on HANA databases. This emerges as the most notable distinction between S/4HANA and ECC: ECC relies on third-party database systems, such as disks and SSDs, whereas S/4HANA uses the HANA database, which is a purpose-built database that stores data in memory. By eliminating the need to access disks, in-memory databases are designed to allow for faster response times and greater data storage [20].

CRM

Oriented towards DT and innovation of sustainable business models, there is nothing like building a digital revolution to inspire customer loyalty and maximize customer interaction. The concept of CRM emerged in the 1970s as a new tool to control and optimize sales force automation in companies [21]. CRM is essential for the long-term success and survival of every company, acting as a tool that, supported by the use of technology, aims to automate the company's processes to manage interactions with customers. CRM includes tasks such as sales, marketing, and customer service, with the purpose of locating, attracting, developing, and retaining new customers for future business. It is used in companies to meet customer expectations while also aligning with the organization's vision and goals, in order to achieve long-term success and to strengthen customer relationships, making them more effective [22] [23]. Accordingly, CRM enables better management of customer relationships and can be divided into 3 distinct focuses of action: Collaborative CRM, Operational CRM and Analytical CRM [24].

Collaborative CRM is focused on creating a customer-centric business culture dedicated to attracting and retaining consumers. In such an approach, resources would be allocated where customers would benefit the most, reward systems would encourage staff behavior, thereby enhancing customer satisfaction and retention, and client data would be collected, shared, and used throughout the organization [21]. Therefore, it is an integrated, enterprise-wide system that improves responsiveness to customers throughout the supply chain by promoting organizational collaboration. This collaboration has productivity benefits, resulting in increased profitability through greater cross-functional effectiveness [25], [21].

Operational CRM automates customer-oriented business processes and the use of process management tools. By encouraging the collection of consumer surveys, order placement and organization-consumer interaction, this aspect of CRM is ideal for handling customer communications and assisting companies in managing the automation and integration, of their marketing, sales and service functions. The operational CRM focus is on how people learn about the business and the reasons they became customers.

Analytical CRM , finally, includes the strategic study of customer data to improve both customer and business value through tools that process large amounts of customer data.

Customer data is used by these same tools to enable strategic information delivery and customer insight, and serves as the basis for analytical CRM, including: sales data (purchase history), financial data (payment history, credit score), marketing data (campaign response, loyalty scheme data), and service data. These are often structured datasets held in relational databases, where each row contains all the data for a single customer, and each column reports a specific variable: name, zip code, etc. [26]. This component of CRM is considered the most relevant by companies, since it is the one that enables them to increase operational efficiency when it comes to processing customer data, allowing to strategically pass important customer information to other departments [27]. For this reason, many CRM solutions now include analytical CRM as a standard feature, as it provides quick and personalized answers to customer problems while opening the door to more powerful cross-selling and up-selling programs as well as more successful customer retention and acquisition programs [27].

Some of the most relevant CRM solutions that have been released to the public are developed by Microsoft. In 2003, the company introduced Microsoft Dynamics CRM. This is a customer relationship management system that assists organizations in managing their customer database, generating new leads, engaging consumers, and addressing customer service concerns [28]. It is, at its most fundamental level, a database that allows companies to organize and manage their customers data. Using the program, users can contact customers and prospects, and all interactions with them are recorded and tracked. This allows the company to create a comprehensive overview of its connection with customers, giving them a personalized experience [29].

In November 2016 Microsoft decided to innovate and relaunched its Dynamics package as Microsoft Dynamics 365, a cloud-based enterprise application platform that combines CRM and ERP components into a single package [28]. While a CRM system boosts sales and customer relationships, the ERP system helps streamline operations and reduce overall costs. Combined, a CRM and an ERP can maximize business growth. In this sense, the association of both concepts is quite advantageous, and opting for the CRM component of Microsoft Dynamics 365 does not imply using its ERP component. An example of this is Amorim group, where the ERP component was provided by SAP S/4HANA and the CRM component by Microsoft Dynamics 365. Following this, there are nine key applications within Microsoft Dynamics 365, part of them CRM and part ERP, and each company can select the ones they need. When it comes to the CRM component, which was previously marketed as Dynamics CRM, it is now sold as four separate applications: Dynamics 365 for Sales, Dynamics 365 for Customer Service, Dynamics 365 for Field Service, and Dynamics 365 for Project Services Automation [29]. More precisely, for the development of this project, the Dynamics 365 applications for Customer Service and Dynamics 365 for Sales were the ones that were used.

Microsoft Dynamics 365 consolidates all customer information into a single system, providing users with a single source of truth, giving them a comprehensive view of their customer journey, and allowing them to track, create, and evaluate leads, capitalizing on opportunities. By enabling users to engage with their consumers and provide superior, expedited service, the

application can increase customer happiness at every stage of the sales funnel and reinforce brand loyalty over time [28].

2.1.2 Data Movements

Data movement is defined as the ability to move data from one place, of a particular organization, to another, through a variety of technologies, with the most famous and widely used being extract, transform, load (ETL). Data movement is used for the purposes of data migration and data warehousing. The accuracy and timeliness of reporting and predictive analytics depends on the ability to get high quality data into the DW from operational databases and external data sources. In this regard, ETL, consisting of a set of tools designed based on business rules, plays a crucial role in finding and fixing data quality issues, as well as ensuring the efficient loading of large volumes of data into the warehouse. Data from all kinds of data sources are brought into a staging area where ETL performs [30]. As detailed in the figure 2.2, an ETL framework consists of three sequential functional phases:

- *Extraction:* During data extraction, sources of raw data are gathered, validated and copied or exported to a staging area. Data management teams can extract information from various distinct data sources, such as the OLTP databases mentioned previously [16] [31].
- *Transformation:* In the staging area, data processing is performed on the raw data. Here, the data is transformed and consolidated in preparation for its intended analytical application. ETL encompasses a variety of techniques, some of which include validating, authenticating, deduplicating, aggregating, and/or mapping (relate equivalent data fields from different data sources) the data to render it standardize, trustworthy and queryable [32].
- *Loading:* In this final step, transformed data is usually moved from the staging area to the target DW. This typically entails an initial load of all data, followed by periodic loads of incremental data changes and, less frequently, full refreshes to remove and replace data in the warehouse [31].

ETL is considered a crucial piece in the BI process, being a determining factor in defining the rules of data exploration in the business and the link that enables the conduction of data for analysis. Therefore, the process of data extraction, transformation, and loading is fundamental to any BI process, especially in the integration of data from different origins and their treatment.

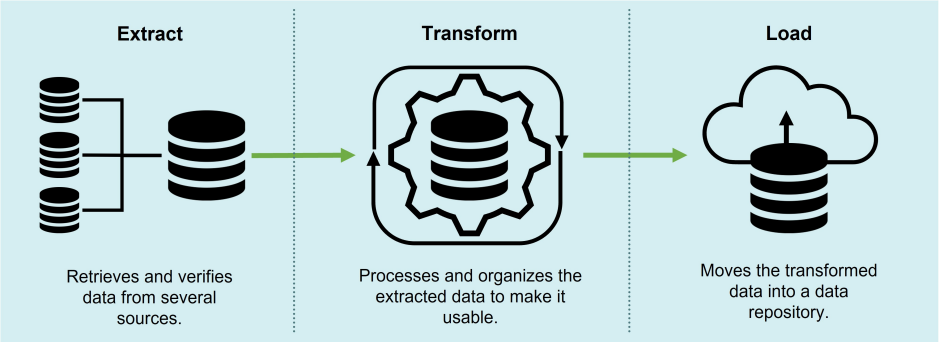


Figure 2.2: ETL process.

2.1.3 Data Warehouse

The data over which BI tasks are performed is typically loaded into a centralized repository called DW, in a business context also referred to as enterprise data warehouse (EDW), which then is available for reporting and analytics. A DW stores read-only information from multiple sources making it easy to access historical data providing a central location with standardized formats, keys, and data models. Typically, it will utilize the previously mentioned ETL processes to collect the data, enabling BI applications to query and analyze this data. Multiple parameters distinguish a DW from an operational database in terms of characteristics. In OLTP databases, data is continuously inserted and updated, whereas in a DW, the characteristics of the data are distinct and can be classified as: (1) *Subject oriented* The data is logically structured around the most important topics of the organization, such as customers, sales, and products; (2) *Integrated* All subject data are compiled and can be studied together; (3) *Time variant* In-depth historical data is kept; and (4) *Nonvolatile* Data is read-only and cannot be modified or altered by users [33]. To standardize data analysis and enable simplified usage patterns, DW are typically organized as problem-driven units known as data marts (DM); each DM is devoted to the study of a specific problem [34].

When establishing an EDW, businesses must decide whether to do it in the cloud or on-premise. On-premise solutions reside on local networks, which entails a large initial investment due to the requirement to invest in hardware and software licensing. Additionally, the required abilities may need the hiring of a consultant to assist with installation and ongoing maintenance. The advantage of on-premise storage is that every component of the repository is controlled by teams within the organization, and it is possible to control when data leaves the network [35]. In contrast, when an EDW is hosted and maintained in the cloud, the provider is responsible for all hardware-related expenses, software licensing, infrastructures, and maintenance. This alternative, which represents a central trend in the modernization of DW, is advantageous in several ways. Among the key benefits are fast deployment and cost-effective scaling of storage and processing capabilities; most providers offer a pay-as-you-go strategy, minimizing upfront expenses; a disaster recovery, i.e., as a result of the distributed nature of cloud DW, if one server fails, others activate and substitute the failed one automatically; and finally even though a cloud DW need a company management, there is no need to dedicate a whole staff to this task [35]. In Amorim's case, the group

adopted a cloud solution from a service provided by Microsoft Azure. Daily operational data created is collected and imported directly into the DW and thus enables the creation of analytical models (OLAP).

Data Warehouse Architecture

In terms of DW design, the Inmon and Kimball methodologies are two of the most commonly studied and explained DW techniques.

Based on operational relational database management system (RDBMS) - a type of DBMS in which data is stored in a row-based table structure that connects related data elements -, the Inmon method enables the storage of all events within a company [36] [37]. It is considered a "data-based" method, since company data is loaded without prior knowledge of the user's needs. The architecture of the Inmon DW (see figure 2.3) takes into account all data sources in the company, rather than considering only fragments of information. According to Inmon, a DW and a DM are physically distinct. The DW has its own physical presence and is designed for storage, traceability, and scalability in response to new needs. On the other hand, DM have their own physical existence and a performance-based compensation system in response to user demands. To summarize, Inmon proposes building DM separately for each department. All the data that goes into the DW is integrated and the DW acts as a single data source for multiple DM to ensure integrity and consistency across the enterprise [38].

Inmon's approach is characterized as a top-down approach. In top-down, data is stored and queried in the DW and then distributed among the DM. It aims to serve the needs of the organization as a whole and not individual departments. Top-down has an overview that goes from the high level to the most detailed.

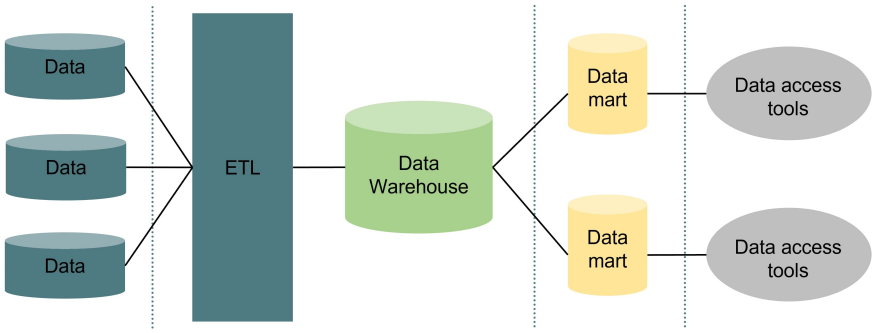


Figure 2.3: Inmon's DW architecture [38].

Kimball's strategy is based on the concept of dimensional modeling. He criticizes the idea of end-user isolation formulated by Inmon, since his technique heavily involves the end-users in the early stages of the project, which is why it is called the "user requirements-driven approach" [38]. Kimball has a unique perspective on DW (see figure 2.4), and according to him, the DW can be viewed as a collection of consistent DMs with shared dimensions. A multidimensional view on data emphasizes the subject to be analyzed and the various angles of analysis, and according to this perspective DWs must be designed to be understandable and fast. Kimball's

approach is characterized as a bottom-up approach. In bottom-up development, the DM make up the DW. Bottom-up goes from the lowest to the highest level.

Associated with the strategy idealized by Kimball, there are two key concepts:

- *Fact table* contains the data to be analyzed. It incorporates observable data (facts) regarding the subject of the inquiry, organized along various analytic axes (dimensions). This could include sales revenue, the number of products sold, etc. Foreign keys to dimension tables are included in fact tables. These foreign keys link each row of a fact table to its corresponding dimensions and levels [39].
- *Dimension table* is a data classification structure that allows end users to respond to business questions. It contains analytical axes (dimensions) that store attributes describing aspects of fact entities. When subjected to a multidimensional analysis, these data provide the necessary insights for decision makers. Between the foreign key of a fact table and the primary key of a dimension table, a many-to-one relationship exists. In other words, the dimension table stores data about how the fact table's data can be analyzed [40].

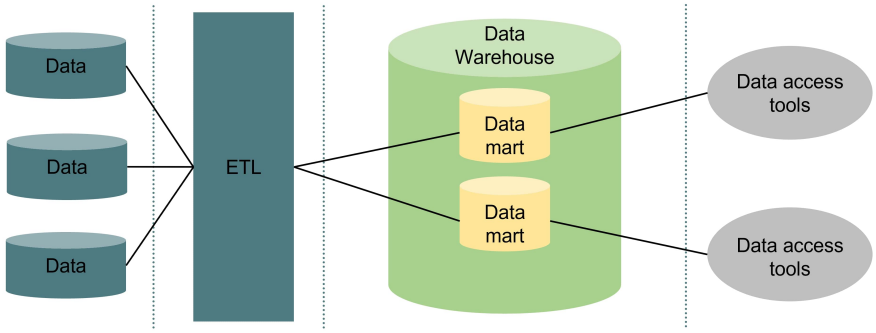


Figure 2.4: Kimball's DW architecture [38].

The fundamental component of the dimensional DW model is the *star schema*, which connects a fact table to any number of dimension tables. It is illustrated on the figure 2.5 left side, where a fact table (which contains all the *orders* facts) is connected to several dimension tables - one table describing the customer, another the industrial unit (IU) where the order was placed, the product purchased, etc. Therefore, there will be no interconnected dimension tables, and the attributes of each table will be aggregated. This indicates that analyzing the implementation of this type of solution is simpler, but the fact tables are not normalized [41].

A *snowflake schema*, depicted on the right in figure 2.5, is a multidimensional data model that extends a star schema by dividing dimension tables into subdimensions. Snowflake schemas, like star schemas, contain a central fact table that is related to numerous dimension tables by foreign keys. However, these schemas are more standardized than star schemas. Due to its stricter adherence to high normalization requirements, Snowflake schemas offer greater storage efficiency, but query performance is not as good as with denormalized data models. Denormalized data models, such as star schemas, contain greater data redundancy (data duplication), which improves query performance at the expense of duplicated data [41].

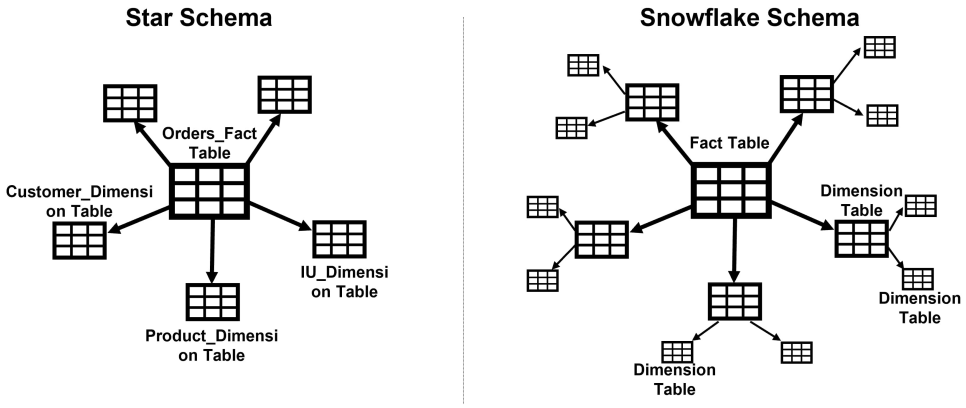


Figure 2.5: Examples of Kimball's Star and Snowflake schemas.

2.1.4 Mid-tier Server

While the methodologies and data schemas presented above represent how data is collected and stored, complementary ways of modeling, accessing, and extracting information from data have been developed. Thus, DW servers are supplemented by a collection of mid-tier servers that offer specialized functionality for various BI use cases. Online Analytical Processing (OLAP) servers are among the most widely adopted by businesses because they can efficiently expose a multidimensional view of data stored in DW to front-end applications or users [42]. OLAP databases are specialized databases that are intended to facilitate the extraction of this BI information from the data already stored, allowing for the rapid calculation of analytical business information, using metrics for modeling, planning, or forecasting [16]. An OLAP cube, also known as a multidimensional cube or hypercube, is a data structure stored in SQL Server Analysis Services (SSAS) that is constructed with OLAP databases to enable near-instantaneous data analysis, providing the foundation for analytics that support numerous business reporting and simulation applications. The OLAP cube adds multiple dimensions (distinct categories for analyzing business data such as product, region and time period) to the data by extending tables with additional layers, as shown in figure 2.6 [43]. Then, this information can be detailed into other hierarchies, allowing for a comprehensive business data analysis. For instance, an OLAP dimension "Country" can be detailed into "Region" and "City," and so on [44].

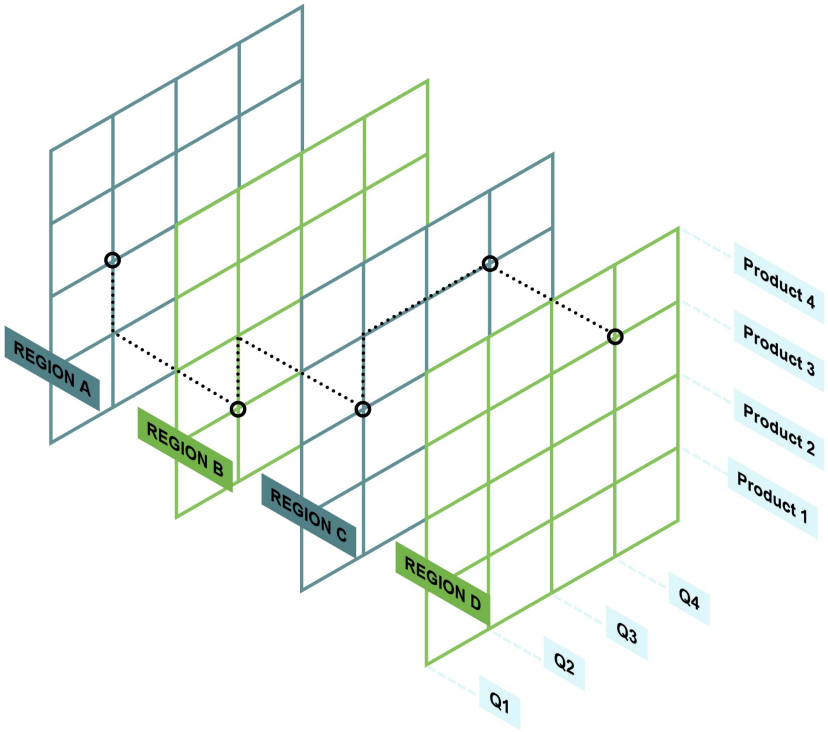


Figure 2.6: OLAP cube.

Analysts can then perform five types of OLAP analytical operations on these cubes [45]:

- *Drill-Down* allows users to travel from less-detailed to more-detailed facts. Drilling down can be accomplished either by reducing the idea hierarchy for a dimension or by introducing more dimensions (figure 2.7).

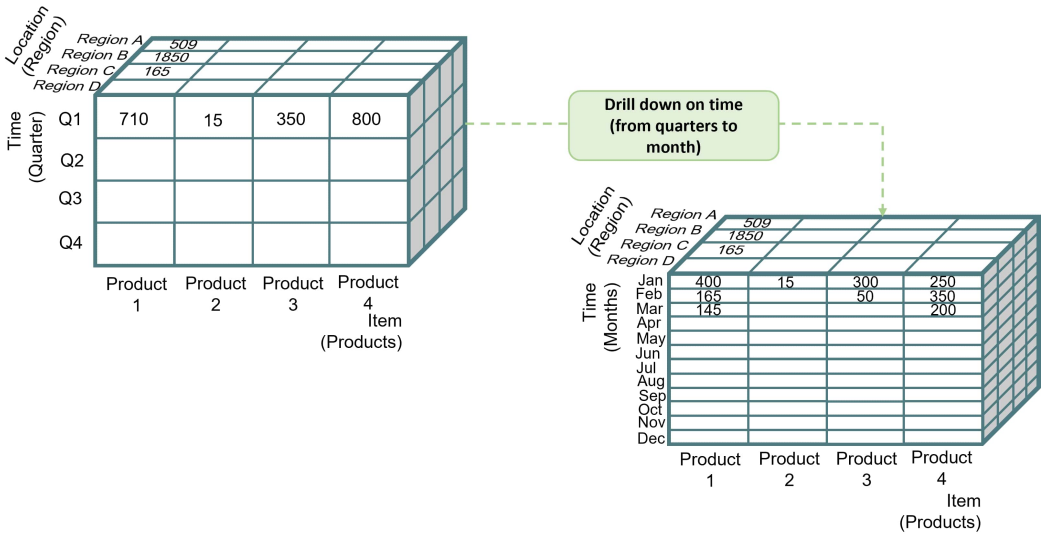


Figure 2.7: Drill-Down operation.

- *Roll-Up* operation aggregates a data cube either by ascending a concept hierarchy for a dimension or by reducing the dimension size (figure 2.8).

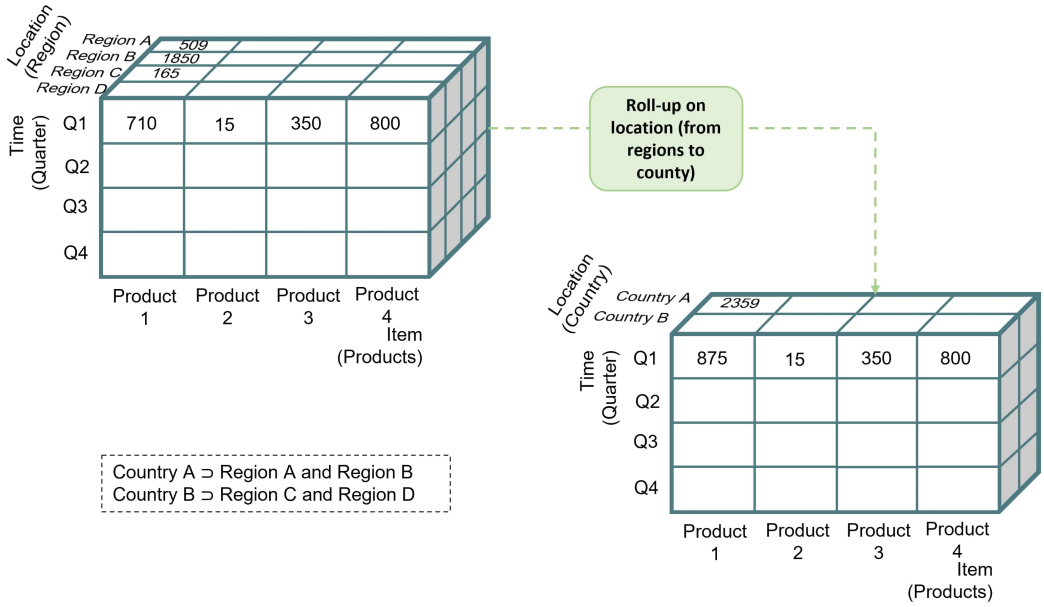


Figure 2.8: Roll-up operation.

- *Slice* is a subset of cubes that corresponds to a single value for one or more dimension members (figure 2.9).

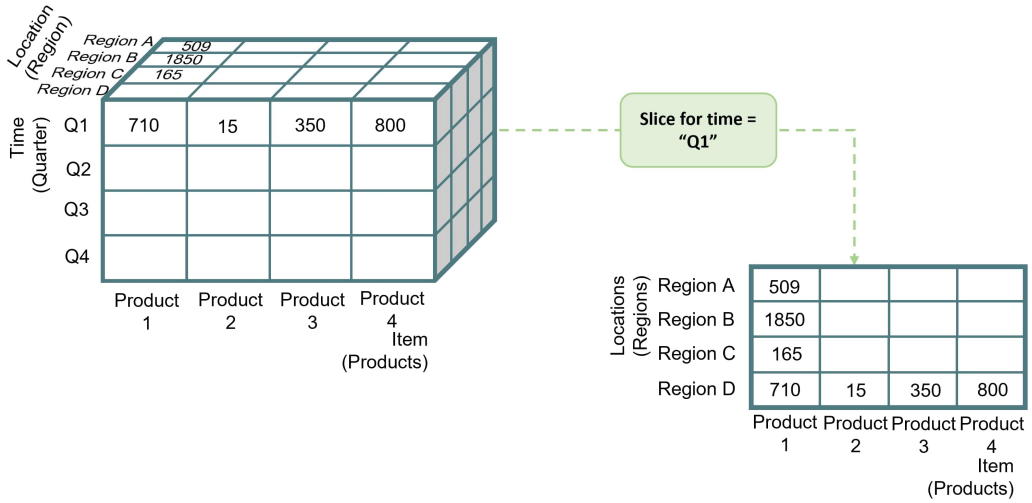


Figure 2.9: Slice operation.

- *Dice* is an extension of slice that permits the generation of a sub-cube from two or more dimensions of a given cube (figure 2.10).

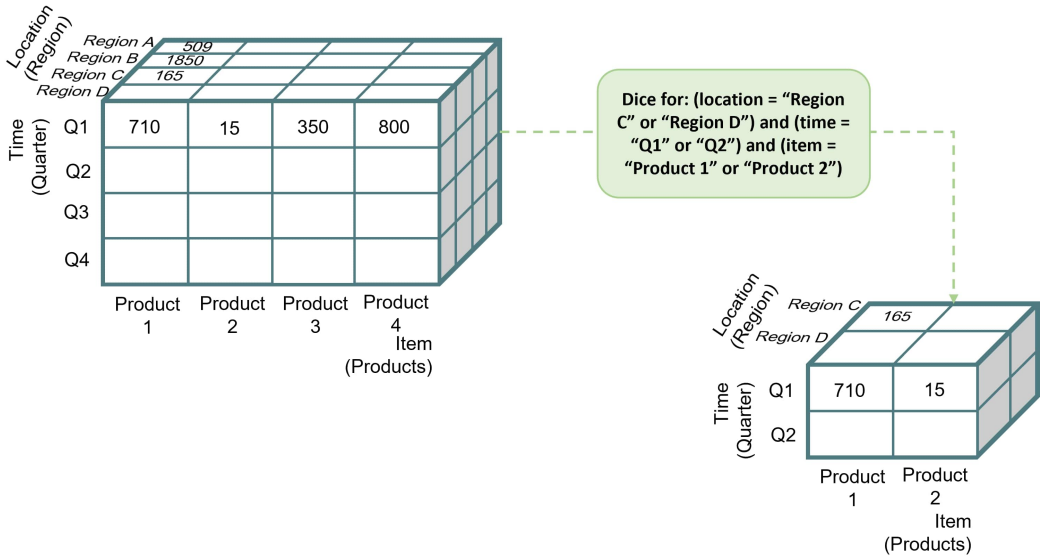


Figure 2.10: Dice Operation.

- *Pivot* is a data visualization procedure that rotates the visible data axes to create an alternate data presentation. It may include exchanging rows and columns or transferring one of the row-dimensions to the column-dimensions (figure 2.11).

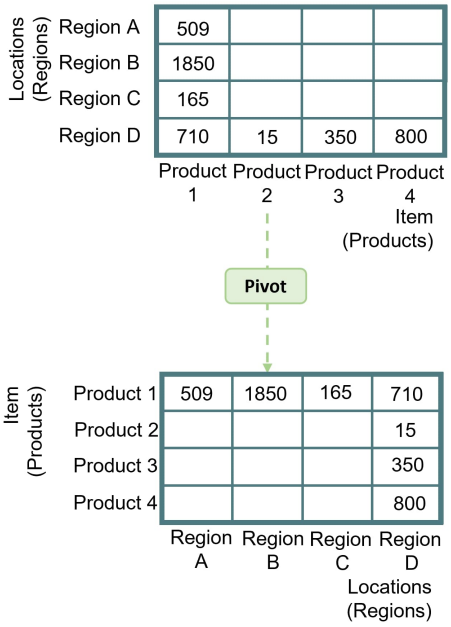


Figure 2.11: Pivot Operation.

Then, OLAP software identifies the intersection of dimensions, such as all products sold in a particular region during a specified time period, and displays them as measures - quantitative values to be analyzed. Each cube must have at least one measure by definition. In actuality, one cube can contain several hundreds of measures. Measures in the cube are grouped (measure groups) based on information recorded in the DW's fact tables. In other words, fact tables

contain numeric information for DW, whereas measure groups contain measures for an OLAP cube [46] [44].

There are numerous software providers of OLAP tools which are ready for implementation. In the case of AC-SA and ATS, the implemented software is Microsoft's Azure Analysis Service (AAS), which was deployed right on top of the companies' cloud DW. It is a fully managed service that has the same key capabilities as SSAS. The AAS allows the structuring and storage of the various cubes of companies information, the development of relevant metrics for subsequent analysis and the application of security protocols when making information available to end-users [42]. As a cloud-based service, it has rapid data refresh rates and is accessible from anywhere, depending on the permissions given to the users.

2.1.5 Front-end applications

The BI front-end applications consists in tools that companies use to access the data and track business trends. BI tools are software used to collect, process, analyze, and visualize enormous amounts of historical, present, and future data in order to provide actionable business insights, generate interactive reports, and streamline the decision-making processes. These BI systems provide important capabilities including data visualization, visual analytics, interactive dashboarding, and KPI (key-performance indicators) scorecards. In addition, they enable users to leverage automated reporting and self-service predictive analytics in a single package, so making the analytical process quick and accessible.

2.2 BI Tool: Power BI

Originally introduced in July 11, 2011, Microsoft Power BI (PBI) was conceived and developed by Ron George in 2010, who published it as "Project Crescent." Microsoft changed the name to "Power BI" and released it to the public in September 2013 [47]. PBI is a combination of applications, software services, and connections that transform disparate datasets into visually interactive insights. It is compatible with simple data sources, such as Microsoft Excel, as well as complex data sources, such as cloud-based or on-premises hybrid DW [48]. According to *Gartner Magic Quadrant for Analytics and Business Intelligence Platform*, PBI is an industry-leading business intelligence and analytics tool that enables both self-service data exploration and visualization and corporate BI installations [49]. It comprises a Microsoft Windows desktop software called Power BI Desktop, an online SaaS (Software as a Service) called Power BI Service, and mobile Power BI applications that can be accessed on mobile devices [50].

Linking data sources is the first step to creating a report in Power BI. Following this, Power BI Desktop is the platform where analysts and other users can build data connections, data models, consult them and create reports. In turn, in Power BI Service, these reports can be shared and published so that others can access and interact with them, namely cloud and mobile users.

Still regarding Power BI Desktop, this is a development tool capable of connecting to various data sources; transforming and cleaning the data in order to generate a data model;

creating visuals, such as charts, that allow the desired information visualization; and finally, generating dashboards and reports (which are collections of visuals) and sharing them [50]. Overall, Power BI Desktop is a tool for analyzing and displaying data, which incorporates the capability of other Microsoft tools, such as Power Query and Power Pivot, as well as the enhanced visualization methods of Power View, to make it possible to create dynamic visuals upon which the dashboards and reports in Power BI Service are based. It is worth noting that dashboards are a combination of visuals to convey the narrative graphically and tools to interact with the end user, while a report is often a complete view of a huge dataset [51].

For its part, the data cleansing and transformation process is done using the built-in Power Query Editor. Power Query is a self-service ETL application that allows users to extract data from various sources, transform the extracted data into the desired format by changing its type, deleting columns, or merging data from various sources, and load it into PBI. All activities from importing to manipulating data are represented in the form of a query - a sequence of instructions in the Power Query programming language also called *M*. By changing the query, the steps can always be updated and repeated an unlimited number of times.

Moving on to Power Pivot, this is an in-memory data modeling component that offers highly compressed data storage as well as incredibly fast aggregation and computation. Power Pivot can load data by itself or can load data into Power Query. Using Power Pivot, it is possible to get data from the DW or the already structured OLAP cubes, supplement it with data from other sources by linking the loaded tables in a custom *Data Model*, create custom measurements written in the Power Pivot internal language DAX (Data Analysis eXpressions), and analyze the data. These technologies do not replace the centralized DW or OLAP solutions, but rather complement it to facilitate agile data analysis. To summarize, using Power Pivot, one is able to pull data from the DW, supplement it with data from other sources by linking the loaded tables into a custom *Data Model*, create custom measures written in Power Pivot's internal language DAX, and analyze the data.

Regarding Power View, this is an interactive visualization tool with a drag-and-drop interface that allows users to build dashboards as well as reports with charts, graphs, KPIs, tables and interactive maps (provided by the built-in Power Map tool). In addition, it is possible to filter the data for each view component and the full report and apply slicers that can be used to enhance the slicing and dicing of data (the user can highlight a portion of the data so that it can interact with each other, e.g. select a product and obtain its sales volume).

Finally, for business users to interact with their data, Power BI Service, as mentioned earlier, offers a simple and intuitive interface, allowing for the sharing of dynamic dashboards that give a single, unified picture of the business and which are presented in an appealing way that makes it simple to extract insights without the need for analytical expertise [48].

Chapter 3

Methodologies

The present chapter provides an overview of the methodologies which are relevant to the development of this project. These include Agile methodology and thereafter SCRUM, an Agile-specific methodology.

3.1 Agile

Agile is the strategic management tool that enables greater market times, flexibility and productivity, higher-quality products, thereby increasing customer satisfaction. Nowadays, the adoption of Agile methodologies by companies is becoming increasingly important in the pursuit of competitiveness, bringing new values, principles, and practices, and providing an alternative to traditional methodologies based on command-and-control management. Agile was born in 2001 as an innovative software development methodology. Motivated by the growing need for business digitalization and the numerous ongoing DT projects, this strategy quickly migrated from the operational to the strategic level. Many DT programs fail to meet their objectives, deadlines, and budgets because they are typically developed and implemented using outdated techniques such as the Waterfall approach, where each task of the project is executed in phases in a linear and sequential way.

Agile methods, as described in the manifesto released at its inception, prioritize: (1) "individuals and interactions over processes and tools"; (2) "working software over comprehensive documentation"; (3) "customer collaboration over contract negotiation"; and (4) "responding to change over following a plan", that is, while the items on the right have value, the items on the left have greater value [52]. From these four values derive the twelve principles of the manifesto that promote customer satisfaction, teamwork, face-to-face communication, rapid and continuous delivery of functional software, periodic reviews, simplicity, technical excellence, sustained development, and self-reflection to self-correct and improve. For these reasons, Agile teams are more adapted to innovation, while being small and multidisciplinary.

When faced with a complex problem, they break it down into modules, develop solutions for each component through rapid prototyping and short feedback loops, and integrate the solutions coherently. The adaptation to change has more value over adherence to a plan, and hold themselves accountable for outcomes (such as growth, profitability, and customer fidelity) rather than outputs (such as lines of code or number of new products). In turn, the executive team sets priorities and sequences opportunities to improve the team's experiences, creating conditions for increased success. The Agile leadership team, like any other Agile team, has an initiative owner who is accountable for overall results, and a facilitator who coaches the team members and helps keep everyone actively engaged [53] [54].

Agile offers a number of significant advantages compared to conventional management strategies. It increases team output, employee and customer satisfaction, and decreases waste caused by unnecessary meetings, repetitive planning, extensive paperwork, quality failures, and low-value product features [53]. In addition, it delivers goods and services more rapidly and predictably, and reduces risk by enhancing visibility and continuously adapting to changing consumer preferences. It broadens organizational experience and promotes mutual trust and respect by incorporating team members with diverse specializations as collaborative peers. Furthermore, there is evidence that implementing BI projects using an Agile methodology is more effective than traditional approaches [55]. In addition, the concept of co-creation, when combined with Agile methodologies, can increase their benefits. Co-creation promotes end-user involvement throughout the development process. This strategy permits the achievement of high levels of user acceptance, usability, and satisfaction. Depending on the nature of the project, co-creation principles can be incorporated into an Agile framework in various ways [56].

There are several variants of application of Agile methodologies, which despite having many similarities, end up focusing on slightly different things. They include SCRUM, which prioritizes creative and adaptive teamwork in solving complex problems; Lean development, which focuses on the continuous elimination of waste; and Kanban, which centers on reducing delivery times and the amount of work in process. SCRUM, since it is the one that is of most interest to the project in question and, moreover, since it is the most widely used of the three, will be explained in detail below [53].

3.1.1 SCRUM

SCRUM is the most popular Agile methodology available today, and can be applied to a wide range of scenarios and purposes. Its tools and practices can be easily adapted to different industries, and it is mainly used for product and software development. It is suitable for complex environments where teams have to react quickly and adapt, making use of an empirical, iterative, and incremental approach that seeks to better control risks in product development processes [57], [58].

SCRUM was proposed by Schwaber, in 1995, as a simple development methodology that incorporates iterative and incremental development principles. The SCRUM framework comprises the so-called *Artifacts*, which are means by which the team has the opportunity to

understand the work in general, creating the opportunity to evaluate and adapt what has been developed so far. In addition, SCRUM consists of a series of development iterations called *Sprints*. Each Sprint, in turn, includes different types of *Events*: the Sprint Planning, the Daily SCRUM, the Sprint Review, and the Retrospect Sprint. Sprints are carried out by a *SCRUM Team*, which is based on three different roles: Product Owner, SCRUM Master, and Development Team members [57], [58].

Sprint

A Sprint is a short and ideally constant period of time, usually ranging from two weeks to a month, in which a set of previously defined objectives must be accomplished. A new Sprint starts only after a previous Sprint has been completed, and throughout it no changes should be made that could potentially affect the Sprint goal [57] [58].

SCRUM Artifacts

SCRUM artifacts are a very important component and provide key information that the team and stakeholders need to know to understand the developing product [57] [58].

- Product Backlog: All of the specifications that the finished product must fulfill are included in the product backlog, as well as any necessary adjustments. All the Product Backlog items contains description, order, estimate, and value [57] [58].
- Sprint Backlog: The work items (typically referred to as User Stories) that must be completed during a single Sprint are included in the Sprint Backlog. Burn charts can be used to monitor the amount of work that remains in the Sprint Backlog. They are a way to measure and manage progress, as they allow prediction of the chances of completing the Sprint goal, as well as the overall amount of work still to be done [57] [58].
- Increment: Increment is the final usable product resulting from a sprint. The result of a Sprint Backlog should be a version of the product that reflects a step ahead in the development process, i.e., an increment that is added to all the increments from previous Sprints. As the SCRUM Teams move forward, they add new updates to the product under development. The product is in a usable state and satisfies the established SCRUM Team criteria when the increment is declared as "done" [57] [58].

SCRUM Team

The SCRUM team consists of three basic members which include the Product Owner, the Development Team, and the SCRUM Master. SCRUM teams are multi-functional and self-organizing, integrating many different areas, and stand for the values of courage, commitment, openness, respect, and focus [57] [58].

- SCRUM Master: The SCRUM Team is led by the SCRUM Master, who ensures that the work has been understood and applied. He is responsible for ensuring that the SCRUM Team follows both Agile concepts and SCRUM rules and values, guiding the team, product owners, and the business through the process and looking for ways to improve practices. An effective SCRUM master deeply understands the work done by

the team and can help it optimize transparency and delivery flow. As a master facilitator, he schedules the necessary resources (human and logistical) for sprint planning, rapid meetings, sprint review, and sprint retrospective [57] [58].

- Product Owner: The Product Owner is responsible for maximizing the efforts of the Development Team to create a high quality product. The Product Owner's roles include clearly identifying the items in the Product Backlog, prioritizing the items in the Product Backlog to achieve the predetermined goals, maximizing the value of the work performed by the Development Team, and ensuring that the Product Backlog is understandable to everyone to effectively manage the Product Backlog. Everyone in the company must accept the decisions of the Product Owner in order for the project to be successful. Any changes that need to be made should be directed to the Product Owner [57] [58].
- Development Team: At the conclusion of each Sprint, the Development Team delivers a possible usable increment of the product. Since no one gives them instructions or guidance on how to convert the Product Backlog into usable increments of functionality perhaps ready for release, the Development Team is self-organized. Team members have different skill, which are passed from one to the other so that none of them becomes an obstacle to the delivery of the work. The SCRUM team drives the plan for each sprint. They forecast how much work they believe they can complete during the iteration using their previous velocity as a guide. Keeping the iteration duration fixed provides important feedback to the development team in their estimation and delivery process, which in turn makes increasingly accurate predictions over time [57] [58].

SCRUM Events

One of the most well-known components of the SCRUM framework is the set of sequential events or meetings that SCRUM teams frequently execute. There are four required events - Sprint Planning, Daily SCRUM, Sprint Review, and Sprint Retrospective - each of which has a specified maximum duration. They provide an opportunity to check or modify the items [57] [58].

- Sprint Planning: The work performed during a sprint is planned during Spring Planning, at which the whole team is present. The meeting is led by the SCRUM Master and the User Stories to be included in the Sprint Backlog are decided based on the Product Backlog. These User Stories have to be approved by the development team, which evaluates the feasibility of achieving the intended goals within the time frame of a Sprint [57] [58].
- Daily SCRUM: A short duration meeting, typically 15 minutes, which occurs daily, preferably at the same time and location, led by the SCRUM Master. Includes an assessment of the work accomplished since the previous Daily SCRUM, as well as a determination of what needs to be accomplished before the next Daily SCRUM and anything that might prevent the SCRUM Team from completing the Sprint Goal. The Daily SCRUM acts as a tracker to monitor the progress of the Sprint Goal, ensuring that work is progressing according to the Sprint Backlog [57] [58].

- Sprint Review: After the Sprint has concluded, a Sprint Review is conducted. The SCRUM Team and stakeholders are present. At the Sprint Review, an assessment is made of what has been accomplished during the Sprint, the work left over from previous Sprint Reviews, and what remains to be done to complete the current Sprint within the allotted time frame. The SCRUM Team inspects the Increment and, if necessary, modifies the Product Backlog. After the Sprint Review, they frequently review the Product Backlog and determine the most likely Product Backlog items for the following Sprint [57] [58].
- Sprint Retrospective: It is a meeting held after the Sprint Review and prior to the Sprint Planning for the next iteration. The Sprint Retrospective provides the SCRUM Team with the opportunity to examine the completed work and formulate a strategy for enhancing its working practices for the subsequent Sprint. Sprint Retrospectives are structured opportunities to focus on comprehensive inspection, adaption, and enhancement [57] [58].

A project conducted using a SCRUM methodology is initially divided into sprints, which typically last two to four weeks. At the beginning of each sprint a Sprint Planning is done in order to define goals to be accomplished in that time frame and the means to achieve them - Sprint Backlog. At the conclusion of each Sprint, a review is conducted to determine which objectives were achieved and which were not. This review is conducted in accordance with a process of verification and validation. Verification entails examining a tool to determine if it satisfies predetermined User Stories and identifying potential errors. Validation, on the other hand, involves determining whether the developed product meets the requirements and expectations of the end-user. These steps help in providing feedback to the end-user while retrospectively reviewing the work, assisting the team in gaining a general understanding of the project's status, and contributing to continuous learning and improvement [59]. Subsequently, each team member begins the day with meetings - Daily SCRUM - to update the rest of the team on the progress made and future tasks. Instead of having a project manager as the leader, the SCRUM team is guided by the SCRUM Master [57] [58].

In successful SCRUM development, the customer/stakeholders participates regularly by contributing ideas for new features (which are recorded as user stories and kept in a backlog) and by signing off on completed features at the end of each sprint [57] [58].

Finally, SCRUM provides tools for tracking the team's productivity by measuring task velocity that can be plotted on a so-called burndown chart. The team estimates how time-consuming specific development tasks (expressed in story points) and self-assigned work will be for a given sprint. The number of backlog items, expressed in story points, performed over time gives us a measure of the team's productivity. Measuring velocity not only motivates teams by seeing their productivity and progress on the burndown chart, but also helps in planning future work [57] [58].

Chapter 4

Business Intelligence Project at Amorim

As part of a comprehensive DT project, Amorim has been noticing a constant increase in the flow and volume of data, with a growing need to take full advantage of it. Consequently, one of AC-SA and ATS primary objectives was to invest in BI tools that make data analysis easier and more intuitive. In this context, the focus of my internship project is the integration of data from a CRM tool and the currently implemented ERP system into PBI in order to simplify the analysis of these data.

In terms of organizational structure and respective charges, the implementation of BI tools, and therefore the implementation of my internship project, has been delegated to the MC department. MC's main goal is to provide and explain information, properly validated and tested, so that later decision-making is properly grounded, thus preventing the occurrence of undesirable situations that may deviate the company from the objectives it has set itself and, on the other hand, promoting actions that lead it as quickly as possible to those same objectives.

Keeping this in mind, the project I worked on began with an analysis of the companies' data structure, was followed by a collection of the initial requirements of the project's stakeholders, and concluded with its development and implementation. Overall, during the entire development process, the constant participation of the stakeholders was prioritized so that, in a post-implementation phase, they can make the best use of the tools.

4.1 Data Architecture at Amorim

Regarding the project under consideration, it was required to understand part of the data architecture adopted by Amorim's companies on which the project was be developed, namely the ERP (SAP S/4HANA) and CRM (MSD CRM) software.

Implemented in mid-2019, the ERP SAP adopted by Amorim is "a business process management software that manages and integrates the activities of finance, supply chain, operations, reporting, manufacturing and human resources (...)" [60]. By integrating all business processes and their inherent data, which are being stored over time, SAP becomes one of the sources of information that serves as a basis for the BI project to be developed.

Updated daily, the data stored in the DW, associated with SAP, is streamed through an ETL process into a Microsoft Azure Cloud. Subsequently, using Azure Analysis Service (AAS), multidimensional models, also known as OLAP cubes, are created. These models increase the analytical power over the data, as they aggregate and pre-calculate values and make the analysis almost instantaneous [61]. Hence, AC-SA and ATS have five multidimensional cubes - Financial, Production, Order to Cash (O2C), Purchase to Pay (P2P) and Transportation - which enable grouping and categorizing information and, consequently, simplify the analysis work over smaller datasets with relevant information.

Although the ERP implemented at Amorim provides access to practically all the information linked to the value chain, and is related to the optimization of the companies' operational processes, it does not allow the companies to work on commercial processes and optimize the customer contact procedure. To fill this gap, MSD CRM appears, a software that manages several ways the customer interacts with the business. Adopted in 2020, MSD CRM improves the companies' ability to manage their customer database, generate new leads, engage customers, and resolve customer service issues. At its most basic level, it is a database that helps companies organize and manage the recording and tracking of their customer data, as well as all customer interactions. It allows them to build a retention plan by improving and personalizing the relationship with their customers. In addition, it enables companies to group and work on all leads (new sales prospects) and opportunities (a contact or account that has been qualified as a prospective customer with sales deals likely to be made).

Overall, CRM at Amorim has been centralizing customer information, facilitating and improving the working methods of the CS department and the Sales department. Regarding CS, each collaborator is provided with a time-based overview of each customer and their interactions with the support team, thus increasing productivity and optimizing the whole process. From a sales point of view, sales representatives, through access to a centralized CRM system, have the ability to better understand customer characteristics, streamline the process of retaining and obtaining customers, identify leads for future business as well as opportunities, all aspects that favor a personalized approach based on a strategy that will facilitate and accelerate the closure of the sales process.

4.2 Business Intelligence Integration

Before the implementation of BI tools, data control and analysis was performed using Excel spreadsheets. However, there were many disadvantages inherent with this approach, whether by the difficulty in automating data input, the fact that it is a document does not allow access to several people simultaneously, the occurrence of human error is quite common leading to analysis errors on top of resulting in a database spread over several files. With this

in mind, one of the goals of the DT project was to centralize information and provide secure analysis tools to the stakeholders. In this sense, BI appears as a "technology-driven method to evaluate data and provide information that helps executives, managers, and workers make informed business decisions" [62].

After the adoption of the PBI software, development, access and visualization licenses were assigned and, through the PBI Service, it became possible to group in several *Workspaces*, dashboards and reports according to the needs of the stakeholders involved. Thus, and although several analysis options are provided by the CRM tool (MSD CRM), both AC-SA and ATS chose to integrate all data sources in PBI. Combined with the fact that PBI is recognized as one of the most complete tools in the BI tools panorama [49], it made possible to centralize and relate several data sources in a single platform as company's main DSS.

4.2.1 Stakeholders

Engagement of stakeholders from the beginning to the end of a business intelligence project is crucial for its success. By engaging in regular communication, it is possible to ensure that the project meets the needs of all stakeholders and that data gaps are addressed from the beginning. An effective BI implementation will provide the minimization of threats and maximization of potential benefits felt by the stakeholders [63]. As critical factors, there is the need to ensure the coherence and consistency of the information, the flexibility of the tool, and to manage resistance to change, through stakeholder involvement. Overall, it is possible to say that the project was divided into two distinct phases: the first focused on the CS department and the second one on the Sales department. Regarding implementation methodologies, in both cases a SCRUM based methodology was applied. Sprints typically lasted two to three weeks, and at the conclusion of each one, a meeting was held with the respective department directors, during which the Sprint Review was conducted, presenting the project status and increment, and the Sprint Backlog items were validated. In addition, the Sprint Planning for the upcoming weeks was done, along with a discussion of which goals should be included in the Sprint Backlog, as well as proposals for improving the work already accomplished. In addition, 15-minute-long Daily Scrums were conducted with the implementation manager, during which the project status, goals for the day, and problems solved the previous day were presented.

Customer Service Department

AC-SGPS, as previously mentioned, is composed of several distinct companies. Thus, based on several meetings with the two directors of the CS departments from both companies (AC-SA and ATS), the parameters and objectives of the project were outlined. It should be noted that the dashboards developed would only be accessed by the directors and part of the selected and filtered information would later be sent to the remaining collaborators.

Initially, a review was made of the Excel sheets on which the previous analyses were performed. Based on this information, the fields on which the dashboard would focus were selected. Subsequently, the connection between MSD CRM and PBI was made from a tool

from XRMToolBox, the Power Query (M) Builder, designed to automate the creation of Power Queries in order to connect MSD CRM data with the PBI.

Once the data has been imported into the PBI, the second phase of the ETL process begins in which data cleansing and transformation is performed. In this phase, possible data errors and inconsistencies are detected and removed in order to improve data quality. In this follow-up, with the data ready for analysis and over a constant interaction with the stakeholders, the process of formulating KPIs adjusted to the teams' objectives begins. After that, based on the fields and created metrics, the dashboard and report design phase is ready to start.

With this in mind, pages were created regarding the main types of cases/incidents that the CS teams work on (e.g. orders, brand requests, logistics). In addition to the previous pages, a specification page has been created where all incidents (open or closed) are described in detail and the user can get case specific information and details regarding the duration of the open status of the case. It should be noted that, from this specification page, it is possible to directly link the specific incident (via a URL) to the MSD CRM web page, where the user can add or modify the entered data.

After the process of development was concluded, methods for sharing the information with the remaining collaborators were discussed. In this line, it was decided to create robots to send regular information about each collaborator through Power BI Robots: this tool allows to take screenshots of the PBI pages and automatically send them, as a PDF file, to each of the previously filtered CS representatives. In this way, and due to the functioning of PBI accesses, it becomes possible to provide a dynamic access tool to directors and a slightly less interactive, but still relevant, access to CS representatives.

Once the entire BI tool had been developed, the sharing phase with the teams began. The directors were responsible for disseminating the usefulness and purpose of the tool, supported by training sessions that I provided to the remaining users. After a period of consistent use, post-use questionnaires were distributed to all team members. These questionnaires were distributed to both directors and other collaborators in an effort to collect implementation results, perceptions, and suggestions for improvement.

Sales Department

Once the dashboard and reports for the CS department were finalized, the second major phase of the project began. From here on, the focus shifted to the Sales department and its representatives, who, by directly contacting with new leads and potential business opportunities, lacked tools capable of providing important information both for the sales process as well as to monitor objectives and priorities. Similarly to the CS departments, the two Sales departments covered by this project belong to two distinct companies within the AC-SGPS business unit. However, in general, they both share the need for information to enable data-driven decision making. Therefore, after some meetings with the directors of the departments, it was established that the objective of the project was to obtain and relate data from MSD CRM with data from the companies' ERP. It is important to highlight that

some companies use CRM as their main software for collecting data on potential business opportunities and actual data of invoiced sales. In the case of Amorim, however, ERP is used as a transactional system of record for business (sales, inventory, financials, etc.), grouping the actual data of invoiced sales, whereas the CRM system manages front-office tasks to increase sales volume and is only linked to data of prospects and business opportunities. Therefore, the purpose of ERP and CRM integration is to ensure that automated and consistent information is shared between both systems: a CRM system controls sales and customer data, while an ERP system streamlines business operations. Integrating the two systems can result in substantial benefits, including a shorter time to market, an increase in cash flow, and greater agility [64]. In addition, it was desired that access be granted to the entire team in addition to the sales directors.

Adopting the same approach as with the CS department, meetings have been held and the relevant fields to be selected from both software have been discussed. For the MSD CRM the process was identical to the previous one: the connections were established through the Power Query (M) Builder and the respective data were imported into the PBI. On the other hand, the access process regarding SAP data was different: as already mentioned, the data collected from SAP is transmitted to Microsoft Azure Cloud where, using AAS, it is added to the respective OLAP cube of the company. So, in this specific case, access to SAP data occurs between the PBI and the O2C cube. Designed for the Sales department, the O2C cube represents each and every sales process from creating an order, order fulfillment and shipping, invoicing and accounts receivable. In other words, it represents the process from the moment a customer order is placed until payment.

Once all the connections are made, a key part of the project emerges: the creation of a relational model between both data sources (O2C and MSD CRM) and from which the accesses would be filtered by user without disregarding the organization's security policies. Due to the fact that there are three distinct ways to connect data sources to the PBI, and that each of these methods has unique characteristics, a model was developed to permit the simultaneous filtering of O2C and MSD CRM data. This model would allow the access properties (user and role) given to the O2C cube, in AAS, to be used to filter access to MSD CRM data.

With all data properly connected and organized, the creation of the dashboard started. Assuming that the goal was to highlight the MSD CRM information, a main page was developed, which provides an overview of all data regarding opportunities won or lost on a variable timeline, through graphs and KPIs.

On the next page, a concept of a *Control Tower* was developed where the four factors under analysis were: (1) *Open Opportunities*, business opportunities that are still under negotiation; (2) *Sales FOB Values*, analysis of the price agreed upon, when a seller relinquishes ownership and a buyer accepts ownership of products purchased under particular payment terms in this case, FOB means that the buyer assumes all risks and costs with the transport of the goods [65]; (3) *Sales Orders*, documents provided by the seller that contain details on the goods ordered by the buyer; and (4) *Receivables*, the amount owed to a company for goods

provided but not yet paid for by customers. They were presented from a general view, with little detail, in order to allow the simultaneous visualization of different parameters under the influence of the same filters in the same time interval. Through the *Control Tower*, four links (each referring to each of the parameters enumerated) were also added to four other pages developed in order to further detail the information. It is important to mention that, due to the access model created, additional necessary metrics were created.

Due to the fact that this was the second major phase of the project, the implementation time was insufficient to execute a procedure identical to the one conducted with the CS departments. Although there was insufficient time to train the entire team, the directors acted as key components by actively participating in the project's development, and as a result, acquiring the necessary skills to use the tool. The final phase of implementation was therefore delegated to the respective sales directors and MC department. To obtain some form of feedback on the development and implementation of the project, an interview was conducted with one of the sales directors which acted as a key stakeholder and responsible for coordinating the project.

Chapter 5

Development and Implementation of Business Intelligence tools

In each of the main phases of the project, there is a different dataset, which in turn leads to different processing methods in order to extract business-relevant information. Following the presented architecture of the models, next is presented all the data processing from its source to the analytical model, a model that already allows users to consult the desired information. Since both workflows have processes in common, these will be explained once, and then only the necessary adjustments for a particular phase will be mentioned.

Therefore, the respective workflows, for both departments, and the entire detailed process from data identification and extraction to the creation and sharing of analysis models, will be presented.

5.1 Development for the Consumer Service Department

For the development of the CS dashboard it was necessary to create a dataset based only on data coming from MSD CRM. The whole process, as already mentioned, is demonstrated in the workflow 5.1. All the stages are covered in the sections that I will present below.

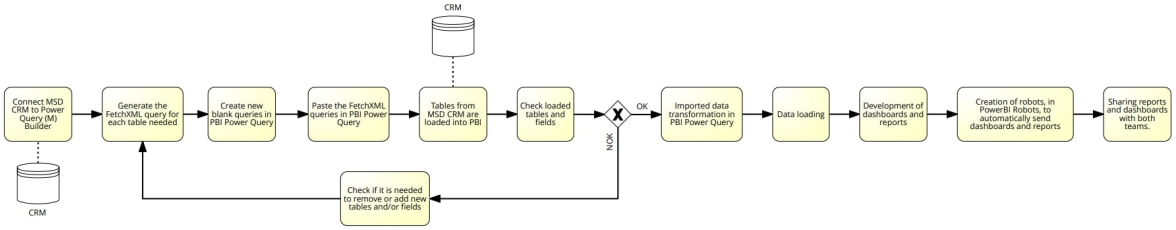


Figure 5.1: Workflow developed for the implementation of the BI tool for the CS department.

5.1.1 Identifying and Extracting Data

The accurate selection and identification of the data to be included in the final BI solution is one of the most important steps in this phase. Occasionally, this identification is straightforward when the name assigned to the fields in the source matches the name of the field in the user interface (UI); however, when this is not the case, it is necessary to identify the fields prior to their selection. Therefore, the names of the columns and tables in the source are frequently distinct from those presented in the UI. This is the case with MSD CRM: the UI presents intuitive field names, but once linked directly to the PBI, these names are lost and it becomes necessary to map each column to match the display names.

To make this process less time consuming, the Power Query (M) Builder, designed to automate the basic Power Queries for getting data into PBI from MSD CRM, appears as a tool where it is possible to select and format the tables and their attributes to be used. Thus, in the first phase, Service URLs must be created so that developed queries can connect to the server where MSD CRM is hosted. To accomplish this, through the Power Query (M) Builder, the URLs with the names *Dyn365CEBaseURL* and *ServiceRootURL*, are generated, copied and then pasted into two separate blank queries in Power Query. Next, once the connection is made, individually for each of the entities to be used, namely: *Account*, *Case*, *Queue* and *Business Unit*, the respective fields/columns are selected in Power Query (M) Builder as exemplified in figure 5.2.

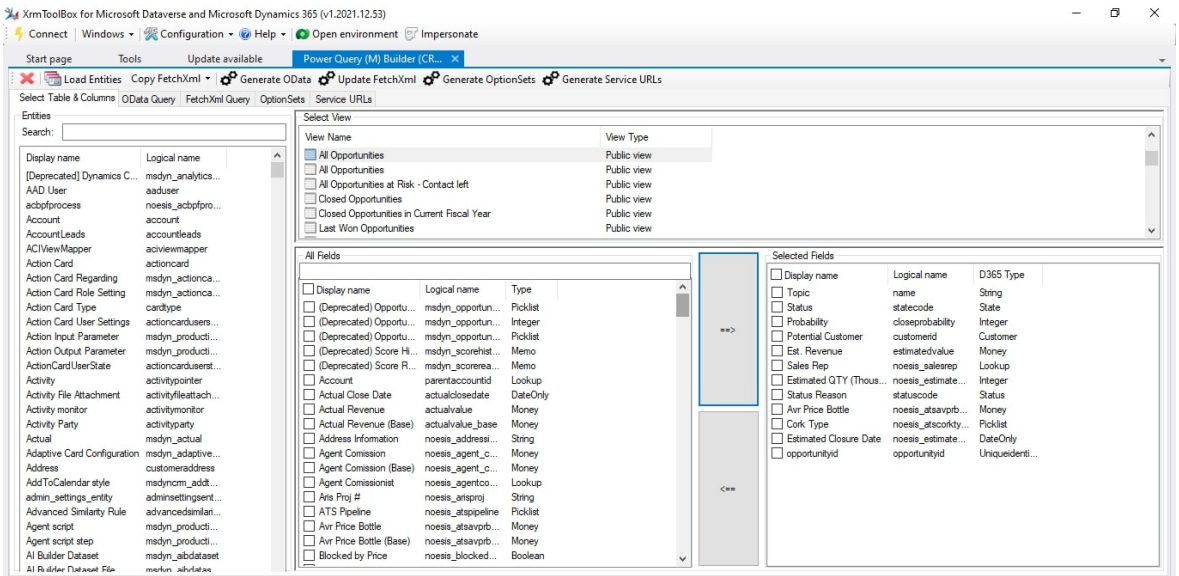


Figure 5.2: Example of the main page of Power Query (M) Builder. On the left are the entities coming from MSD CRM. In the middle are the fields from the selected entity and on the right the selected fields.

After selecting the required fields, in the interface prior to creating the FetchXML (the Microsoft query language used to query MSD CRM data), there is also the option to add an URL that, depending on the context of the selected table, creates a hyperlink to each of the entity rows, e.g., through the PBI, in the *Case* table, after loading the data, it is possible

to directly access the MSD CRM page for the incident under analysis. Having selected all the requirements, it is sufficient to create a query. Then, once the FetchXML code has been generated, it must be pasted into a Blank Query (figure 5.3), and data will begin to be loaded into PBI after a refresh. Due to the fact that a FetchXML code is generated for each table, this process must be repeated for each table being imported.

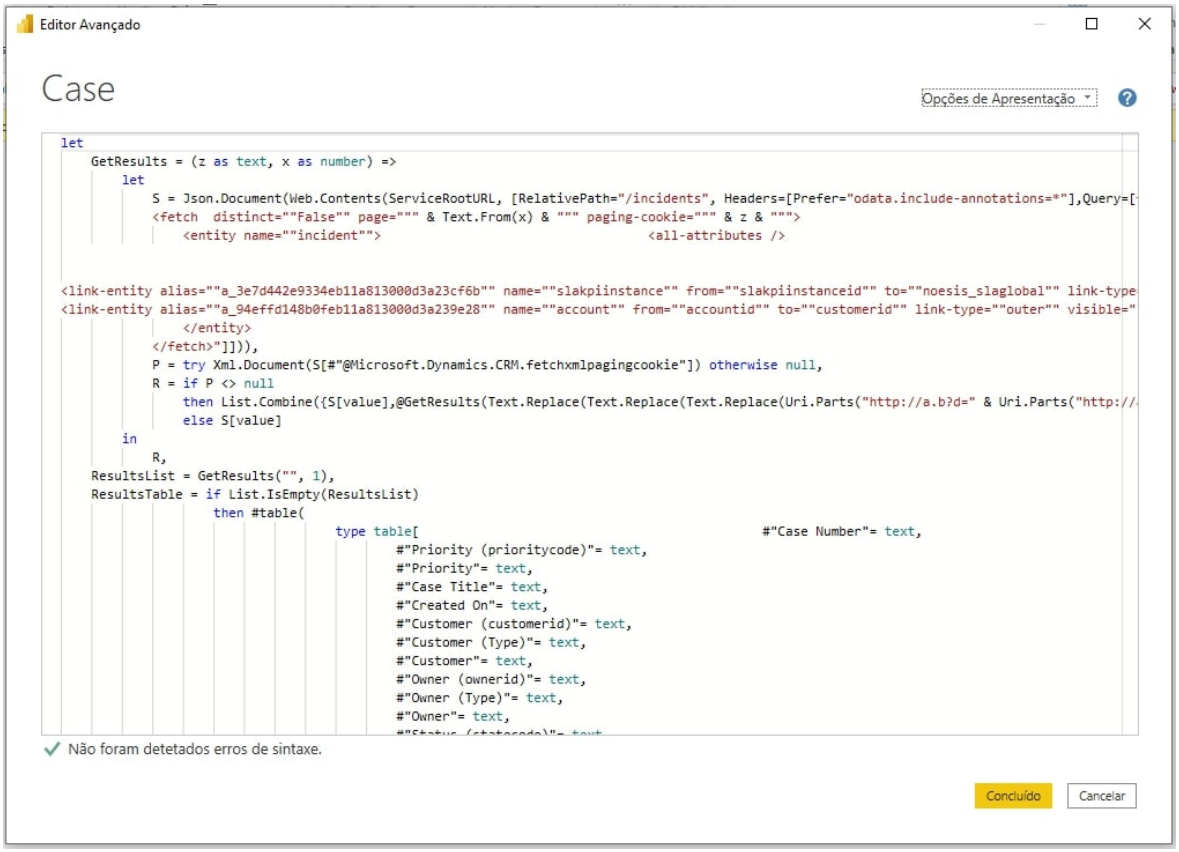


Figure 5.3: Example of FetchXML, generated for the Case table, pasted and connected to the PBI.

It is also important to mention that with this method, called Import mode, the data from the source will be cached into PBI. This means that large amounts of data will consume memory and disk space: during the development of dashboards and reports, the data uploaded to PBI Desktop will consume computer memory and disk space; and after the file is published to the PBI Service, disk space and memory will be consumed on the PBI cloud server. Additionally, in order to have access to the most recent version of the data, the entire dataset must be updated. Therefore, model data is only as up-to-date as the most recent dataset refresh, and import models must be updated on a regular basis - in this case four times per day.

5.1.2 Data Transformation and Cleaning

Now that the dataset has been imported into Power Query, the second phase of the ETL process begins: the transformation and cleaning process. Since the connection method to the data source allows all kinds of changes (Import mode is the only connection method that

allows it, as we will see further on) and given that the data is directly inserted into MSD CRM by the user - prone to insertion errors, duplication of data, and incorrect formatting, for example -, it is necessary to invest time into the transformation and cleaning processes so that the future analysis process is based on credible and previously validated data.

Overall, all imported entities - *Account*, *Case*, *Queue* and *Business Unit* - were submitted to identical processing methods:

- All columns and their data types (integer, text, date, etc.) were reviewed and, if necessary, correctly classified.
- Columns, whose names were not the most appropriate, were renamed.
- Records containing errors and duplicates, usually associated with open incidents without the required data inserted, were removed.
- Date-time fields were translated to the format used by Amorim and, if needed, divided in two different fields: Date and Time.

Regarding the *Case* table, since it is the main table of the model and contains more fields for additional analysis, the treatment procedure was more extensive. In this regard, in addition to the previously mentioned general steps, it was also necessary to develop a duration field: depending on the incident's status (open or closed), it was necessary to calculate how long it has been open or how long it took to be completed.

5.1.3 Relational Data Modelling

After the data has been transformed and is ready to use, the third and last phase of the ETL process takes place: the loading into the PBI. However, although the loading of the data into the PBI occurs without any problems, following the methodology adopted so far (Import mode), it is not possible to bring the relational model associated with the data source directly into the PBI. In order to do this, it is required to edit all the relations between the tables.

When the tables are imported, each table is associated with its respective fields that allow relationships between them to be established. In turn, the *cardinality*, which stands for the type of relationship between entities, is defined by the type of keys (primary or foreign) associated to each entity. A primary key is a column (or columns) whose values uniquely identify each row in a dimension table (e.g. *Account*, *Queue* and *Business Unit*). Primary keys ensure entity integrity by identifying each instance of an entity uniquely. In contrast, a foreign key is a column or columns in a fact table (*Case*) whose values correspond to the primary key values in dimension tables [66].

Once the relationships have been established, it is necessary to have a table that permits horizontal temporal analysis, i.e., the ability to relate multiple temporal events to a particular date. As a prerequisite for all models of temporal analysis, the DAX programming language was used to create a *calendar table* (it can also be generated with Power Query). It contains all dates from the date of the first incident's creation to the last day of the current year, and provides specific access to fields such as month, year, quarter, week of the year, and month name, among others.

Finally, after creating the *calendar table*, the necessary connections are made to the *Case* table and finally the model, shown in the figure 5.4, is obtained.

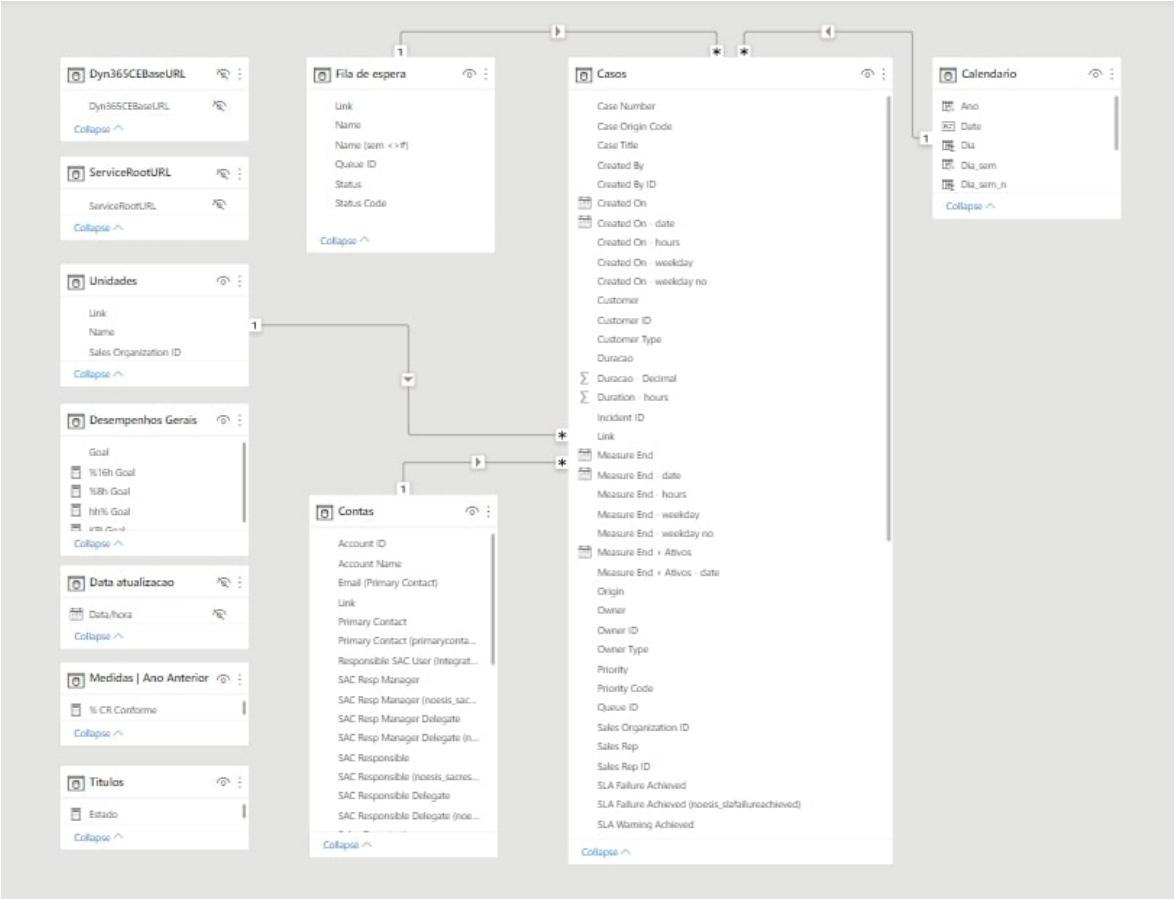


Figure 5.4: Entities and related connections used for the creation of the CS department's dashboard.

Since the entire model is designed for further analysis based on the Cases table, the star scheme was the most appropriate and advantageous to employ. This design enabled a fact table (*Case*), based on which the analysis will be conducted, to be efficiently analyzed by the surrounding dimension tables. In other words, the model relationships between the tables allow filters to be propagated (directly or indirectly) to the *Case* table.

5.1.4 Development of Indicators

Having all the data available and properly related, the performance indicators (KPI) previously discussed with department directors were developed. Since this is a department dedicated to contacting and resolving problems directly with the customer, the number of incidents and respective resolution times are the main variables being evaluated. Service Level Agreement (SLA) compliance evaluation is associated with resolution times. This is a contract between the customer and the service provider that outlines the services the provider will provide and the standards it must meet [67]. At the time an incident is reported, the CS representative and the customer agree on an estimated resolution time. Consequently, some incidents are resolved within the proposed time, as anticipated, while others do not

meet the agreed upon time. To preserve the quality of customer service, percentage goals are established based on the number of incidents resolved in accordance with the SLA.

Consequently, using the DAX programming language, performance metrics were developed such as: (1) average resolution time; (2) incident count; and (3) percentage of cases resolved according to the SLA. For each of the aforementioned, a metric was also developed from which the current value can be compared to the value from the previous year (N-1) using a PBI function: SAMEPERIODLASTYEAR().

By default, if no time period is selected (i.e. day, week, month, etc.), the values refer to the period so far, compared to the value obtained from the entire period of the previous year. For example, as shown in figure 5.5, the the percentage blurred in red of cases solved according to the SLA (*%C.R. Conforme SLA*) between the months of January and March, can be compared with the percentage for the entire 12 months of the previous year.

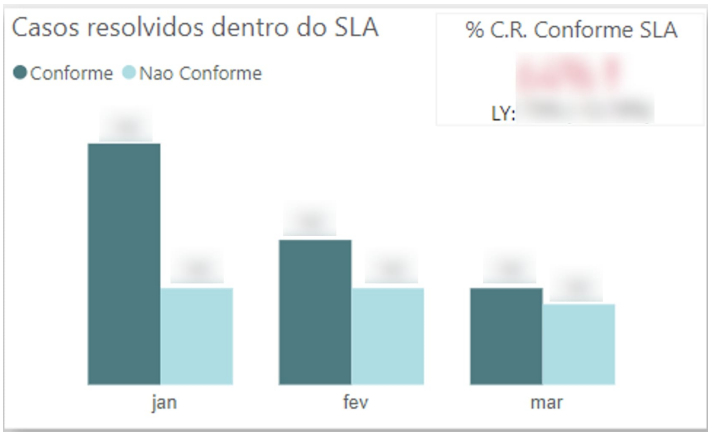


Figure 5.5: The percentage blurred in red is relative to the total number of cases resolved according to the SLA in the January to March period while the LY is relative to the total number of months in the previous year.

Also as part of the temporal analysis, the teams dicided to establish two limits for temporal resolution: (1) below 8 hours and (2) below 16 hours. The objective was to, on the one hand, classify the resolution based on whether it was made within the threshold or not, and, on the other hand, determine, for a given type of incident, whether the number of cases solved was above or below the expected percentage. For instance, let's assume that 10% of "Brand Requests" cases were solved within 8 hours in January 2021. However, the company's objective was to solve 50% of cases in less than 8 hours. Thus, it would be possible to conclude from the dashboard that this objective was not met.

As a result, as shown in figure 5.6, a KPI was developed that can, based on the type of incident selected, assign the corresponding objective, calculate the percentage of cases resolved below one of the two limits (8 or 16 hours), and compare the expected value to the actual value.

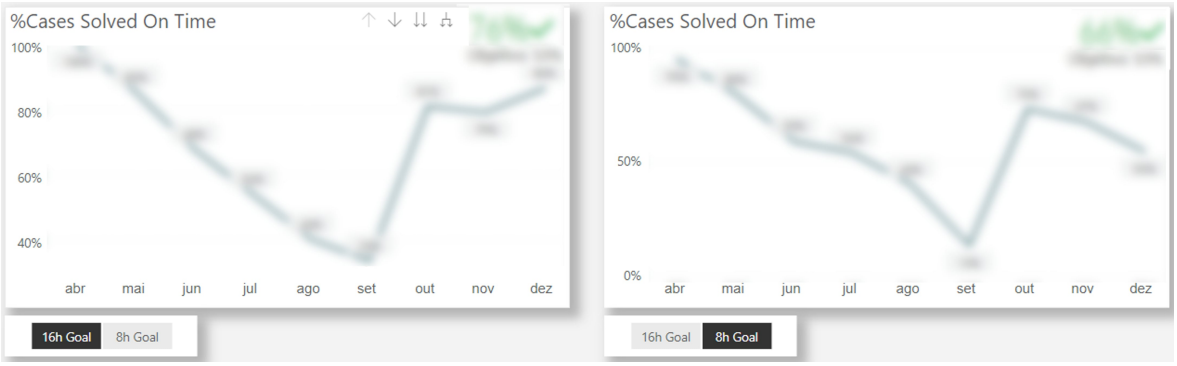


Figure 5.6: On the left, we have the resolution percentages below 16 hours and on the right, below 8 hours. Both have the ability to be presented monthly or for the selected year, as we can see in the box at the top left of both graphs.

5.1.5 Dashboard Design

Moving on now to the design part of the dashboard, it was established that three different page types would be necessary: (1) the initial one as an overview where all the incidents already solved would be briefly presented; (2) 4 others directed to the main types of incidents already mentioned (Contracts, Orders, Brand Requests and Logistics); and the last one focused on (3) detailing each incident.

That said, on the first page (figure 5.7), four different charts have been incorporated in order to give CS representatives a relative view of their performance, as well as directors for an overview of their teams' performance:

- Cases solved per month (*Casos resolvidos por mes*) where the total number of cases resolved for the selected year (Case Count - *Contagem de Casos*) and for the previous year (LY Case Count - *Contagem de Casos LY*) are presented.
- Cases solved according to the SLA (*Casos resolvidos dentro do SLA*) which presents the monthly number of cases solved according to the SLA (*Conforme*) and not conforming (*Não Conforme*). In the upper right corner we have the already mentioned KPI of the percentage of cases resolved in compliance with the SLA (*% C.R. Conforme SLA*) compared to the previous year.
- Type of cases resolved (*Tipo de caso resolvido*) which gives an overview of the number of cases resolved by type so far (*Contagem de Casos*) compared to the previous year (*Contagem de Casos LY*).
- Average resolution time, in hours, by type (*Tempo médio de resolução por tipo (h)*) which, by type of case, gives the average resolution time for both the selected year (*Média Working Time Effective*) and the previous year (*Média WT LY*). In the upper right corner there is the total average compared to the previous year's average.

Figure 5.7: Consumer Service Overview dashboard page.

In addition, on this page it is also possible, through the added slicers, to filter the information by company (*Unidade*), case type (*Tipo de Caso*), CS representative (SAC Rep), sales representative (Sales Rep) and also by month and year. Notice that the header on this and the others pages, besides the title, display the date and time of the most recent dataset update so that the end-user can determine when the data presented was last entered and/or modified. It is also important to mention that whenever an indicator is in red it means that the goal for that indicator is not or was not met; green represents the opposite.

For the four next dashboard pages, each focused on only one type of incident, the approach was identical between all of them. Therefore, as an example, the Orders page (*Encomendas*), in the figure 5.8, will be used. Each of the pages, after filtered by case type, comprises two graphs identical to the Overview page where on one it is possible to analyze the number of cases solved in conformity with the SLA (*Encomendas resolvidas em conformidade com SLA*) and on the other the total number of cases solved in comparison with the previous year (*Total de Encomendas por mes*). The remaining two allow to obtain:

- The average time and percentage of cases solved on time (*Tempo médio resolução (h) / % On Time*). The average is given per month (*Média de Working Time Effective*) and can be compared with the same month of the previous year (*Média WT LY*). The on-time percentage (*% Goal*) appears associated with each of the months and in the upper right corner we have the value associated with the percentage for the period of the selected year and the respective goal (*Objetivo*) to achieve. This can be altered via a switch in the bottom-left corner of the page (8 or 16 hours).
- The responsible and respective solved cases (*Responsavel e respetivos casos resolvidos*), i.e., it is possible to obtain the number of cases concluded per CS manager.

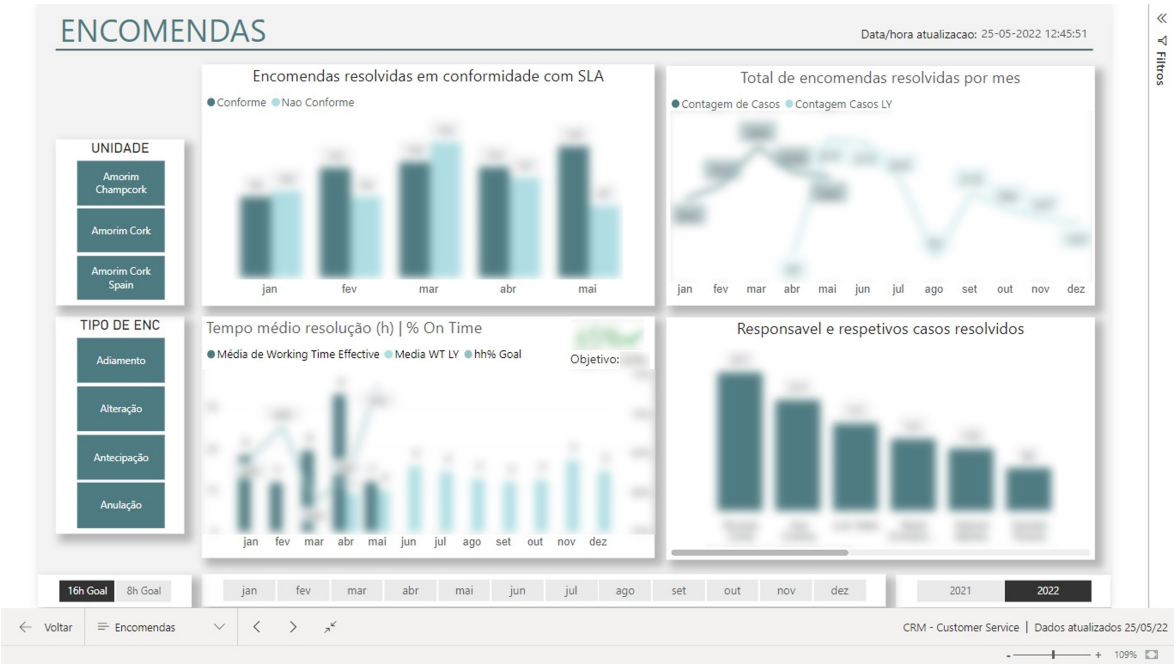


Figure 5.8: CS Orders dashboard page.

Moreover, note that in the specific case of Orders, besides the temporal and unit filters common to all, it is also possible to filter by the type of order intended to be analyzed.

Finally, focusing on the detail of each particular incident, on the last page (figure 5.9), the end-user has access to a set of attributes: Case identifier code (*Id*); Sales representative (*Sales Rep*) associated with the case; case's CS representative (*SAC Rep*); *Customer* for whom the incident occurred; *Case* title; time it took to be closed, or length of time it has been open, based on the state (active, cancelled, or resolved) (*T. Resp*); and a direct *Link* to the case in the MSD CRM.

As can be seen, there are additional filters that can be added to the information, allowing the end user to access only the data needed. These include the company (*Unidade*) referring to the incident; the incident status (*Estado*) (active, canceled or resolved) ; the priority (*Prioridade*) associated with the incident (high, low or normal); the case type (*Tipo de Caso*) and its detail (*Classificação do Caso*); the CS (*SAC Rep.*) and Sales (*Sales Rep.*) representatives; as well as the *Customer*.

It is important to remember that the development process was tested and demonstrated multiple times with CS directors. After all changes were made and the model was approved, it was uploaded to the PBI Service so that directors could access it.

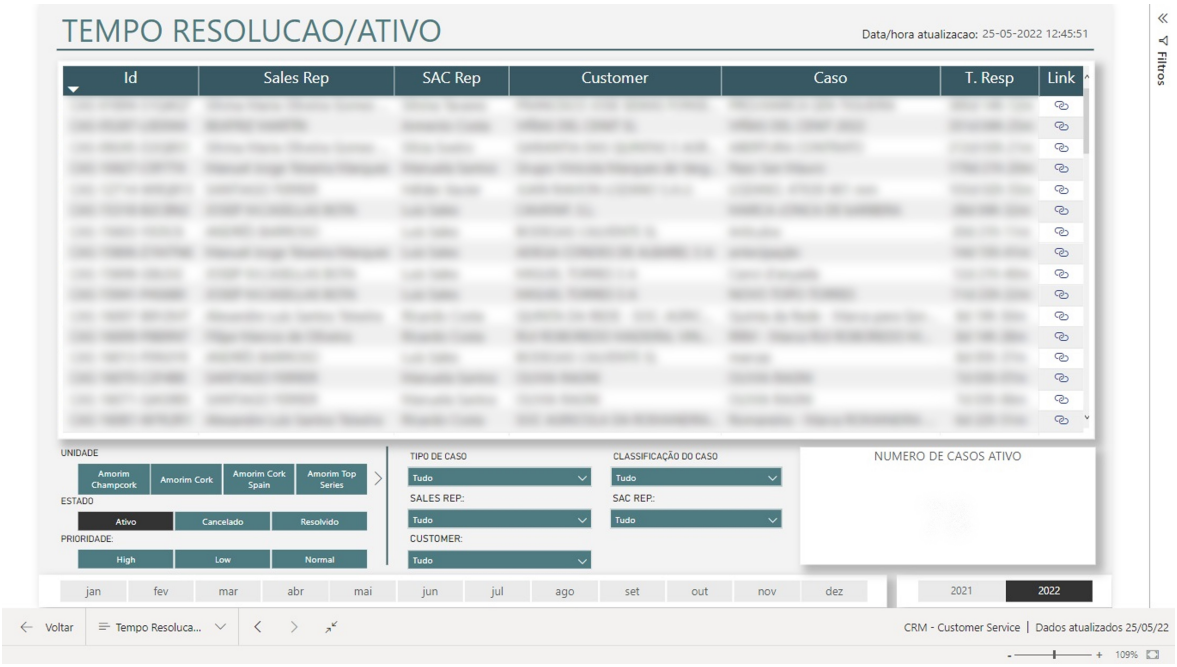


Figure 5.9: CS Detail dashboard page.

5.1.6 Automating the sharing process with the team members

Since one of the goals of the project was to give access to information to all team members, for the CS department the approach taken was to give direct access PBI Service to the directors and develop a method that, setting aside all the dynamic part of the PBI, could give the necessary and properly filtered information to each member of the CS teams. Therefore, it was decided to use Power BI Robots, a software that takes periodic screenshots of the PBI dashboard via Robotic Process Automation (RPA) [68]. The screenshots are then saved as a PDF file and sent directly to the respective email address of the CS representative.

However, only the information intended for each manager should be transmitted. For this purpose, a copy of the dashboard was created, and after some modifications were made - to remove all slicers and dynamic elements, as they would have no effect in the PDF - another PBI functionality, the *bookmark* feature, was applied. *Bookmarks* are primarily used to save dashboard views, i.e., various visual modifications can be applied to a page, and as long as they are saved as a bookmark, the page can be revisited at any time. Based on this principle, bookmarks with the appropriate filters for every member of both teams were generated.

With the information properly organized and filtered, the submission model was created in PBI Robots. Initially, two automation *playlists* were generated for each team using an identical procedure. Figure 5.10 depicts the four steps of the automation process divided in four tabs:

- *General* - is where the playlist is named and the format of the document to be sent (PDF, image, etc.) is stipulated. It is where the sending frequency and time are specified, along with the type of delivery (email, SharePoint, etc.) and, if via email, the custom message that follows the sending.

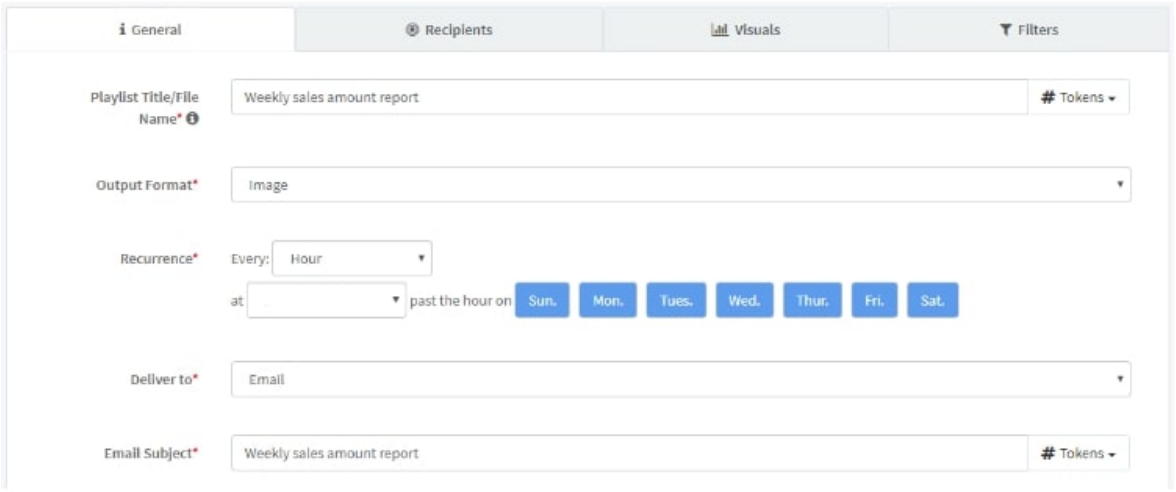


Figure 5.10: Creation of a playlist in PBI Robots.

- *Recipients* - is the tab dedicated to fill in the recipients and respective names with whom the file will be shared.
- *Visuals* - here the chosen dashboard and its individual pages are selected for sharing.
- *Filters* - on this tab, it is possible to add additional filters, among which the application of previously created bookmarks

Before creating the playlists, both team directors were consulted regarding the frequency of sending they felt was necessary. It was determined that one team should receive the report weekly, while the other team should receive, in addition to the weekly report, a daily update regarding open incidents. Thus, a second playlist was created that would only send the detail page. It is important to note that the sent file is in PDF format because, in addition to the quality of the screenshots, the links on the detail page are still active, allowing access to a specific case in the MSD CRM via the PDF.

5.1.7 User training

Once the development process was complete, the process of spreading the final tool to the departments began. For this purpose, two training sessions were given, one for each of the CS teams (in each of the companies), where the team members and the respective director were present.

Each training session had a duration of about 1 hour and, throughout them, the pages of the reports whose collaborators would receive were presented, as well as the regularity with which updates would be received, depending on the team (daily and/or weekly), and the type of information available to them. In addition, it was explained in detail how the information was distributed through the report, namely the KPI's and graphs developed, as well as the respective analysis that could be done from them. With specific reference to the detail page

(figure 5.9), it was explained the possibility of directly accessing the MSD CRM platform from the link provided for each of the incidents that the collaborator has open and in his charge.

Furthermore, it is worth mentioning that all the concepts related to the PBI dynamism were not addressed, since, except for the directors, the PBI reports are sent in PDF format via e-mail to all the collaborators, not allowing, as already mentioned, the ability to change any of the mentioned elements (KPI and graphs). At the end, all participants were given the opportunity to expose their questions, making clear the availability to clarify any issue after the training session.

5.2 Development for the Sales Department

As soon as the CS department's tasks were completed, the Sales dashboard development began. This time, faced with the need to connect two different data sources, it was necessary to create a dataset based not only on data from MSD CRM, but also on the data from O2C cube. A workflow, depicted in figure 5.1, was created in order to illustrate the whole procedure that will be explained in the following sections.

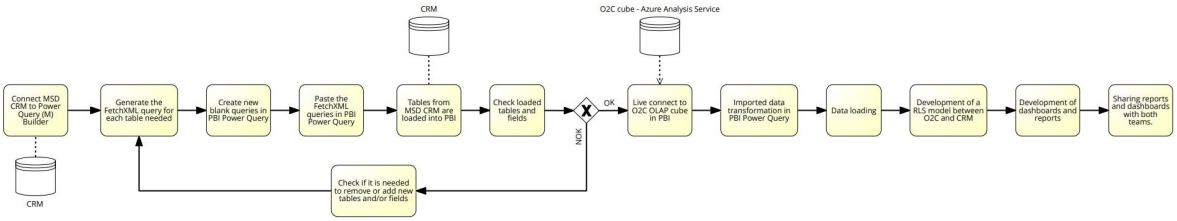


Figure 5.11: Workflow developed for the implementation of the BI tool for the Sales department.

5.2.1 Identifying and Extracting Data

Assuming an identical approach to that already used for the CS department, the necessary data and its sources were defined in order to shape the final BI solution. Despite the fact that the primary focus of the project continues to be on extracting useful information from the MSD CRM data, the Sales dataset was designed using not only this data source and all the customer management functionalities it offers, but also actual sales, orders, and accounts receivable data from Amorim's SAP ERP, allowing the relationship between prospective sales data (MSD CRM) and actual sales data (O2C). Due to the significant differences between the data sources, it became necessary to develop a model that combines the data entered, and easily modified by the user, in the MSD CRM, with the previously cleaned and validated data sourced from the O2C cube, which is fed by SAP data.

Regarding the MSD CRM data, the extraction process is identical to that of the CS department, with the exception of the extracted data: because the objectives of the two departments are distinct, the extracted data is no longer based on support services (MSD CRM for Customer Service), but rather on the customer acquisition and retention process, business creation, and revenue growth (MSD CRM for Sales). Consequently, once the connections between MSD CRM and Power Query (M) Builder are established, FetchXML codes are generated for each of the necessary entities: *Accounts*, *Quote*, *Opportunity*, *Opportunity*

Product, *Product*, *Customer Product*, and *ATS Sales Process*. The data can be loaded into the PBI once the queries have been created. Nevertheless, as previously stated, the SAP data collection method differs from the MSD CRM data collection method. When connected to MSD CRM, the specified fields are imported and consume disk space and memory on the machine during the development process, and later on the cloud server where the shared dashboards are accessible to end users.

Regarding the Amorim's adopted ERP, SAP S/4HANA, the process from the collection, processing, storage and subsequent availability of data for analysis is different. Since it is a fully integrated cloud-based ERP, Amorim has chosen Microsoft Azure to host its entire data infrastructure. Therefore, data goes through an ETL process associated with SAP S/4HANA, i.e. it is selected, extracted, transformed and cleaned, and finally uploaded to a DW in the Microsoft Azure cloud. Azure is a SaaS that, in addition to storing the entire data infrastructure, enables the development of OLAP databases directly on top of cloud-stored data via AAS. Several multidimensional cubes are developed in this manner in order to optimize the query process and generate reports based on specific data.

As stated previously, the O2C cube stores all data, from the moment a customer places an order until the payment is received. Given the functionality of the O2C cube for the sales data analysis process, a direct link is established between the cube and the PBI. Unlike MSD CRM data, the AAS connection does not require the import of the data model. In this line, the PBI connects directly to the AAS server where the O2C cube is stored, via a URL. This type of connection is known as a *Live Connection* because the data is accessed quickly and directly on the AAS, i.e., at the source and in real time, but in exchange, the PBI loses all of its metric creation and model customization capabilities.

Since the dataset being analyzed is derived from two distinct sources, the PBI does not support the *Live connection*. Instead, the connection type automatically shifts to Direct Query mode, and although the nearly instantaneous connection to the data is lost, the data is not imported into PBI, therefore there are no storage capacity issues. In contrast, a so-called *Composite model* makes it feasible to connect multiple data sources. This permits the connection of imported and Direct Query sources and, to a certain extent, the creation of custom PBI metrics. As the PBI is directly linked to the O2C cube, which contains multiple entities, only those whose use was required for the analysis of three elements - *Sales FOB Values*, *Sales Orders* and *Receipts* - were selected in advance.

It is important to notice that the data from the two sources are updated differently. While the imported data is updated four times each day, Direct Query always presents the most recent data from the underlying source.

5.2.2 Data Transformation and Cleaning

Due to the fact that the dataset is comprised of both Direct Query and Import mode data, and given the characteristics of each, the treatment and cleaning process is only applied to those coming from MSD CRM. As such, the main process is identical to that already performed for the CS department, including the formatting of the data type, the renaming of

some columns to more appropriate names, and all the date formatting previously mentioned. However, in order to meet some requirements, it was also needed to make a few additional modifications to the data structure in Power Query:

- In order for *Opportunity* and *Lead* to be analyzed and filtered (by one or the other) in the same visual, it was necessary to combine the two entities in a single table;
- Exclusively for the *Opportunity* entity (not being particularly relevant to Leads), an *Aggregated Date* column was developed. This column, as the name suggests, aggregates, based on the opportunity's status (*Open*, *Lost*, or *Won*), the most relevant date (*Estimated Close Date*, *Actual Close Date* or *Created On Date*) that is currently available. It will later be used to link to the *calendar table*;
- Using the *Estimated Revenue* and *Estimated Quantity* (per thousand) to be Sold, a unit pricing column was developed so that products can be filtered based on whether they are higher or lower than a specified value per thousand;
- In the *Accounts*, all customers with whom AC-SA and ATS have made or plan to make sales are stored. Each customer can be associated with multiple companies. Therefore, a new record is created for each company with which a customer has established contact, with the customer's name and the company code and name as the primary fields. In cases of incorrect data entry in which the code and company name fields were missing, the record was deleted. If only one of these two fields was missing, however, the record was automatically corrected.

Although both data sources were ready to be used, it was necessary to utilize Power Query to build a strategy to relate them, as will be seen below.

5.2.3 Relational Data Modelling

As was the case with the data used by the CS department, the initial modeling phase began by linking the entities originating from MSD CRM. Thus, beginning with the three main tables - *Accounts*, *Opportunity*, and *Product* -, relationships were established and the scheme depicted in image 5.12 was obtained, with the *calendar table* already coupled with the *Aggregated Date* field from the *Opportunity* entity.

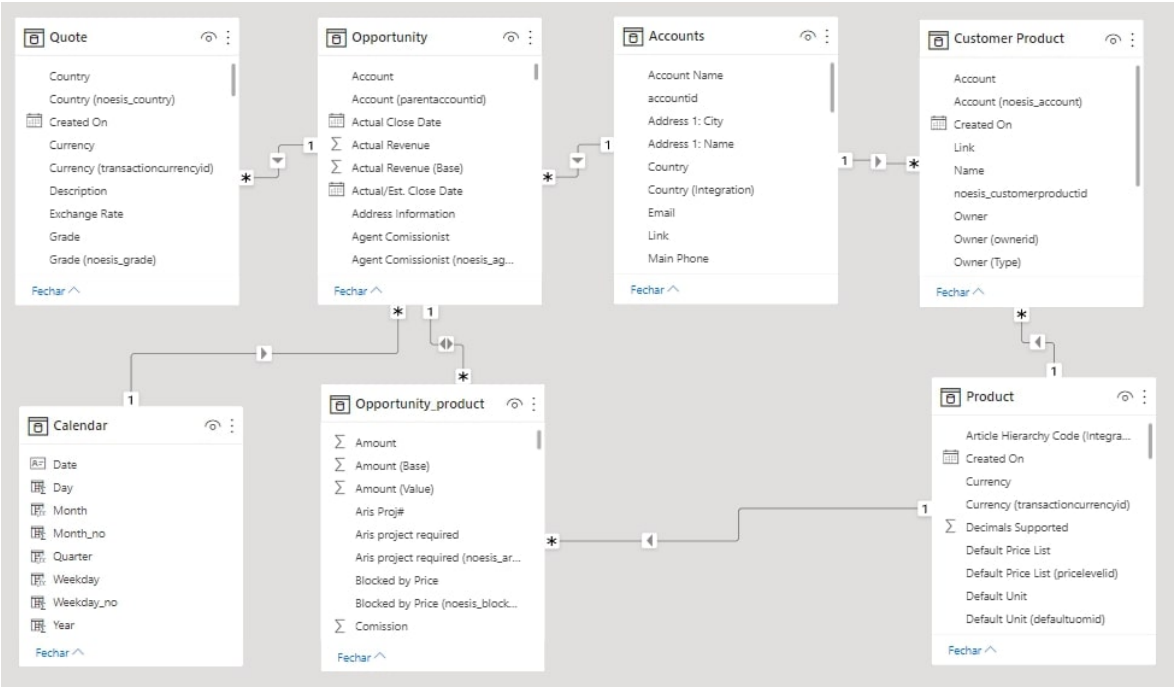


Figure 5.12: Schema created for the data imported from the MSD CRM.

Given the objectives to be achieved, it was necessary to create a mechanism capable of connecting MSD CRM and O2C, as previously stated. Although both data sources have entities with similar purposes (e.g. keep records of customers or available stocks per product), their structures are different: it was the case of O2C's *Business Partner* and *Material* tables, which share properties with MSD CRM's *Account* and *Product* tables, respectively.

Beginning with the *Business Partner* and *Account* entities, it is required to outline their operation and the relationship's purpose. The *Business Partner* table is sourced from O2C and displays customer-related information, such as: the customer's name, id and country, the company with which a transaction was completed, the respective name/s and sales representative/s code/s (internal or external to the company), among others. On the other hand, the table *Account* is imported from MSD CRM and contains identical data type to *Business Partner* regarding prospects with whom a deal has been made or is intended to be made. The *Account*'s data has begun to be entered since the introduction of CRM in the organization, which is more recent than the adoption date of SAP ERP, which feeds the O2C cube; hence, there are clients without entries in MSD CRM.

Consequently, the aim of the relationship is to allow simultaneous filtering of both data streams. However, connecting both tables was insufficient because the goal was not for one to filter the other, but for both to be filtered simultaneously. For this purpose, a "bridge" was established: a table called *Connect BP*, whose purpose was to filter both models even if one of them had no data to display. Thus, the modeling of the table began by importing the required costumer-related columns from the *Business Partner* table and renamed it *Connect BP* (Direct Query mode permits the import of tables).

In light of the fact that the *Account* table contains only one sales representative for each

customer, whereas the *Business Partner* table can contain multiple representatives (internal and/or external), it was determined that: for the data coming from the *Business Partner* table, for each customer's sales representative (internal and/or external) and respective code, the internal one would take precedence, and in its absence, the external one would be used. After the necessary modifications, table 5.1 depicts all imported fields and their new names. Therefore, the following phase begins by appending the *Account* table with the *Connect BP*, as explained in figure 5.13, followed by the elimination of all non-common columns.

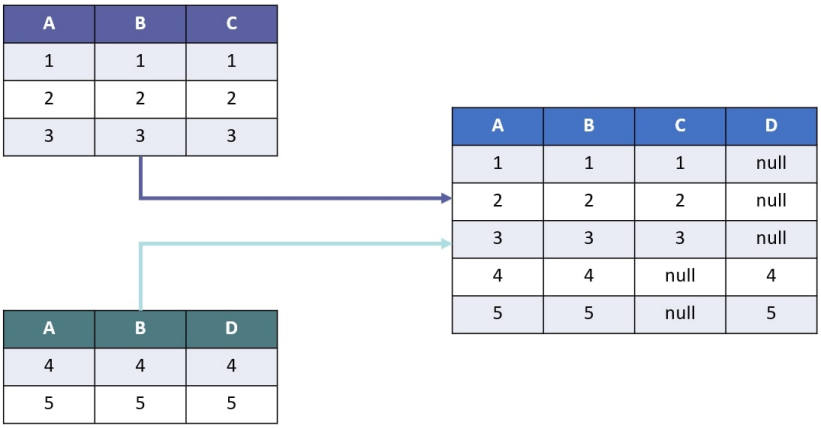


Figure 5.13: The append operation produces a single resultant table by appending the contents of one or more tables. The resultant table combines the column headings of the input tables [69]. In this scenario it is possible to see that the columns in common (A and B) overlap and the others remain null (C and D).

Table 5.1: Fields imported from the *Business Partner* table (O2C) to the *Connect BP* table after changes.

Business Partner fields	**Connect BP fields**
Responsável de Vendas (sales representative)	*Sales Rep. User*
Responsável de Vendas Externo (externa sales representative)	
Código Responsável de Vendas (sales representative code)	*Sales Rep. (Integration)*
Código Responsável de Vendas Externo (external sales representative code)	
Business Partner	*Account Name*
Código Business Partner (business partner code)	*Account Code*
Organização de Vendas (sales organization)	*Sales Organization*
Código Organização de Vendas (sales organization code)	*Sales Organization Code*
País (Country)	*Country*

With the *Connect BP* table containing information regarding O2C and part of the required information from the *Account* table (only the connection code was missing), the next step was to obtain the *accountid* field, which enabled the connection between the *Account* table and the *Connect BP* table. To accomplish this, the *Account* and *Connect BP* tables were merged based on two common fields: *Sales Organization Code* (a code associated with the business that makes or intends to close a deal) and *Account Code* (code associated to customers with

sales invoiced in O2C and/or, at least, one record in MSD CRM). By "overlapping" the two previously mentioned fields of both tables, the *accountid* field is pulled to the *Connect BP* table whenever the values match, thereby enabling the connection between both tables. Figure 5.14 exemplifies this procedure. Keeping in mind that the process of creating the *Connect BP* table originated from the *Business Partner* table, it is not necessary to add a field that enables the relationship between the tables.

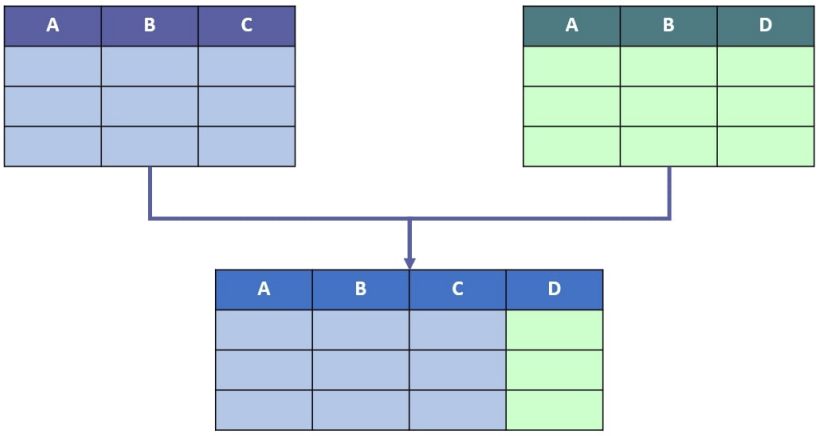


Figure 5.14: A merge queries process joins two existing tables with matching values in one or more columns [70]. In this scenario, the join could have been done by one or both of the columns A and B (which were shared by both tables) and then by pulling column D (from the table on the right) obtain the final table consisting of columns A, B, C and D.

Once the table has been created, the only remaining step is to establish the connections between the data sources. For this purpose two cardinality many-to-many connections were created as shown in figure 5.15. The functionality behind this type of relationship is that even if there are multiplied or missing values between each of the pairs *Business Partner-Connect BP* and *Account-Connect BP*, by directing the cross-filtering between the pairs in one direction (from Connect BP outwards), both can be filtered simultaneously, without the occurrence of ambiguity in the data.

Once the connections between the preceding tables are established, one moves on to the relationship between *Product* and *Material*. Each material/product produced by the company is catalogued in the *Material* entity with a unique code - primary key *PKMaterial* - that defines it and enables the connection with the rest of the O2C model. In addition, there are five hierarchies of details according to the characteristics they share in order to group them into distinct categories. In turn, the *Product* entity, besides other specific fields, has a primary key - *productid* - that establishes a connection with the rest of the MSD CRM model, as well as a field imported directly from the O2C cube - *Product ID* - that is associated with each product in the MSD CRM model. The relationship's objective derives from the need to hierarchically divide MSD CRM products via O2C and the development of metrics (described further on) based on data from both models. Contrary to what has happened so far, both entities have a field from which it becomes possible to create a direct relationship - *Product ID* of MSD CRM connects directly with *Código Hierarquia Material*(Material Hierarchy Code).

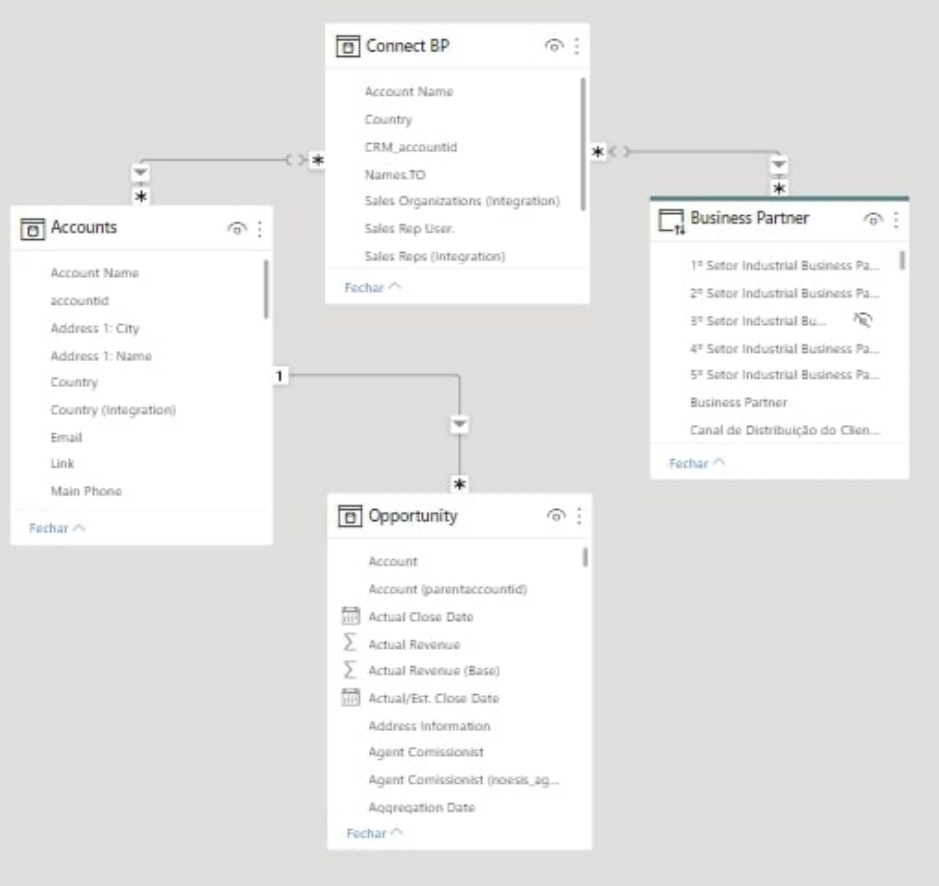


Figure 5.15: *Account* and *Business Partner* tables relationship through the *Connect BP* table.

However, inherent to the necessary relationships created in the previous step, the PBI makes it impossible to create the direct relationship since the model would go into ambiguity, i.e. the data could be filtered in several directions making the information uncertain and unsafe.

Based on this principle, it was determined to employ a method identical to that used for the *Business Partner* and *Account* entities, as it is the method that best meets the requirements and prevents errors in later-created analysis tools. Thus, the *Connect Material* table was created so that it was possible to filter both models based on materials and hierarchies. To accomplish this, a portion of the *Material* table, containing the columns *Código Hierarquia Material*, *Nível 1 EN Hierarquia Material* (Level 1 EN Material Hierarchy), *Nível 3 EN Hierarquia Material* (Level 3 EN Material Hierarchy), and *Nível 5 EN Hierarquia Material* (Level 5 EN Material Hierarchy), was imported. Given that *Material* and *Product* share a common column (even if with different names), it was sufficient to establish the relationships between the three tables the same way as for *Business Partner*, *Connect BP* and *Account*.

Having accomplished this, it is possible to obtain the *composite model* with all the entities-relationships established as depicted in figure 5.16. It displays all of the created relationships for the MSD CRM model as well as the connection with the O2C model. Note that the O2C model is not shown in its entirety because its size and complexity would cause the file to become too large. Therefore, by simply pulling the tables required to create the connections -

Business Partner and *Material* - the models are directly linked.

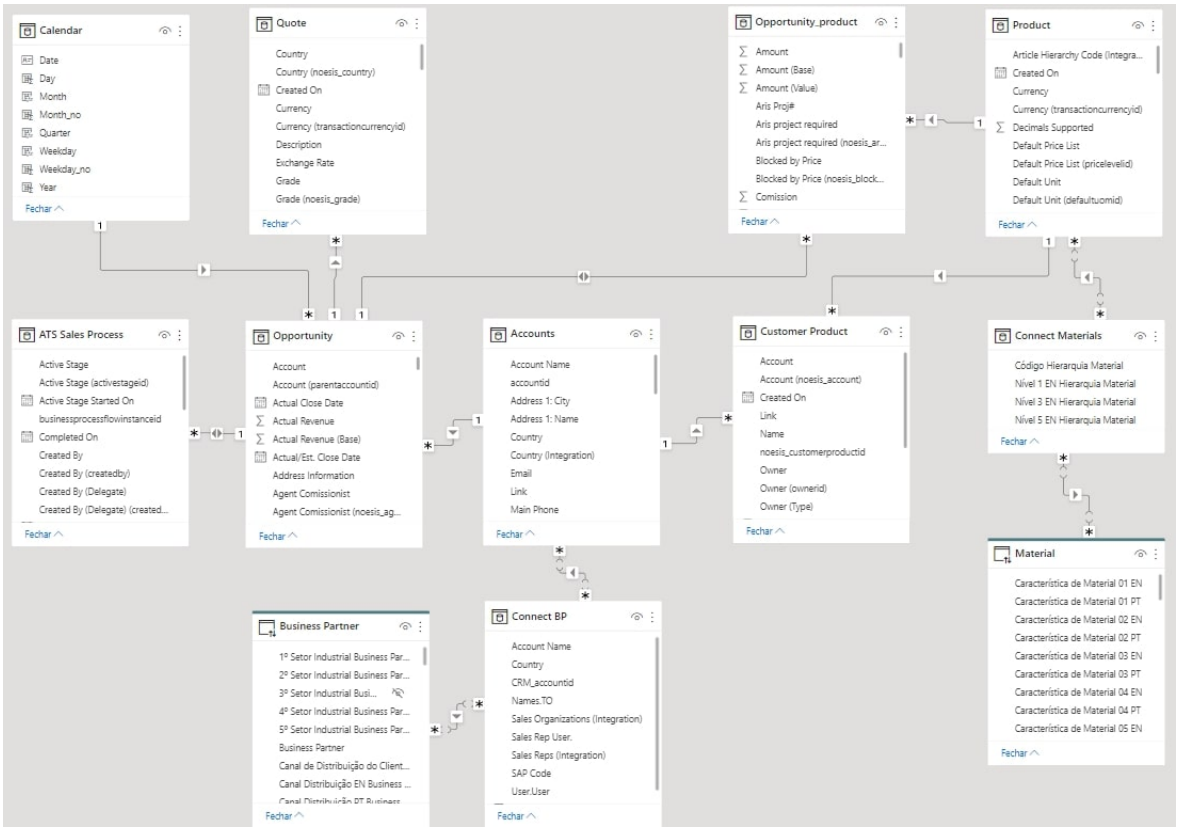


Figure 5.16: Final relational model for the Sales department composed of data in Direct Query (O2C) and Import (MSD CRM) - *Composite model*.

Development of an Access Method

With the model created, it remains necessary to address one of the teams' requirements: providing personalized and properly filtered access to all team members, ranging from commercial directors to sales representatives. In general, external-hosted models, as is the case of O2C, can enforce *Row-level security* (RLS), that, as the name suggests, limits the data that can be retrieved for a particular user. Although Import mode permits the creation of security levels in the PBI, there was no way to correctly filter MSD CRM users alongside those already filtered from O2C since, from an organizational standpoint, the MC department approves the accesses, and the OSI team assigns it. Thus, if the PBI functionalities were to be utilized, the accesses would have to be granted by the PBI itself, which is not recommended by the Amorim's security policies. To address the issue, a method was developed with the following objective: through the user in O2C - be it an external or internal sales representative, or even a director - match the same user in MSD CRM, and then provide common access to all the information available in both O2C and MSD CRM, i.e., the user in O2C provides access to itself in MSD CRM. A sales representative, for instance, will only be able to access information regarding customers with whom he has or has had sales opportunities, or with whom he has close a deal. On the other hand, sales directors will have access to all clients with whom their team is interacting.

Therefore, in the table *Connect BP*, the field *Sales Rep. User* was previously inserted in order to associate, to each business partner or possible customer (represented by the field *Account Name*), the respective sales representative. However, for the accesses to be filtered it was necessary to create a DAX metric - *Access Filter* - on the O2C cube, whose functionality was to identify which user had logged into the dashboard. For that, it was discussed with the teams which assumptions to adopt and which would allow giving the best solution to the problem, resulting in the decision that each user would need to have at least one sale linked with him, so that he would have at least one record in O2C. This approach has, on the one hand, negative aspects associated with it because new users/sales representatives will not have access to their opportunities in MSD CRM until they have some sale in their name. On the other hand, the positive point is that both representatives and sales directors will have properly filtered access to each of the data sources, as well as personalized information. Although not the perfect approach, it was the one with the most positive points considering that the two data sources in question - MSD CRM and O2C - have distinct associated data structures that do not allow a direct relationship.

5.2.4 Development of Indicators

Once the models were connected and ready for analysis, two sets of metrics were formulated according to the user's requirements. The first set focuses on taking advantage of the CRM data and offering insights on both individual and team performance. In order to do this, using the DAX language, a set of metrics were developed, which, applied to opportunities already closed (*Won* or *Lost*), can be compared with the equivalent metric for the same period under analysis in the previous year. Thus, as presented and explained in table 5.2, KPIs are obtained and from which it becomes possible to compare current performance with the same period of the previous year. Assuming that the user's goal is to have equal or better performance compared to the previous year, if this does not happen it is possible to determine the cause and subsequently take measures that may change the situation.

Table 5.2: Developed metrics and KPI for the MSD CRM model.Developed metrics and KPI for the MSD CRM model.

Status	Metric	KPI	Definition
Lost	%Won or Lost Opp.	%Opportunities Lost	Reflects the proportion of closed opportunities that did not yield a profit for the company.
	LY %Won or Lost Opp.		
	%Diff. Est. / (Act.&Est.) Rev. (L/WL)	%Revenue Lost (Est.)	Represents the ratio of estimated lost revenues to the sum of the amount of revenues that were estimated to be earned (actual earned revenues may be different than estimated) and estimated lost revenues.
	LY %Diff. Est. / (Act.&Est.) Rev. (L/WL)		
	Total Est. Revenue	Estimated Revenue Lost	Represents the overall estimated revenue loss.
	LY Total Est. Revenue		
	#Est. Qty	#Estimated Quantity Lost (K)	Estimated quantity of unsold units (in thousands–K).
	#Est. Qty		
	#Opportunities (W or L)	#Opportunities Lost	Count of opportunities that were not closed effectively.
	LY #Opportunities (W or L)		
	#Diff. Customers (W or L)	#Customers Lost	Corresponds to the number of clients with whom opportunities were opened (one or more per client) but none were successfully closed.
	LY #Diff. Customers (W or L)		
Won	%Won or Lost Opp.	%Opportunities Won	Represents the proportion of total closed opportunities that actually brought or will bring profit to the company.
	LY %Won or Lost Opp.		
	%Diff. Actual / Est. Rev. (W/WL)	%Actual / Estimated Revenue (W/WL)	Represents the proportion of revenues actually earned to the sum of revenues that were estimated to be earned and estimated revenues that were lost.
	LY %Diff. Actual/Est. Rev. (W/WL)		
	Total Actual Revenue	Actual Revenue Won	Reflects the real revenue earned from the opportunities won.
	LY Total Actual Revenue		
	#Est. Qty	#Estimated Quantity Won (K)	Estimated amount (in thousands–K) expected to be sold for a successfully closed opportunity.
	LY #Est. Qty		
	# Opportunities (W or L)	#Opportunities Won	Total number of successfully closed opportunities.
	LY #Opportunities (W or L)		
	#Diff. Customers (W or L)	#Customers Won	Represents the number of customers with whom at least one opportunity was successfully closed.
	LY #Diff. Customers (W or L)		

Following this, knowing that the metrics are applied to opportunities already closed, the DAX code was developed in such a way that, whenever possible, instead of creating a metric per status (*Won* or *Lost*) for each of the parameters (e.g. revenue, number of customers or number of units), directly update the metric with the change of the status under analysis. This alternative helps to make the report more visually appealing since the user only has to select the status under analysis and automatically the values change.

Once the indicators for MSD CRM have been created, one moves on to the second set. Here the goal is to create mechanisms that, associated with the relationships already created in the model, allow to correctly filter metrics between both models. This means that although the relationships allow filtering either by customer or by material, relating metrics in the same period of time is not possible since the MSD CRM *calendar table* does not influence the dates of the metrics associated with *Sales FOB Values*, *Sales Orders* and *Receivables*. Following this, regarding the metrics needed for analysis, presented in table 5.3, a method was developed where from the date of the *calendar table* it is possible to filter, besides the metrics applied to MSD CRM, all the remaining ones. Finally, some additional metrics were developed for both the *FOB Sales Values* and *Sales Orders* detailed in table 5.4.

Table 5.3: Developed metrics that connect the MSD CRM and O2C models.

Entity	Metric	Definition
Sales FOB Values	FOB Quantity	Quantity (in thousands) of units sold on customer invoices.
	FOB Value	Net value on customer invoices.
Sales Orders	OV Number (Open)	Number of current open orders.
	OV Quantity (Open)	Quantity (in thousands) of units expected to be shipped with the current open orders.
	OV Value (Open)	Amount that is expected to be obtained from the current open orders.
Receivables	%Overdue over 60+	Percentage of amounts that are overdue by at least 60 days (from the invoice date).
	%Overdue Values	Ratio between open amounts overdue and values within the payment term.
	Receivables Value (Open)	Total outstanding amounts to be paid.
	Receivables Value (Overdue)	Total open amounts past due beyond the payment period.

Table 5.4: Additional metrics developed for the O2C model.

Entity	Metric	Definition
Sales FOB Values	FOB Value N-1	Net value on customer invoices from the year before the selected one.
	FOB Value Deviation	Difference of net values obtained between the selected year and the previous one.
	FOB %Value Deviation	Percentage of deviation between the selected year's net values and the preceding year's net values.
	FOB Quantity N-1	Quantity (in thousands) of units sold on customer invoices in the year prior to the selected year.
	FOB Quantity Deviation	Variation between the selected year and the previous year's sales volume.
	FOB %Quantity Deviation	Variation percentage between the selected year's and the previous year's sales quantities.
	Potential Bottle	Target number of units (in thousands) to be sold per material type.
	%Quantity Objective	Ratio between the number of units sold and the predetermined goal, per material type.
Sales Orders	OV Avg. Price	Average of the net value of sales orders divided by the number of units ordered (amount per thousand).

5.2.5 Dashboard Design

Subsequently, the dashboard was designed. The main objective of this step was to allow the visualization of all available and previously discriminated information, in a simple and appealing way. It is important to highlight that all the following pages were revised and changed several times throughout the development process, ensuring a quality response to the needs of the end-user. Before describing each page, it is essential to mention that all pages are filtered by the company based on the team for which the dashboard is meant; the *Access Filter* is applied to all visuals (graphs, tables and data slicers/filters) presented; and all monetary values are displayed in Euros (except for orders, as will be explained later).

As previously stated, the primary objective of the project is to highlight the MSD CRM data. As a result, the report's homepage, depicted in figure 5.17, provides an overview of already-closed opportunities. In addition to the time line shared by all pages and displayed in the footer, it is possible to divide the page into three distinct sections, which are highlighted

by different letters:

(A) In this section, the slicers that can be applied to the remaining visuals are displayed. From the status slicer, one can choose whether to analyze won or lost opportunities. The remaining slicers are related to those involved in an opportunity, i.e., there is an owner, which can be a person or a team, and for each opportunity created there is a sales representative (who can be the owner himself) responsible for closing the deal with a particular client. Thus, the slicers *Owner* and *Sales Rep* permit the selection of a particular owner and/or sales rep, whereas *Filter by* modifies the category of the data axis presented in the graph below - *Actual and Estimated Revenue per Sales Rep.* or per owner;

(B) Highlighted and centered in the middle of the page are the KPIs developed and presented in table 5.2. As can be seen, the presented values vary depending on the status under analysis (won or lost). In terms of design, two sets (each comprised of six KPI cards) were created, with each card associated with its respective status; subsequently, the creation of two bookmarks made it possible to select the analysis on either won or lost opportunities;

(C) In this last section, earned and lost revenues are depicted in three different graphic ways. The first of the two graphics, on the right, reflects estimated revenues that were lost - *Estimated Revenue per month / Lost* -, while the second represents the actual earnings compared to the estimates for opportunities won - *Actual and Estimated Revenue per month / Won*. The graph on the left depicts the same data as the previous graphs, but this time by Owner or Sales Representative. In the upper right corner of it, only applied to won opportunities, there is an arrow that allows users to overlay (using bookmarks) a second graph that displays the revenues filtered by country directly on a map, as depicted in figure 5.18.

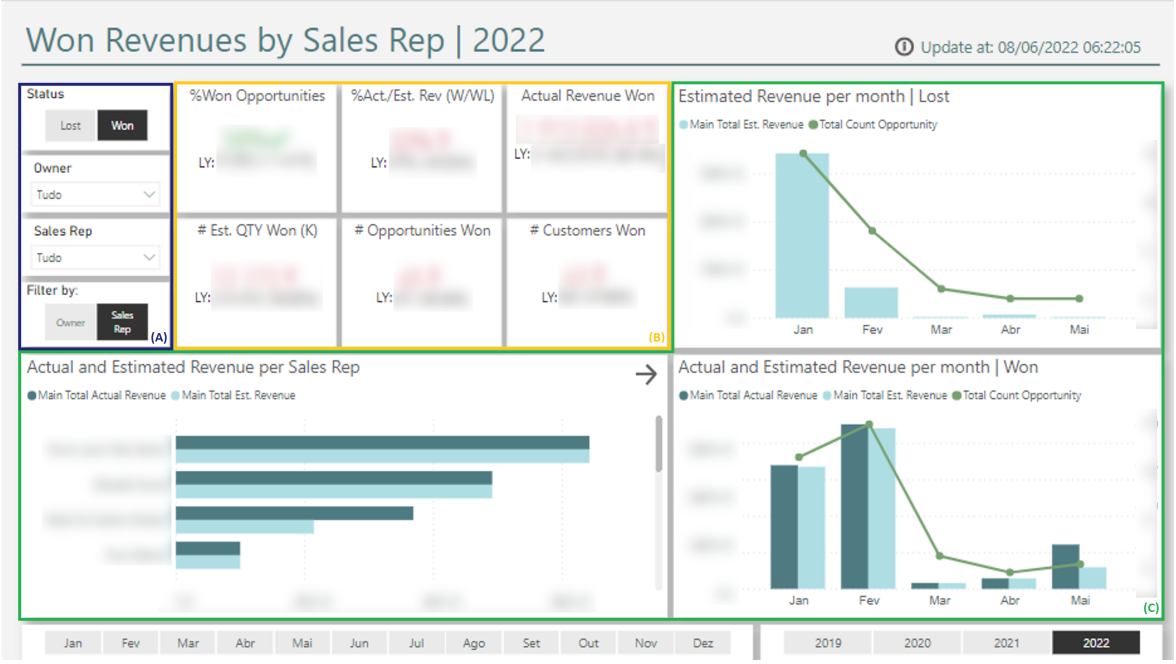


Figure 5.17: Sales Department dashboard homepage.

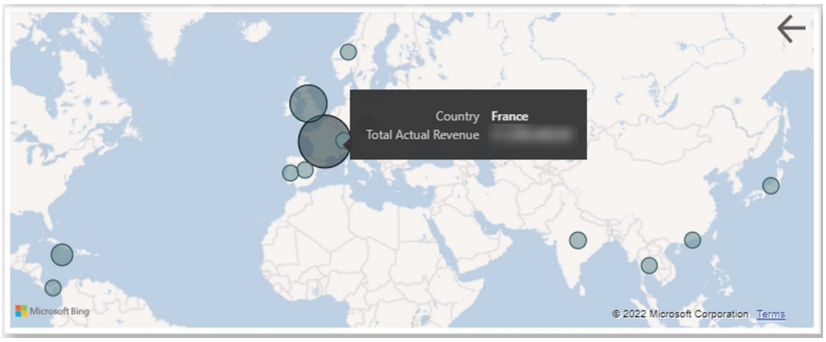


Figure 5.18: Map with amount of revenue earned per country.

Meanwhile, the second page refers to the relationship between the two data models (O2C and MSD CRM). In general, the development of this page was based on the need to create a concept of *Control Tower*, in other words, a transversal data collection hub that organizes and delivers data. In figure 5.19 it is possible to see the final result, where each of the groups created and developed is highlighted by a different letter:

(A) Area where a set of four slicers can be identified, namely: (1) *Business Partner* which corresponds both to customers to whom there are already sales associated, as well as to potential customers who have sales opportunities associated to them; (2) *Sales Rep.* related to the sales representative, both of opportunities and of closed sales; (3) *Country* which corresponds to the customer's country; and (4) *Sales Order Currency* which, being applied only to the *Sales Order* table, allows slicing orders by the currency that the customer used/will use to make the payment, before the exchange is made to the currency used by the companies, in this case the Euro;

(B) Area where four factors are highlighted in analysis, distributed in tables divided by month: (1) *Open Opportunities*, where it is possible to check the estimated values of revenues and quantities (in thousands) for a set of open opportunities; (2) *FOB Value of Sales*, from which one can compare the revenues and quantities sold for the period under analysis, with the same period of the previous year (N-1); (3) *Sales Orders* where it is possible, by filtering the currency, to obtain the values, quantities and number of orders placed; (4) finally, in the *Receivables* table one can obtain the values of sales made but for which payment has not yet been done.

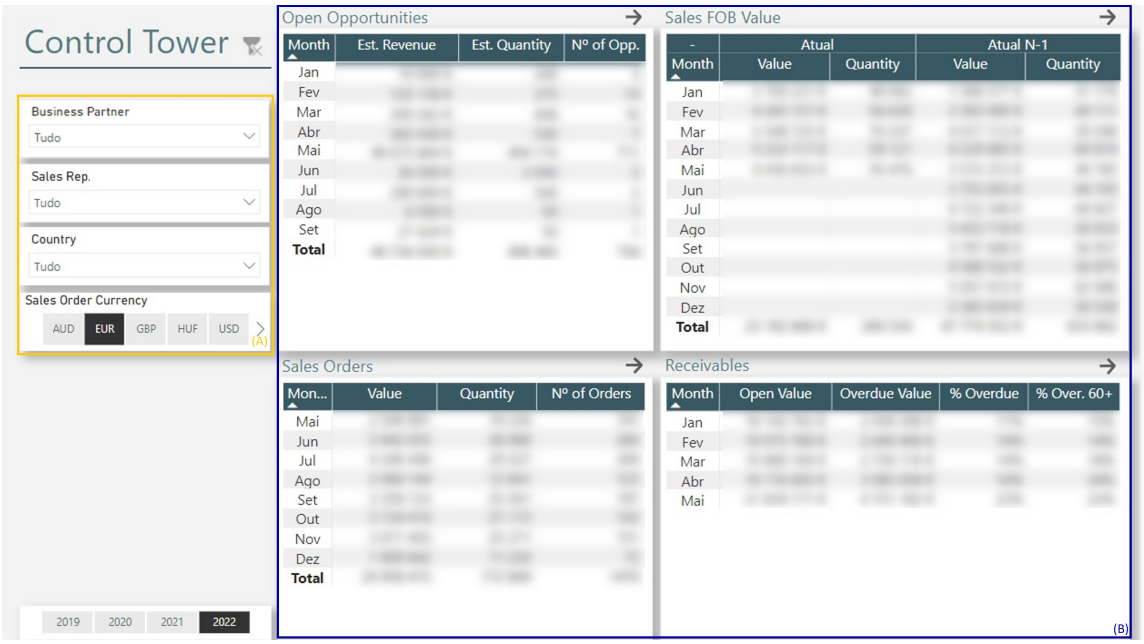


Figure 5.19: Sales Department *Control Tower*.

It is important to note that the metrics responsible for the relationship between the O2C and MSD CRM tables are explained and presented in table 5.3, which has already been referenced. Additionally, in the upper right corner of each table is an arrow button that leads to the respective detailed pages.

Beginning with the Opportunities and Leads page, the user is redirected from the *Control Tower* to the page depicted in figure 5.20 As can be seen, there are 2 slicers already selected (by *Opportunity* and *Status* as *Open*), because the filters applied to the *Control Tower* are automatically pulled to each detail page, whatever it is. That said, what this page offers is a more detailed view of the field of opportunities and leads. Namely, it is possible to analyze each one by: (1) *Potential Customer*, which in the case of leads, represents the name of the contact that is created and that, later on, may (or may not) become a potential customer for an opportunity; (2) *Topic* where some details regarding leads or opportunities are presented; (3) *Created On* which represents the date of creation of the leads and opportunities; (4) *Actual/Est. Close Date* which, for leads, represents the date they were qualified or disqualified from becoming an opportunity, and for opportunities, for those that are open, it represents the estimated date until they are successfully completed, and for the rest, it represents the

closing date; meanwhile, (5) *Est. Revenue* and (6) *Actual Revenue* are not fields applicable to the prospects (they are set to 0), and for the opportunities they represent the estimated and actual revenue earned, respectively (open and lost opportunities are supposed to have 0 values for the actual revenue earned); for (7) *Owner* and (8) *Sales Rep*, the definitions were given above and are also applicable to the leads; (9) *Est. Qty* gives the amount of material expected to be sold or actually sold; and lastly the (10) *Link* allows the user to directly access MSD CRM on the web and make the necessary changes to an opportunity or lead. To finalize the elements of this page, just below the table are the filters applicable to the information provided in the table. Among these, there is the possibility of filtering by (1) *Lead* or *Opportunity*; (2) *Status* of the opportunities (*Lost*, *Open* or *Won*) or leads (*Qualified* or *Disqualified*); (3) *Unit Price*, applicable only to the opportunities, filters them by estimated price, above or below 250€, per thousand units; (4) *Sales Rep*, (5) *Owner* and (6) *Country* that were explained before; (7) *Active Stage*, which, applicable only to open opportunities, represents the stage (*Qualify*, *Propose*, *Contract*, *Close*) the opportunity is in; (8) *Segment* of the opportunity market; (9) *Rating* (*Hot*, *Warm*, *Cold*) assigned to the opportunity based on revenue, probability of success and the customer itself; and finally (10) *Business Partner* that filters out both prospects and actual customers.

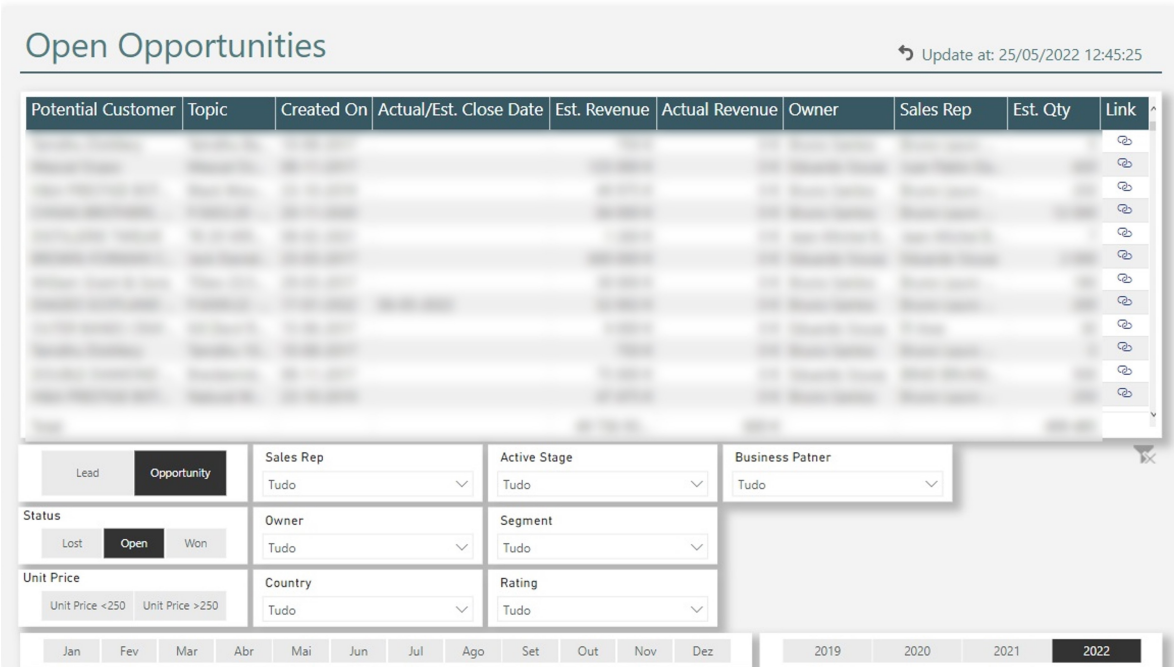


Figure 5.20: Sales Department *Opportunities* detailed page.

Proceeding to the pages whose development focused mainly on O2C data, let's start with the *Sales FOB Value* page shown in figure 5.21. By accessing this page, the user is presented with a table, filtered by invoice issue date, whose parameter under analysis can be changed between: (1) *Country* and (2) *Business Partner*, whose definition is similar to the previous pages; (3) *Commercial Rep.*, which corresponds to a specific attribute created in O2C and groups, in a single field, all those involved in a sales process (internal sales representative,

external sales representative, commissioners, etc.); (4) *Material* which shows all the types of cork stoppers commercialized; and (5) *Others* which groups all the remaining services and products besides cork stoppers - in general, the whole report is filtered so that the type of material under analysis is cork stoppers, since it is the main product commercialized by the companies under consideration, and only in fields of the *Others* type can values and quantities of other types of products be analyzed.

For each of these parameters there are three different ways to visualize the information. By default, when entering the page, the user can analyze, associated to the selected parameter, the quantities, revenues and profit margin percentages (proportion of a product's price that corresponds to the company's net income), for the selected period in comparison with the same period of the previous year. In addition, two other sections are provided (for each of the parameters). The first section, *Objective 2022*, aims to show the quantity of cork stoppers that is intended to be sold in comparison with the values actually sold and the percentage of the objective already achieved. On the other hand, in the *Deviations* section it is possible to analyze, in addition to the quantity and revenue fields, the actual and percentage deviations of these same fields in comparison to the previous year, in other words, this section allows to remove the contribution margins from the homepage and add the deviations.

Still on this page, 5 slicers were applied to filter by 2 hierarchies of cork stopper material (*Hierarchy level 3* and *Hierarchy level 5*, where level 3 represents the type of stopper and level 5 the specific name of the stopper) as well as the previously mentioned *Business Partner*, *Sales Rep.*, and *Country*.

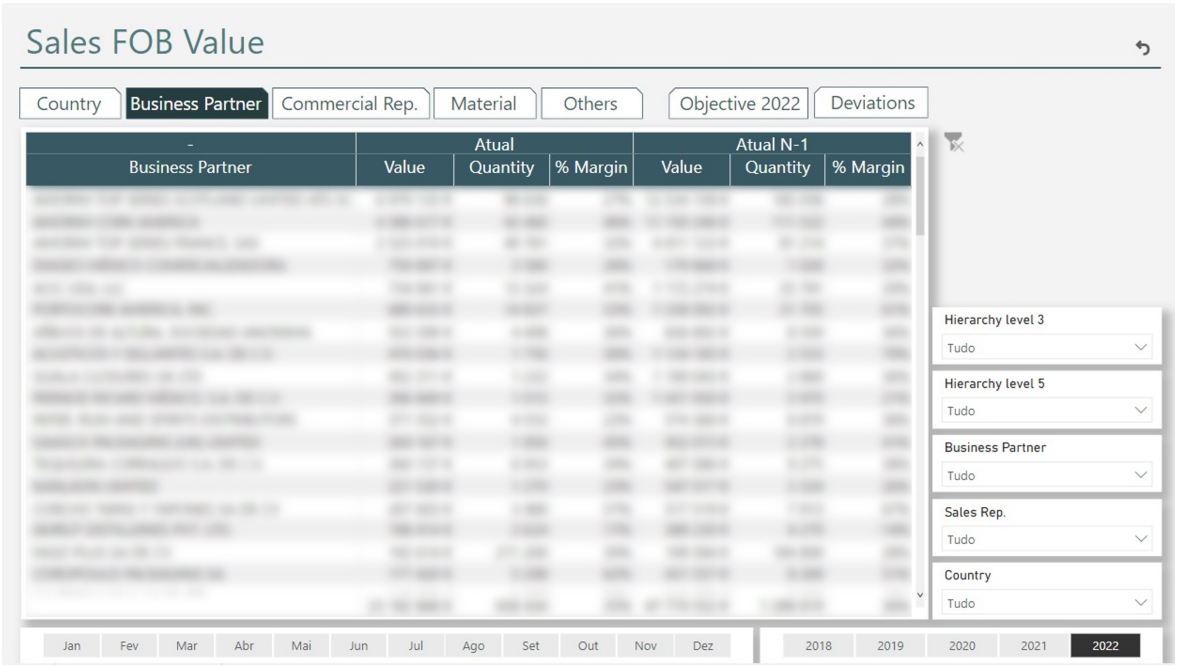


Figure 5.21: Sales Department *Sales FOB Values* detailed page.

Proceeding to the next page, as shown in figure 5.22, the analysis on *Sales Orders* is introduced. On this page it is possible to access all the orders filtered directly by the estimated

date of shipment of the products. These can be analyzed according to parameters similar to those presented for the page *FOB Sales Values*, namely by *Country*, *Business Partner*, *Material* and *Others*. On this same page, the values under analysis are the following: (1) *Quantity*, (2) *Value* of the order(s); (3) *Nº of Orders*, which represents the number of orders that have not yet been shipped; and finally (4) *Average Price* which corresponds to the average price for a thousand units ordered (for an order or for a set of orders). Regarding slicers, four were created in total: *Business Partner*, *Sales Rep.*, *Country* and *Currency*, corresponding to the currency in which the order was made. Note that the currency selection does not convert the values to the selected currency, instead, depending on the selection made, only the orders placed in that currency will appear.

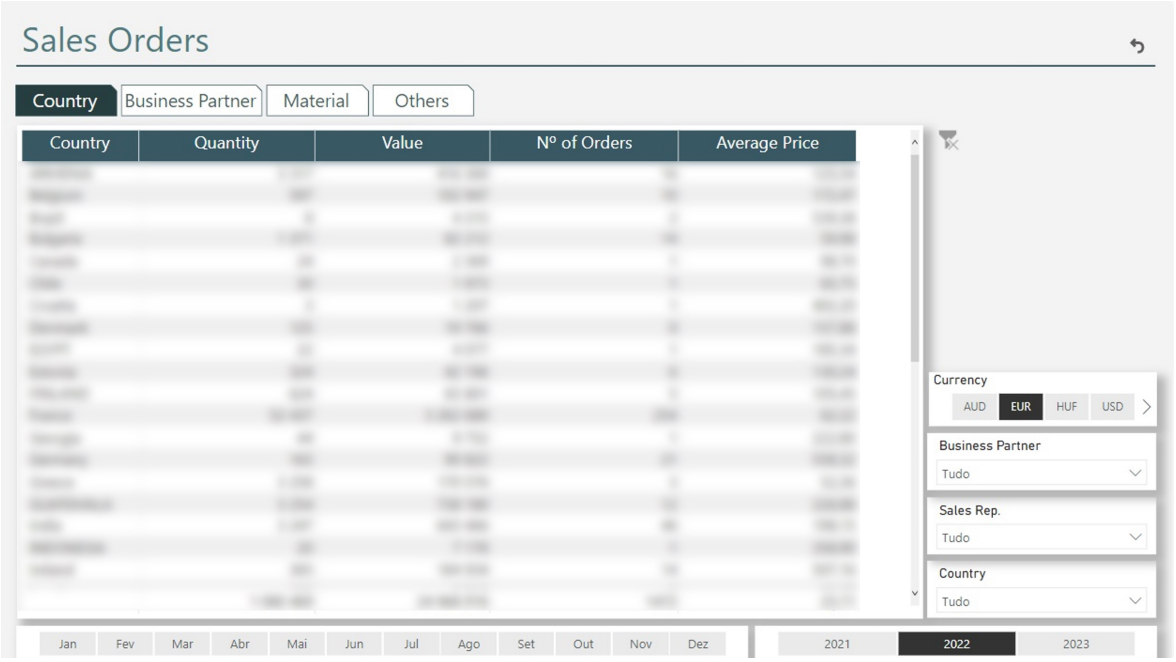


Figure 5.22: Sales Department *Sales Orders* detailed page.

Concluding with the *Receivables* page (figure 5.23), all tables are filtered by the payment due date, and the analysis parameters are *Country*, *Business Partner*, *Commercial Representative*, and *Invoice*. For the three initial parameters - *Country*, *Business Partner*, and *Commercial Rep.* - the tables allow access to the values that have not yet been paid, identified as *Open Value*, while those that have already exceeded the agreed payment date are identified as *Overdue Value*. Regarding the values that exceed the payment agreement, these are divided into different periods of nonpayment, which vary from 30 in 30 days: *Overdue [0-30[*, *Overdue [30-60[*, *Overdue [60-90[*, *Overdue [90-120[*, *Overdue [120-150[*, *Uncollectibility Risk* and, finally, *Doubtful Debt Collection*, this last being the worst of the scenarios since it is assumed that the payment will never be made. Regarding the fourth parameter, *Invoices*, these are highlighted individually making it possible to analyze them by: (1) *Commercial Rep.* and (2) *Business Partner* both already explained previously; (3) *Invoice ID* which, as the name indicates, represents the unique code associated with each invoice; (4) *Invoice Date*

corresponding to the invoice issue date; (5) *Invoice Due Date* which represents the date agreed upon between the two parties (the seller as the company and buyer as the customer) to the deal to be paid; (6) *Payment Condition* which represents the number of days (30, 60, 90, etc.) since a certain agreed date (e.g. from the invoice issue date or from the end of the month in which the invoice is issued) and from which the invoice is overdue and the customer disregards the agreed conditions; and finally, (7) *Open Values* and (8) *Overdue Values* both already explained above. Concerning slicers, on this page only the already mentioned *Business Partner*, *Sales Rep* and *Country* have been implemented.

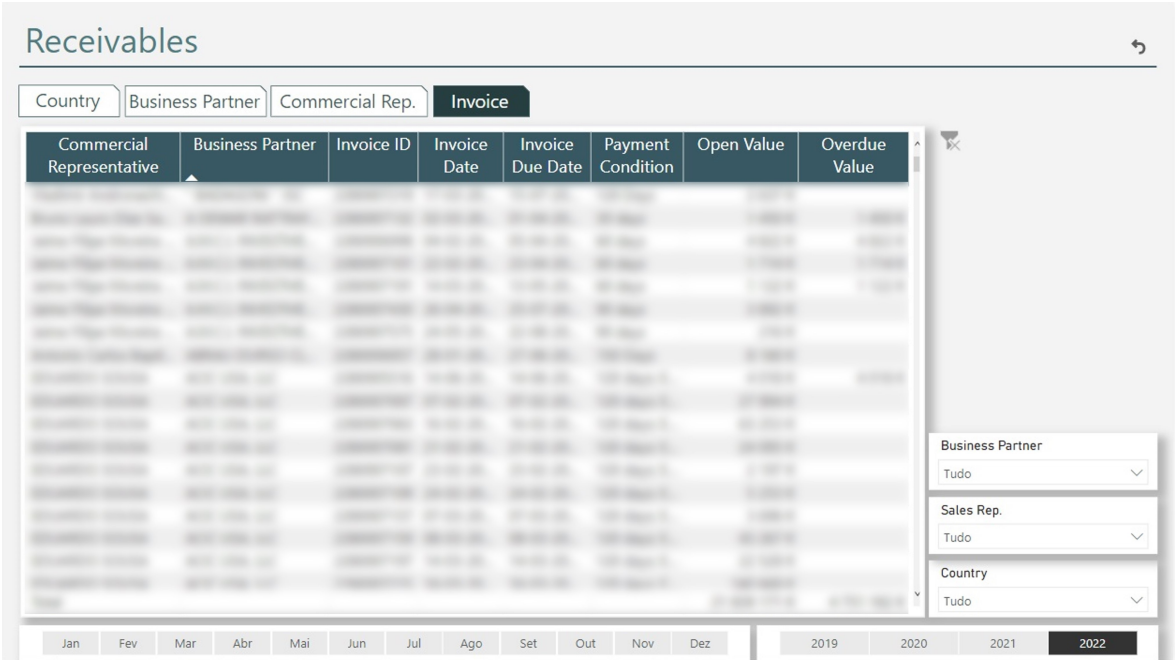


Figure 5.23: Sales Department *Receivables* detailed page.

Chapter 6

Results and discussion

Once the tools were implemented in both departments, a survey was conducted with the end-users in order to obtain the final results of the project. As already mentioned, the implementation period was different for each of the departments and, as a consequence, the collection of results and feedback was also different. Regarding the CS department there was the opportunity to complete the implementation processes, so post-use questionnaires were distributed to all team members in order to assess the applicability, functionality and relevance of the tool. Regarding the Sales department, there was no time to apply the full implementation among all team members, since the duration of the internship did not allow it. Even so, in order to obtain feedback that would enable the evaluation of the quality and applicability of the tool in the department, an interview was conducted with one of the key stakeholders of the project: the Sales Director of the ATS team.

6.1 Consumer Service Department results

To collect and analyze the results of the BI tool implementation for the CS department, post-use questionnaires were distributed to all team members after around five months of consistent use (following the training). The post-use questionnaire (attached in Appendix A) was created using Google Forms, and shared with end-users in order to determine their level of satisfaction with the tool, the most important aspects of the report, and any necessary improvements.

Questionnaires were chosen as a data collection method because, given the sufficient sample size (N=12), they allow for a quantitative study. Additionally, several other projects in the area use questionnaires to collect data, such as the article "Factors influencing the implementation of business intelligence among small and medium enterprises in Lebanon" [71], which analyzed the implementation of BI tools from three perspectives (organizational, process, and technological) by applying questionnaires to 56 managers of SMEs. Another example is

the study described in the article "Predicting critical success factors of business intelligence implementation for improving SMEs' performances: a Case Study of Lagos State, Nigeria" [72], in which 165 users of BI tools in SMEs were surveyed using a quantitative research method based on questionnaires to determine the factors that affected the implementation of these tools.

In this follow-up, the structure of the post-use questionnaire included multiple-choice questions, closed-ended questions, and likert scale questions were employed. Concerning the likert questions, a seven-point scale (1-Strongly disagree; 7-Strongly agree) was chosen because the adjacent options are less disparate from one another, allowing for a wider range of options and giving the participant more freedom to respond precisely according to their preference [73] [74].

6.1.1 Post-use questionnaire

The purpose of the questionnaires is to determine, from the user's perspective, the level of implementation success and the adherence of the companies' collaborators to a new information consultation tool, as well as their level of satisfaction with the new report and the areas in which it did not meet their needs. The report was answered by 12 (10 controllers and 2 directors) end users.

As previously stated, the questionnaire results permit a quantitative study. However, due to the small sample size (N=12), only a descriptive analysis was applied to the data, namely using graphs (bar graphs and pie graphs) and measures of central tendency (mean, median and mode). Although the mean is significantly affected by outliers and the median is more reliable and stable, it was decided to use this value because, among the three, it is the only one calculated using all of the data, allowing for a complete representation of the data [75].

The questionnaires were created with seven main groups in mind: (1) contextualization, in which it was intended to obtain relevant general information (age, experience with PBI, etc.) that would allow characterizing the team member, despite the anonymity of the questionnaires; (2) tool integration process, addressing topics such as improvements and difficulties experienced during the implementation; (3) information, in order to determine the quality and security felt in the information provided, as well as functionalities to be added; (4) design, whose objective was to obtain feedback on the presentation of information; (5) benefits, associated with the general improvement in productivity; (6) role, in which specific questions were presented to each respondent based on their position in the team (CS director or CS manager); and (7) overall assessment.

Contextualization

Regarding contextualization, four questions were asked. The first question aimed to place the respondent within one of the specified age ranges, which varied from 20 to 60 (or older) years old. The purpose of this question was to determine the predominant age of the team members, as this is directly related to experience, and may influence the results or contribute to pertinent conclusions. According to the responses, the predominant age range is 30-39, accounting for 41.7% of the sample (5 out of 12). It is then followed by the 20-29 and 40-49

age groups, whose respective percentages are 25% (3 out of 12), for each. Finally, only 8.3% (1 out of 12) of the sample is between the ages of 50 and 59.

Secondly, the users' experience with PBI was inquired (figure 6.1). This question is relevant because prior experience with the tool can influence acceptance and adaptation. According to the responses, only 25% (3 out of 12) of the participants had prior experience with PBI, while 75% (9 out of 12) of the participants were dealing with the tool for the first time.

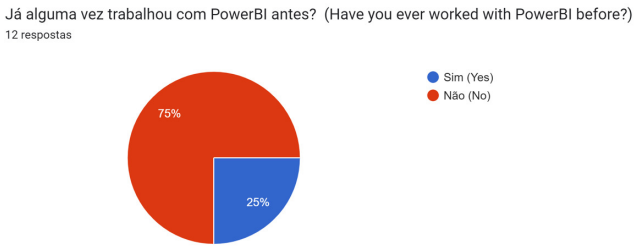


Figure 6.1: Percentage of users with previous PBI experience.

The participant's role and the type of plan they have access to (daily PBI report, weekly PBI report, and/or online PBI) were requested in the third and fourth questions, respectively. 16.7% (2 out of 12) of the participants held the position of CS director, while the remaining 83.3% (10 out of 12) held the position of CS representatives. Due to the fact that only directors have access to the online PBI, this parameter was only filled out by them (16.7%, 2 out of 12). 25% (3 out of 12) of CS representatives reported receiving both daily and weekly reports, while 58.3% (7 out of 12) reported receiving only weekly reports.

Tool integration process

Focusing on integration process, it was evident from the first question that the majority of respondents viewed the new access to information as an improvement over the previously employed methods (figure 6.2), with mean=6.25, median=6, and mode=6 on a scale from 1 to 7. As for the integration procedure (figure 6.3), the balance was positive and the majority of users were once again satisfied. In spite of this, the mean value decreased slightly (mean=5.75), the median remained unchanged (median=6), and the mode increased (mode=7), indicating a greater dispersion in the responses compared to the previous one. This may lead to the conclusion that there is less consensus regarding the tool's integration, indicating that future implementation processes for similar projects may require enhancements (even though it was approved by the majority). In this follow-up, suggestions for improving the integration were requested. Although the evaluations failed to produce a consensus, the majority of respondents were unable to identify any improvement. The only suggestion received identified "resistance to change" as one of the primary obstacles in the integration process, emphasizing that investing in raising awareness for greater "acceptance of the tool by collaborators" is of the utmost importance. The participation of all team members in the development process, as well as the role of directors, could be crucial for mitigating this issue.

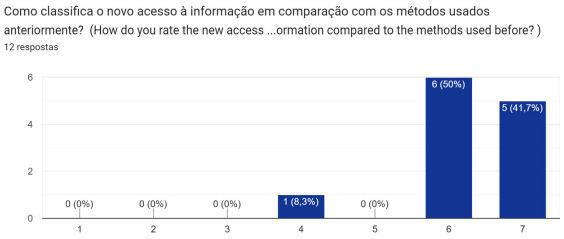


Figure 6.2: Assessment of the new information access vs. previous methods.

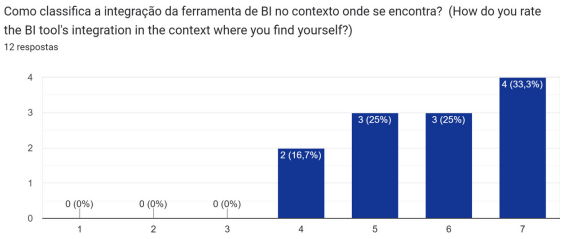


Figure 6.3: Assessment of BI tool implementation.

Also related to the integration of the tool, in figure 6.4 it is possible to see that the majority of users reported feeling comfortable using it (mean=6.17; median=6; mode=6). Therefore, it is possible to conclude that, despite the fact that there is room for improvement, the implementation model achieved its goal of providing users with the necessary tools to access information.

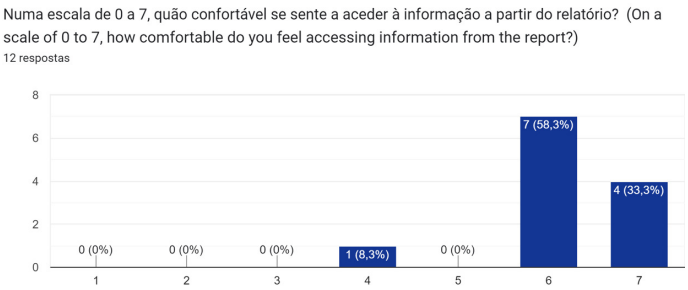
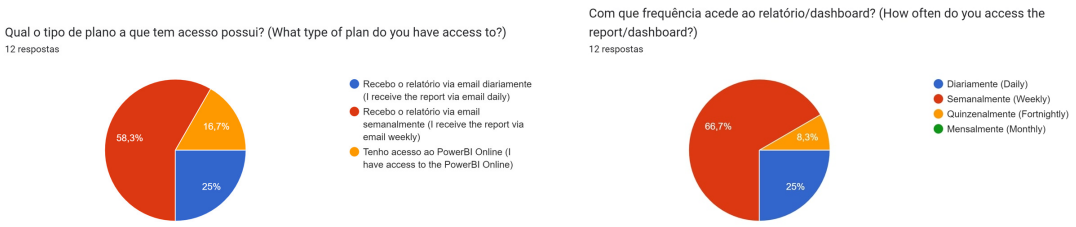


Figure 6.4: User convenience when utilizing the BI tool.

However, when asked about the frequency of use of the BI tool, 66.7% (8 out of 12) reported weekly access, 25% (3 out of 12) reported daily access, and 8.3% (1 out of 12) reported fortnightly access. Comparing the type of user access (figure 6.5), it can be concluded that only 3 of the 5 users, who receive daily updated information, access to it daily. Assuming that 2 of these 3 users are directors, it is assumed that weekly access is utilized by the majority of employees (8 out of 10), allowing us to conclude that weekly access best meets the needs of the CS representatives. This is consistent with the responses to the next question, which indicate that 83.3% (10 out of 12) of users do not feel the need for their information to be updated more frequently.



(a) Type of access the user possesses. **(b)** How often the users access the information.

Figure 6.5: Comparison of user type and frequency of access to reports/dashboards.

Information

Regarding the informational content of the BI tool, the majority of users expressed satisfaction (mean=6, median=6, mode=6). From a more particular standpoint, each page was evaluated separately, and the respective central value measures are displayed in table 6.1. In general, the values indicate that users are satisfied with all pages, and when asked which ones should be improved, the majority (5 out of 12) did not mention any. However, 4 out of 12 users felt that the "Resolution/Active Time" page required improvements, followed by the "Cases Solved", "Orders", and "Brand Request" pages, each of which received 1 vote for improvement. Since there is no more detail about the needed improvements, a meeting with the department would be required in order to specify the needs for each of the highlighted pages.

Table 6.1: Central value measures for each CS dashboard page.

Page	Mean	Median	Mode
Cases Solved	5.83	6.00	6.00
Contracts	5.83	6.00	6.00
Orders	5.67	6.00	6.00
Brand Request	5.83	6.00	6.00
Logistics	5.83	6.00	6.00
Resolution/Active Time	5.75	6.00	6.00

To conclude the discussion, 91.7% of users (11 out of 12) responded positively when asked how secure they felt with regard to the information provided (figure 6.6). This demonstrates that, overall, the entire data extraction and processing process was carried out correctly and that the resulting data is accurate. One respondent, however, indicated that he lacked confidence in the provided information. One possible reason for this may be unrelated to the development of the BI tool. Due to the fact that MSD CRM relies on manual data entry by the user, it is susceptible to errors, including incorrect data entry. These errors, if not properly corrected, will lead to inconsistencies in the information.

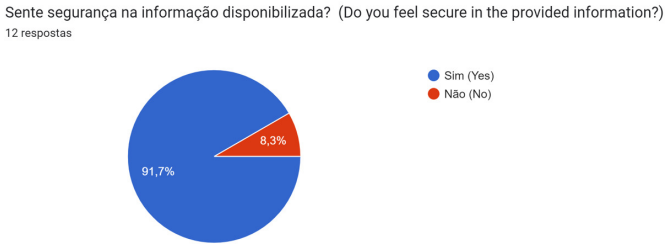


Figure 6.6: Perceived security of the made-available information.

Design

Regarding the design of the report, the majority of responses were positive (mean=6.17; median=6; the mode can't be used a measure of central tendency because there is more than one mode). This result is significant because the attractive appearance of the tool influences its acceptability and can make the user's work enjoyable and intuitive.

Benefits

Regarding the advantages brought about by the implementation of the BI tool, 100% of users reported that the process of searching for and gathering information has become easier. This result, in addition to being excellent, validates one of the most anticipated post-implementation benefits, namely a simplification of information accessibility. 75% (9 out of 12) and 83.3% (10 out of 12) of respondents agreed that the tool contributed to a more independent work method and a better decision-making process, respectively. This leads one to believe that the existence of a centralized information source enables individuals to find information more independently, thereby reducing reliance on third parties and supporting autonomous decision-making. In spite of this, it is natural for there to be negative responses, given that there are processes that require additional validation. Finally, 66.7% (8 out of 12) of users deemed their productivity to have increased. This was the least-agreed-upon of the four questions, yet it was a positive response as well.

Overall, based on the responses of the users, it can be concluded that there have been clear benefits, and that the teams have noticed them despite the short time since implementation.

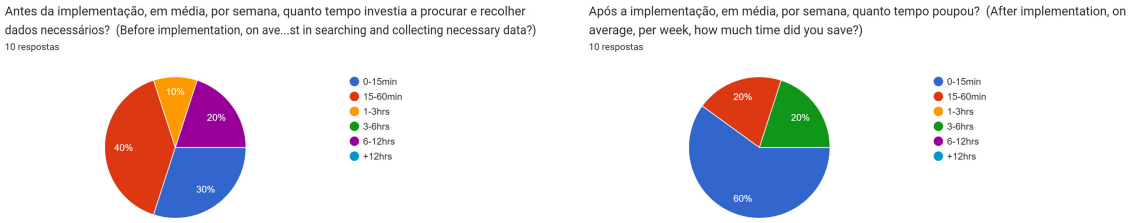
Role

In order to address some specific questions per user type - according to position held and type of information access, keeping in mind that only directors have access to PBI Service and all other CS representatives can only access reports - the questionnaire was divided into two parts. Four questions were developed for each regarding their respective work methods and perceived benefits.

Prior to the implementation of the tool, the directors had three initial assumptions regarding the potential benefits of the PBI: (1) Time in data gathering and preparation; (2) Quality of the information presented; and (3) Ease of access to information. When asked about the parameters in which they believed there had been significant improvements, both

directors pointed to the three stipulated assumptions. From a team management perspective, both respondents assessed the tool's added value in monitoring their team's work; one rated the improvement as 5, while the other rated it as 7. This is a very positive evaluation, but it indicates that there are still aspects that can and should be analyzed and enhanced. Following this, in comparison to previous approaches, an evaluation of the new method of information access was requested, and responses with scores of 6 and 7 were again satisfactory. In terms of enhanced performance regarding the analysis of the data, both directors remarked that they noticed a substantial improvement after implementing the tool.

Turning to the remaining members of the team, the first two questions concerned the weekly time spent organizing and gathering data. Therefore, when asked about the time spent organizing and collecting data before the implementation of the tool (figure 6.7a): 30% of respondents (3 out of 10) reported spending up to 15 minutes per week, 40% (4 out of 10) between 15 minutes and 1 hour, 10% (1 out of 10) between 1 and 3 hours, and 20% (2 out of 10) between 3 and 6 hours. After implementation (figure 6.7b), 60% (6 out of 10) of users claim to have saved up to 15 minutes per week; 20% (2 out of 10) claim to have saved between 15 and 60 minutes; and the remaining 20% claim to have saved between 3 and 6 hours. Overall, users saved a considerable amount of time, which may be enhanced as they become more accustomed to the tool. which shows that the adopted method of information sharing is really intuitive and easy to access. As was the case with the directors, the representatives were also questioned regarding the method used to access information in comparison to previous ones. Again, the responses were quite positive (mean = 6.2, median = 6.5, and mode = 7) indicating that the adopted method of information sharing is truly intuitive and simple to use. In terms of data analysis, the responses were once again overwhelmingly positive, with 90% (9 out of 10) of users stating that their performance had improved.



(a) Time used for searching and collecting data before implementation.

(b) Time saved after implementation.

Figure 6.7: Time spent by CS representatives on data collection.

Overall assessment

The final question of the questionnaire was designed to consolidate the collected opinions and obtain an overall evaluation of the tool implemented (figure 6.8). Generally, the majority of user responses were positive (mean = 6.25, median = 6, mode = 6), indicating substantial user satisfaction.

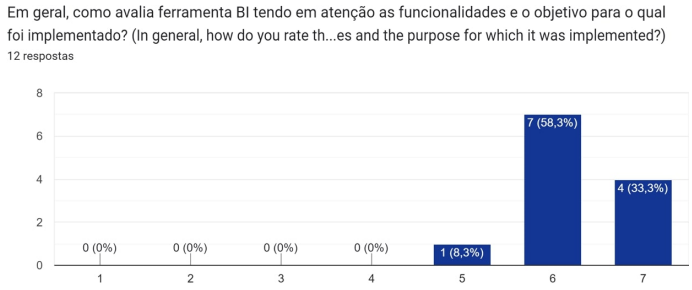


Figure 6.8: Overall assessment.

This result is consistent with the answers to the previous questions and demonstrates that the tool was very well received by the users and that the developed functionalities meet the needs of the users and the project's objective. Nonetheless, it is possible to observe that alongside the majority of positive responses, there is almost always a less favorable response (e.g. figure 6.1, figure 6.4, figure 6.6 and figure 6.8). This discrepancy may be caused by a variety of factors, such as resistance to change that makes it difficult to accept the new tool, lack of experience with PBI (figure 6.1), or the need for additional training. Improvements could be made by putting more effort to involve department members in the implementation of this type of innovation and by investing more in training.

6.2 Sales Department results

Regarding the Sales department's implementation of the BI tool, as previously mentioned, there was insufficient time to train all team members, with the exception of the directors. In order to obtain feedback on the project, it was concluded that the best way to proceed would be to conduct a interview with one of the teams director. The selected interviewee played a crucial role in the development of the project, having been present in all the meetings at the beginning and end of the Sprint, and actively contributed to them with suggestions and improvements. In addition to these factors, this person was the most adequate to provide feedback because, as the director and manager of his team's work, he is among the users who will utilize the tool the most.

Due to the size of the sample, which consisted of only one individual (N=1), it was decided to conduct an interview rather than a questionnaire. Considering that questionnaire data are typically analyzed based on a quantitative study, this type of analysis did not make sense with such a small sample size, so an open-ended interview was analyzed qualitatively. This allowed the interviewee to elaborate on his ideas and opinions, explaining his perspective in greater detail and allowing as much information as possible to be gathered, as opposed to a questionnaire in which the responses are predetermined [76]. In addition, interviews are a common technique for analyzing results in studies concerning the implementation of BI tools. This approach is demonstrated in the article "Effectiveness agile versus waterfall implementation methods in it projects: Analysis based on business intelligence projects" [55],

which presents a case study comparing the effectiveness of BI project implementation using agile versus waterfall methodologies, with the results gathered through interviews. Another example is the study described in the article "Design and evaluation of hospital-based business intelligence system (HBIS): A foundation for design science research methodology" [77], which focuses on the development and implementation of a hospital-based business intelligence system and whose results were again gathered through post-implementation interviews.

6.2.1 Post-implementation interview

The interview with the Sales Director of ATS was created with a focus on the BI tool and comprised seven questions. Initially, a brief explanation of the topics to be addressed throughout the interview was made in order to provide context for the interviewee. Subsequently, it was conducted following 4 points of analysis, namely: (1) the expected benefits to be felt by the team and the companies themselves; (2) the quality and relevance of the information presented in the tool; (3) the design adopted for displaying the information on the dashboard; and finally (4) what future improvements are relevant to be implemented.

Regarding the first topic, which refers to the added value that the BI tool is expected to bring to the team and to the organization in general, three questions were asked. When asked about the benefits that the BI tool could bring to the sales department and, by extension, to Amorim group, the response clearly outlined the reason for the implementation of such projects: "The tool in question is crucial because it collects data from new business management and compares it with the general activity, allowing a steering of the new business development activity in a measurable and factual way". Interpreting the previous response, the interviewee emphasizes the ability to track, review, and correct the entire process of creating new business opportunities from a data-driven perspective. The director was then asked if the tool could contribute to the decision-making process, to which replied promptly: "Obviously. Decisions should always be supported by data and less by emotion, to make the business factually more profitable and efficient". According to the interviewee, these tools enable the decision-making process to be increasingly based not only on the professional's experience but also on concrete data and independent of personal perspectives. Finally, from a team management standpoint, it was questioned to what extent the BI tool can be an asset in monitoring the team's work, as the department director. In response, the interviewee stated that this new approach "helps to establish a routine of critical KPIs for the business, in an objective, very easy (to the day) and intelligible way", implying that it becomes easier to access relevant data not only for the proper functioning of the business, but also for the proper functioning of the team management. In this way, the preceding responses support the benefits that BI tools have for the decision-making process and the proper functioning of teams, which is consistent with what has been advocated throughout this work.

Moving on to the second focus of analysis, related to the quality and relevance of the information accessible from the BI tool, two questions were asked. In the first, when asked about the relevance of the composite model (O2C and MSD CRM) developed, the interviewee stated that although it was "(...) outside the original scope (...) it was a very interesting plus

that the team proposed to us, allowing to have more data on the management of collections and sales in general." As previously stated, the initial objective of the project was to generate useful data for the departments using MSD CRM data. For the Sales department, it was determined during the development of the project that the connection between these two data sources (O2C and MSD CRM) would benefit users by enabling the analysis of transactional data related to sales, from order to payment (O2C), and data related to the entire sales creation process (MSD CRM). In the second question, the metrics developed and presented in the dashboard are evaluated. When asked about the importance of the developed metrics and the information they provide, the director highlighted that "they allow us to extract more indicators for measuring the performance of the activity." Since the developed metrics allowed for the consolidation of data into a single visual element, the analysis is simplified, allowing for more direct and well-founded conclusions to be drawn regarding the "performance of the activity".

The third focus of the analysis was intended to address and evaluate the dashboard's design. When asked about the appearance and organization of the dashboard's elements, the interviewee described them as "very good, fluid, and easy to understand (...)." On the other hand, it was underlined that "(...) initial training is essential". The last part of the response emphasizes a crucial phase in the implementation of this type of tools, as training is essential for a successful consolidation, despite the fact that the dashboard is user-friendly and has been designed with the end-user in mind.

Given the interviewee's familiarity with the tool, the final question inquired about future enhancement suggestions. In general, the proposals aimed to "monitor the results of the analysis (...) and propose adjustments and improvements that make the Sales team management's work more objective and less subjective." Here, the answer relates to two distinct areas of action: the first refers to the process of continuous improvement, keeping in mind that as this is a newly implemented tool, it is crucial that errors are reported and necessary elements are added; the second refers to the need to make the Sales department's work method as objective as possible, basing decisions more and more on facts.

6.3 Results discussion

The final balance is generally quite positive based on the obtained results. The collection of feedback through questionnaires and interviews allowed to realize that the PBI, as an analysis tool, has facilitated the search and collection of information through the centralization of data on a common platform, thereby enhancing decision-making processes. Nonetheless, it is anticipated that users will identify errors to be corrected as well as functionalities to be enhanced, developed, or implemented. In this sense, it is essential to perceive positive feedback as an indication of the best course of action, while never disregarding negative feedback as an opportunity for improvement.

Specifically with regard to management positions, the BI tool can provide greater independence and freedom to explore business information, thereby reducing the department's need for external support. Consequently, directors are able to make more informed decisions, as

they have a clearer picture of the state of the business. Moreover, from a team management perspective, each director has access to a set of tools that enable them to set and track team-wide or individual goals and KPIs.

Among the remaining representatives, the most frequently mentioned advantages were easier and faster information access, as well as enhanced analysis and decision making. Despite the fact that the results for both departments were collected in different ways due to implementation differences, it can be assumed that both departments' representatives will benefit greatly from this tool. Specifically for Sales representatives, it is anticipated that the benefits will be felt even more, as a result of their access to PBI Service's additional features.

The achieved results allow AC-SA and ATS to join the numerous global success stories associated with the implementation of Microsoft PBI. Among these corporations are Bayer, Walmart, and Bimbo [78] [79] [80]. For instance, Walmart Director, Finance Data and Analytics, Micah Dail, stated, "We can't have spreadsheets flowing around the business with different numbers. With Power BI, we have a single-source reporting model that allows associates to drill down into the most relevant details using their preferred method and enables them to manage their part of the Walmart business more effectively" [79]. Meanwhile, Bayer's Vice President of Corporate Controlling, Olaf Lischke, stated that Bayer's Chief Financial Officer was "(...) extremely happy with a one-stop shop that Power BI provided, and the demand of the entire organization is increasing daily for new applications and incorporation of additional data" [78]. Besides these testimonials, there are numerous unmentioned positive feedbacks.

In addition to the preceding examples, a UK-based SME study reveals yet another success story. The results of this study revealed that positions at the top and middle level management positions benefited the most, gaining more autonomy and improved decision-making power [81]. Another study on the implementation of PBI in an Indonesian company, Indomobil, identifies several advantages, including the improvement of the decision-making process and the simplification of information retrieval, and emphasizes the significance of involving users in the process of designing and validating the tool [82].

The examples cited highlight the added value of implementing similar projects, which are consistent with the benefits felt in AC-SA and ATS following the implementation of the PBI.

Chapter 7

Conclusion and Future Work

In this chapter, project reflections and resulting conclusions are presented. In order to develop a successful implementation of the BI project, an overview of pertinent topics is provided. Several limitations experienced throughout the development and implementation of this work are also discussed, along with improvement suggestions.

7.1 Conclusion

The primary objective of this project was to develop and implement a PBI-based centralized data analysis solution for two AC-SGPS companies (AC-SA and ATS) in two departments for each (CS department and Sales department). With this, the companies aimed to automate the process of searching and processing data, providing their collaborators with an intuitive and efficient way to extract the full value of the information owned, in order to improve the decision-making process and autonomy of the departments, support directors monitoring their teams work, and boost productivity. Moreover, it makes perfect sense to implement a tool that enables the centralization of information in departments with direct customer contact. This is because it enables collaborators to be kept more informed about changes in internal data (e.g. quantities sold, number of deals closed, and number of incidents) and specific customer characteristics (e.g. defined SLAs, order size and overdue payments). This enables personalized customer service, enhancing both customer satisfaction and departmental working procedures.

However, the advantages of BI are considerably higher than they initially appear. In addition to measurable and indirectly measurable benefits, it provides other benefits that are difficult to quantify or perhaps unmeasurable, as well as those benefits that are unpredictable and only become apparent after a specific period of BI usage. Nevertheless, given the short period of time and the size of both main parts of the project, it is possible to state that,

according to both qualitative and quantitative results gathered, the overall project was a success.

From a practical standpoint, according to the collaborators in the CS department, the new access to information is clearly superior to the previous method, as it makes information easier to find and contributes to a more independent and productive working method. In addition, the directors viewed the PBI as an asset in terms of monitoring teams, as it provided quality data. Regarding the Sales department, the feedback is also positive, highlighting the importance of implementing such a tool to monitor and correct business creation processes from a factual and quantifiable data-driven perspective, while supporting the decision-making process. In this regard, it is anticipated that the project will contribute to the companies experiencing a reduction in costs resulting from enhanced productivity and quicker decision-making, an increase in revenues and profits as a result of enhanced customer retention and attraction, and increased user satisfaction and motivation. These contributions, taken together, are intrinsically linked to the success of the business strategy and long-term objectives defined in the AC-SGPS multi-departmental DT project.

From a theoretical standpoint, the developed solutions are applicable to nearly every business sector with sales and/or customer service teams. While CRM and ERP software are responsible for collecting important business data, tools such as PBI are responsible for providing a different perspective on data that would be meaningless to the organization if not properly treated and structured. In this manner, the model developed for the CS department adds value to the employee-generated CRM data. In the case of the Sales department, the final objective is identical, but it is not a direct model, i.e., it does not merely involve connecting a database to BI software. This case is relevant for businesses that, like AC, wish to obtain value from multiple data sources and derive the most from each.

7.2 Future Work

Despite the numerous benefits that the PBI brought to the organization, the developed project had some limitations. Due to the limited time assigned for the internship and the resulting need to focus on the main objectives proposed, it was not possible to delve deeper into and resolve each and every problem that arose.

The first limitation to be mentioned is the implementation deadline, which was insufficient to finish the acceptance period in the Sales department. It would be necessary to extend the delivery period in order for the project to be fully completed in both departments. In addition, the time factor associated with the implementation of a completely new tool may have prompted some collaborators, based on the responses to the questionnaires, to exhibit some resistance to change, which may have impacted the tool's acceptance. In order to prevent future occurrences of a similar nature, it is proposed that in future projects of the same type, more users should be involved in the project's early phases, allowing them to feel more a part of its development. In addition, a greater initial contact may result in an early start to understanding how the tool operates, thereby reducing the initial shock to change and enhancing the acceptance process's success.

In turn, the data from MSD CRM may be the source of an additional project limitation. Owing to the fact that the user manually enters data into MSD CRM, the probability of errors is increased, which may lead to errors and redundancy in the information passed to the PBI. To mitigate this limitation, it is proposed to emphasize to users the importance of paying close attention to the data they enter, as well as to develop routines for data review and error prevention.

A final limitation relates to the connection of the PBI to the MSD CRM: since this connection occurs in import mode, the space occupied by the dataset created will continue to grow and, as a result, will reach the space limit specified for a PBI file; moreover, since each update requires the total download of the dataset, these will take longer and longer to complete. Consequently, using AAS, it is recommend the creation of an OLAP cube for MSD CRM data. With the creation of a cube, the problem associated with the creation of an access model would be eliminated, as this solution would make it possible to structure the information, assign accesses based on roles and users, and establish a less space consuming connection to the PBI. Thus, every dataset utilized by PBI would have been previously filtered by the user. To overcome this limitation, it is necessary to import the smallest amount of data possible. For MSD CRM data, it is recommended to create a multidimensional database (OLAP cube) in SSAS. By creating a cube, it would be possible to obtain a variety of benefits, including: developing an intermediate ETL process, which would be very advantageous given the volume and complexity of the data in question; and, given the Amorim's security policy, assigning access based on users and respective roles. Highlighting that this solution has associated costs, its implementation is only feasible when the data complexity justifies it. In this instance, it makes sense to implement a cube; however, due to the limited resources available for this project, the best solution discovered was to import the MSD CRM data. Nevertheless, this solution is still suitable for organizations with smaller data volumes.

References

[1] G. Vial, "Understanding digital transformation: A review and a research agenda," *Managing Digital Transformation*, pp. 13–66, 2021.

[2] C. Fernandez-Rovira, J. A. Valdes, G. Mollevi, and R. Nicolas-Sans, "The digital transformation of business. towards the datafication of the relationship with customers," *Technological Forecasting and Social Change*, vol. 162, p. 120 339, 2021.

[3] D. Curry. "75% of executives don't trust their data." (Feb. 2022), [Online]. Available: `https://www.rtinsights.com/executives-dont-trust-data/` (visited on 07/20/2022).

[4] Amorim. "Missão, visão & valores - corticeira amorim - corticeira amorim, líder mundial setor cortiça." (2022), [Online]. Available: `https://www.amorim.com/pt/corticeira-amorim/missao-visao-valores/`.

[5] ——, "Business units: Cork stoppers." (2022), [Online]. Available: `https://www.amorim.com/en/business/business-units/cork-stoppers/35/` (visited on 10/20/2022).

[6] K. Schwertner, "Digital transformation of business," *Trakia Journal of Science*, vol. 15, pp. 388–393, Suppl.1 2017.

[7] K. Panoho, "The age of analytics and the importance of data quality," *Forbes Agency Council*, 2019.

[8] M. Fruhlinger, *What is business intelligence? transforming data into business insights*, 2019.

[9] D. Arnott and G. Pervan, "Eight key issues for the decision support systems discipline," *Decision Support Systems*, vol. 44, pp. 657–672, 3 Feb. 2008.

[10] S. Chaudhuri, U. Dayal, and V. Narasayya, "An overview of business intelligence technology," *Communications of the ACM*, vol. 54, pp. 88–98, 8 Aug. 2011.

[11] N. Kunnathuvalappil Hariharan, "Data sources for business intelligence," *International Journal of Innovations in Engineering Research and Technology*, vol. 5, no. 11, pp. 75–80, 2018.

[12] B. Evelson. "Topic overview: Business intelligence." (Nov. 2008), [Online]. Available: `https://www.forrester.com/report/topic-overview-business-intelligence/RES39218` (visited on 08/06/2022).

[13] T. Olavsrud, *Decision support systems: Sifting data for better business decisions. cio*, 2020.

[14] H.-c. Chen, R. Chiang, and V. Storey, "Business intelligence research," *MIS Quarterly*, vol. 34, 2010.

[15] R. Skyrius *et al.*, *Business Intelligence*. Springer, 2021.

[16] T. M. Connolly and C. E. Begg, *Database systems: a practical approach to design, implementation and management*. 2015, ISBN: 1292061189.

[17] C. Marnewick and L. Labuschagne, "A conceptual model for enterprise resource planning (erp)," *Information Management and Computer Security*, vol. 13, pp. 144–155, 2 2005.

[18] T. Chandrakumar and S. Parthasarathy, "An approach to estimate the size of erp package using package points," *Computer Standards and Interfaces*, vol. 47, pp. 100–107, 2016.

[19] H.-J. Wei and C.-L. Wei, "Analysis of success factors of introducing sap system for erp implementation in small and midsize enterprises in taiwan," *International Journal of Digital Library Systems*, vol. 2, pp. 1–37, 1 Oct. 2011, ISSN: 1947-9077.

[20] A. Roan. "Sap hana and s/4hana – a simple guide." (202), [Online]. Available: `https://blogs.sap.com/2020/06/04/sap-hana-and-s-4-hana-a-simple-guide/` (visited on 10/24/2022).

[21] F. Buttle. "Customer relationship management: Concepts and tools." (2004).

[22] M. Anshari, M. N. Almunawar, S. A. Lim, and A. Al-Mudimigh, "Customer relationship management and big data enabled: Personalization & customization of services," *Applied Computing and Informatics*, vol. 15, no. 2, pp. 94–101, 2019.

[23] A. Payne and P. Frow, "A strategic framework for customer relationship management," *Journal of marketing*, vol. 69, no. 4, pp. 167–176, 2005.

[24] E. K. Kevork and A. P. Vrechopoulos, "Crm literature: Conceptual and functional insights by keyword analysis," *Marketing Intelligence & Planning*, 2009.

[25] S. Alavi, V. Ahuja, and Y. Medury, "Metcalfe's law and operational, analytical and collaborative crm-using online business communities for co-creation," *Journal of Targeting, Measurement and Analysis for Marketing*, vol. 20, no. 1, pp. 35–45, 2012.

[26] N. Brown and I. Brown, "From digital business strategy to digital transformation-how: A systematic literature review," *Proceedings of the South African Institute of Computer Scientists and Information Technologists 2019*, pp. 1–8, 2019.

[27] M. Xu and J. Walton, "Gaining customer knowledge through analytical crm," *Industrial management & data systems*, 2005.

[28] Microsoft. "What is crm." (Feb. 2019), [Online]. Available: `https://dynamics.microsoft.com/en-us/crm/what-is-crm/` (visited on 07/15/2022).

[29] N. Frank. "Everything you ever wanted to know about dynamics crm." (May 2018), [Online]. Available: `https://www.nigelfrank.com/insights/everything-you-ever-wanted-to-know-about-dynamics-crm` (visited on 07/15/2022).

[30] G. S. Kumar, K. P. Jacob, I. of Electrical, *et al.*, "Improvement of etl through integration of query cache and scripting method," 2016.

[31] IBM. "What is etl (extract, transform, load)." (Apr. 2020), [Online]. Available: `https://www.ibm.com/cloud/learn/etl` (visited on 07/19/2022).

[32] A. A. Center. "Extract, transform, and load (etl)." (2022), [Online]. Available: `https://docs.microsoft.com/en-us/azure/architecture/data-guide/relational-data/etl` (visited on 08/02/2022).

[33] G. S. Reddy, R. Srinivasu, M. P. C. Rao, and S. R. Rikkula, "Data warehousing, data mining, olap and oltp technologies are essential elements to support decision-making process in industries," *International Journal on Computer Science and Engineering*, vol. 2, no. 9, pp. 2865–2873, 2010.

[34] A. Bonifati, F. Cattaneo, S. Ceri, A. Fuggetta, and S. Paraboschi, "Designing data marts for data warehouses," 2001.

[35] A. Leff and J. T. Rayfield, "Integrator: An architecture for an integrated cloud/on-premise data-service," in *2015 IEEE International Conference on Web Services*, 2015, pp. 98–104.

[36] N. Gupta and R. Agrawal, "Chapter four - nosql security," in *A Deep Dive into NoSQL Databases: The Use Cases and Applications*, ser. Advances in Computers, P. Raj and G. C. Deka, Eds., vol. 109, Elsevier, 2018, pp. 101–132.

[37] R. Rai and P. Chettri, "Chapter six - nosql hands on," in *A Deep Dive into NoSQL Databases: The Use Cases and Applications*, ser. Advances in Computers, P. Raj and G. C. Deka, Eds., vol. 109, Elsevier, 2018, pp. 157–277.

[38] L. Yessad and A. Labiod, "Comparative study of data warehouses modeling approaches: Inmon, kimball and data vault," in *2016 International Conference on System Reliability and Science (ICSRS)*, IEEE, 2016, pp. 95–99.

[39] TechTarget. "What is fact table." (2012), [Online]. Available: `https://www.techtarget.com/searchdatamanagement/definition/fact-table` (visited on 07/22/2022).

[40] ——, "What is dimension table." (2012), [Online]. Available: `https://www.techtarget.com/searchdatamanagement/definition/dimension-table` (visited on 07/22/2022).

[41] M. Z. Iqbal, G. Mustafa, N. Sarwar, S. H. Wajid, J. Nasir, and S. Siddque, "A review of star schema and snowflakes schema," in *International Conference on Intelligent Technologies and Applications*, Springer, 2019, pp. 129–140.

[42] Microsoft. "Overview of olap cubes for advanced analytics." (May 2022), [Online]. Available: https://docs.microsoft.com/en-us/system-center/scsm/olap-cubes-overview?view=sc-sm-2022 (visited on 07/20/2022).

[43] IBM. "What is olap." (Jun. 2020), [Online]. Available: https://www.ibm.com/cloud/learn/olap (visited on 09/12/2022).

[44] Galaktiasoft. "What are olap dimensions and measures in bi technology." (Apr. 2018), [Online]. Available: https://galaktika-soft.com/blog/what-are-measures-and-dimensions-in-olap-cube.html (visited on 09/17/2022).

[45] J. Han, J. Pei, and H. Tong, *Data mining: concepts and techniques*. Morgan kaufmann, 2022.

[46] J. Biscobing. "What is olap (online analytical processing)." (Sep. 2020), [Online]. Available: https://www.techtarget.com/searchdatamanagement/definition/OLAP (visited on 09/17/2022).

[47] DataFlair. "Power bi tutorial - a complete guide on introduction to power bi." (Dec. 2021), [Online]. Available: https://data-flair.training/blogs/power-bi-tutorial/ (visited on 07/01/2022).

[48] Microsoft, "Power bi and sap bw," Nov. 2019.

[49] Gartner. "Analytics and business intelligence platforms reviews 2022." (2022), [Online]. Available: https://www.gartner.com/reviews/market/analytics-business-intelligence-platforms (visited on 07/16/2022).

[50] P. B. M. Docs. "What is power bi desktop." (Sep. 2021), [Online]. Available: https://docs.microsoft.com/en-us/power-bi/fundamentals/desktop-what-is-desktop.

[51] J. A. Y. "Power bi dashboard vs report: Top 10 differences & comparison." (Nov. 2019), [Online]. Available: https://www.wallstreetmojo.com/power-bi-dashboard-vs-report/.

[52] K. Beck, M. Beedle, A. Van Bennekum, *et al.*, "Manifesto for agile software development," 2001.

[53] D. Rigby, J. Sutherland, and H. Takeuchi. "Embracing agile." (2016), [Online]. Available: https://hbr.org/2016/05/embracing-agile (visited on 09/26/2022).

[54] D. Rigby, J. Sutherland, and A. Noble, "Agile at scale how to go from a few teams to hundreds," 2018.

[55] J. Kisielnicki and A. M. Misiak, "Effectiveness agile compared to waterfall implementation methods in it projects: Analysis based on business intelligence projects," *Foundations of Management*, vol. 9, pp. 273–286, 1 2017.

[56] F. Tessarolo, D. Petsani, V. Conotter, *et al.*, "Developing ambient assisted living technologies exploiting potential of user-centred co-creation and agile methodology: The captain project experience," *Journal of Ambient Intelligence and Humanized Computing*, pp. 1–16, 2022.

[57] M. Hron and N. Obwegeser, "Why and how is scrum being adapted in practice: A systematic review," *Journal of Systems and Software*, vol. 183, p. 111 110, 2022.

[58] L. Gonçalves, "Scrum," *Controlling & Management Review*, vol. 62, no. 4, pp. 40–42, 2018.

[59] M. M. Jha, R. M. F. Vilardell, and J. Narayan, "Scaling agile scrum software development: Providing agility and quality to platform development by reducing time to market," in *2016 IEEE 11th International Conference on Global Software Engineering (ICGSE)*, 2016, pp. 84–88.

[60] Microsoft. "What is erp and why do you need it?" (2022), [Online]. Available: https://dynamics.microsoft.com/en-us/erp/what-is-erp/.

[61] ——, "Overview of service manger olap cubes for advanced analytics." (2022), [Online]. Available: https://docs.microsoft.com/pt-pt/system-center/scsm/olap-cubes-overview?view=sc-sm-1807.

[62] C. Stedman. "What is business intelligence." (2022), [Online]. Available: https://www.techtarget.com/searchbusinessanalytics/definition/business-intelligence-BI.

[63] C. A. Simmers, "A stakeholder model of business intelligence," *Proceedings of the Hawaii International Conference on System Sciences*, vol. 37, pp. 3509–3517, 2004.

[64] P. Garrehy, "Integrate erp and crm for manufacturing: Smart manufacturing firms bring together technology, business processes and people; a critical component in this plan is the integration of erp with crm.," *Plant Engineering*, vol. 75, no. 8, pp. 30–32, 2021.

[65] C. Banton. "Free on board (fob)." (Nov. 2003), [Online]. Available: https://www.investopedia.com/terms/f/fob.asp (visited on 08/19/2022).

[66] Oracle. "Multidimensional warehouse (mdw)." (2013), [Online]. Available: https://docs.oracle.com/cd/E41507_01/epm91pbr3/eng/epm/penw/concept_MultidimensionalWarehouseMDW-9912e0.html (visited on 07/20/2022).

[67] L. Rosencrance, S. Louissaint, and K. Brush. "What is a service-level agreement (sla)." (Jan. 2021), [Online]. Available: https://www.techtarget.com/searchitchannel/definition/service-level-agreement (visited on 08/18/2022).

[68] A. Harrison. "Powerbi robots a microsoft power bi tool." (Nov. 2021), [Online]. Available: https://www.digitalmarketingcommunity.com/tools/powerbi-robots/ (visited on 06/16/2022).

[69] Microsoft. "Append queries - power query." (2020), [Online]. Available: https://docs.microsoft.com/en-us/power-query/append-queries (visited on 07/16/2022).

[70] ——, "Merge queries overview - power query." (2020), [Online]. Available: https://docs.microsoft.com/en-us/power-query/merge-queries-overview (visited on 08/29/2022).

[71] G. Kfouri and R. Skyrius, "Factors influencing the implementation of business intelligence among small and medium enterprises in lebanon," *Informacijos mokslai*, vol. 76, pp. 96–110, 2016.

[72] M. Lateef and P. Keikhosrokiani, "Predicting critical success factors of business intelligence implementation for improving smes' performances: A case study of lagos state, nigeria," *Journal of the Knowledge Economy*, 2022.

[73] I. E. Allen and C. A. Seaman, "Likert scales and data analyses," *Quality progress*, vol. 40, no. 7, pp. 64–65, 2007.

[74] A. Joshi, S. Kale, S. Chandel, and D. Pal, "Likert scale: Explored and explained," *British Journal of Applied Science & Technology*, vol. 7, pp. 396–403, 2015.

[75] S. Manikandan, "Measures of central tendency: Median and mode," *Journal of pharmacology and pharmacotherapeutics*, vol. 2, no. 3, p. 214, 2011.

[76] L. R. Harris and G. T. L. Brown, "Mixing interview and questionnaire methods: Practical problems in aligning data," *Practical Assessment, Research, and Evaluation*, vol. 15, 2010.

[77] H. Y. Kao, M. C. Yu, M. Masud, W. H. Wu, L. J. Chen, and Y. C. J. Wu, "Design and evaluation of hospital-based business intelligence system (hbis): A foundation for design science research methodology," *Computers in Human Behavior*, vol. 62, pp. 495–505, 2016.

[78] Microsoft. "Bayer creates cfo app for one-stop shop by steering relevant data using power bi." (Aug. 2021), [Online]. Available: https://customers.microsoft.com/en-us/story/1404533828014895899-bayer-creates-cfo-app-for-one-stop-shop-by-steering-relevant-data-using-power-bi (visited on 09/25/2022).

[79] ——, "Walmart finance standardizes on power bi for reporting and analytics." (Oct. 2022), [Online]. Available: https://customers.microsoft.com/en-us/story/1557385809666881648-walmart-retailer-power-bi (visited on 09/25/2022).

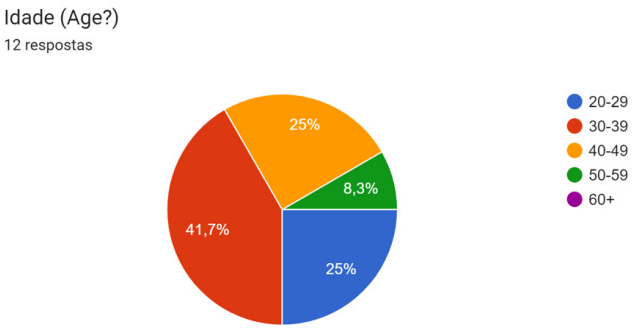
[80] ——, "Grupo bimbo transforms the data analysis of commercial areas with microsoft solutions." (Oct. 2022), [Online]. Available: https://customers.microsoft.com/en-us/story/1556452600911773508-grupo-bimbo-consumer-goods-azure-en-mexico (visited on 09/25/2022).

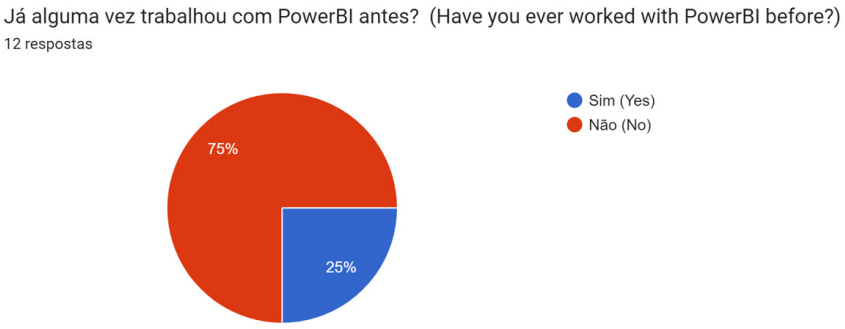
[81] R. Raj, S. H. Wong, and A. J. Beaumont, "Business intelligence solution for an sme: A case study.," 2016.

[82] S. Widjaja and T. Mauritsius, "The development of performance dashboard visualization with power bi as platform," *International Journal of Mechanical Engineering and Technology*, pp. 235–249, 2019.

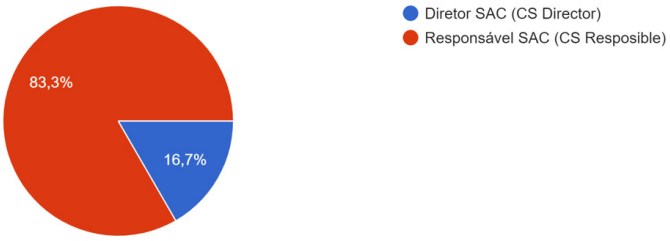
Appendix A

A.1 Contextualization

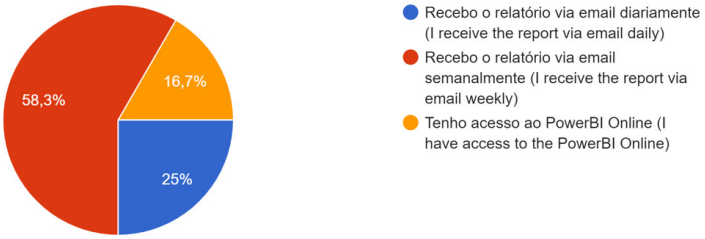




Que tipo de utilizador é? (What kind of user are you?)
12 respostas

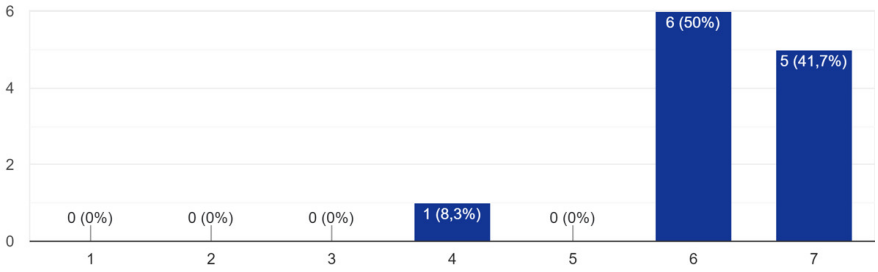


Qual o tipo de plano a que tem acesso possui? (What type of plan do you have access to?)
12 respostas



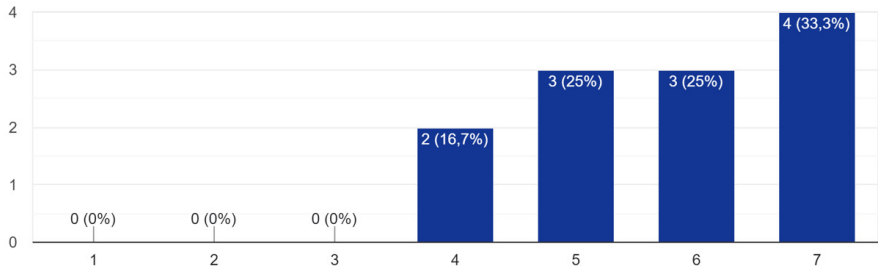
A.2 Integration

Como classifica o novo acesso à informação em comparação com os métodos usados anteriormente? (How do you rate the new access ...ormation compared to the methods used before?)
12 respostas



Como classifica a integração da ferramenta de BI no contexto onde se encontra? (How do you rate the BI tool's integration in the context where you find yourself?)

12 respostas



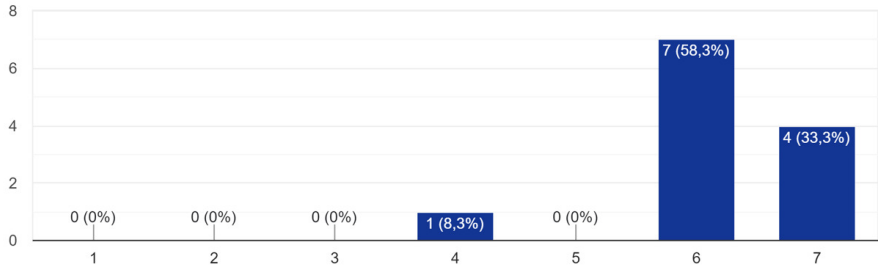
Na sua opinião, de que forma a integração poderia ser melhorada?
(In your opinion, how could the integration be improved?)

4 respostas

- Aceitaacao da ferramenta por parte das pessoas. Resistência a mudança
- Satisfeito com o formato actual
- Penso que a integração foi bem feita
- NA

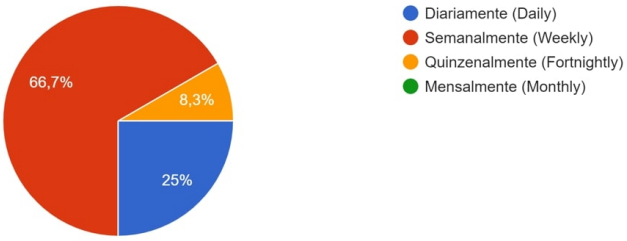
Numa escala de 0 a 7, quão confortável se sente a aceder à informação a partir do relatório? (On a scale of 0 to 7, how comfortable do you feel accessing information from the report?)

12 respostas



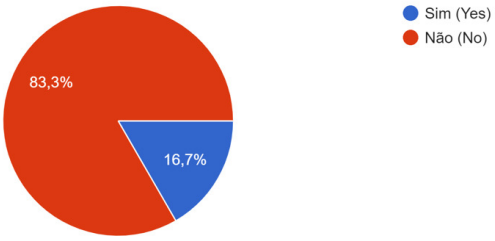
Com que frequência acede ao relatório/dashboard? (How often do you access the report/dashboard?)

12 respostas



Sente necessidade que a informação a que tem acesso seja atualizada mais regularmente? (Do you feel the information you have access to needs to be updated more regularly?)

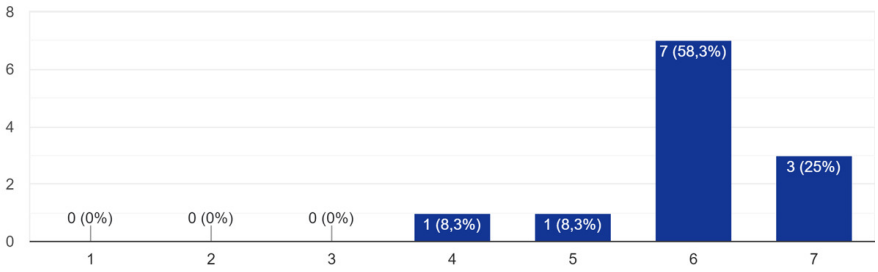
12 respostas



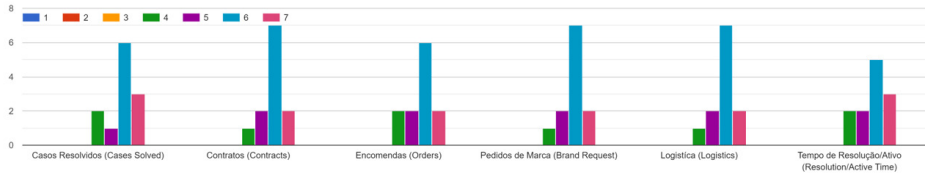
A.3 Information

Quão satisfeito está com a informação apresentada no novo relatório? (How satisfied are you with the information presented in the new report?)

12 respostas

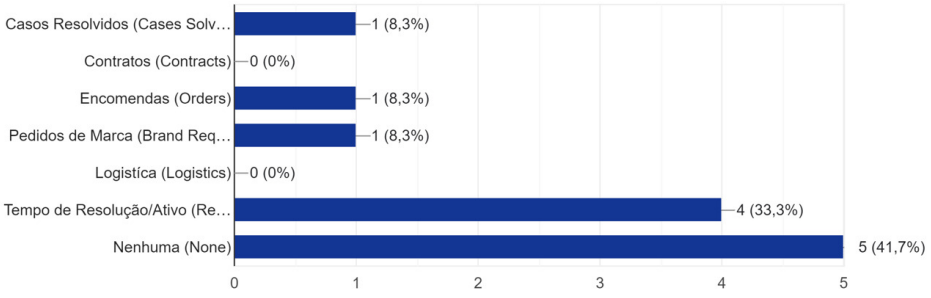


Numa escala de 0 a 7, como classificaria cada uma das secções do relatório? (On a scale of 0 to 7, how would you rate each section of the report?)



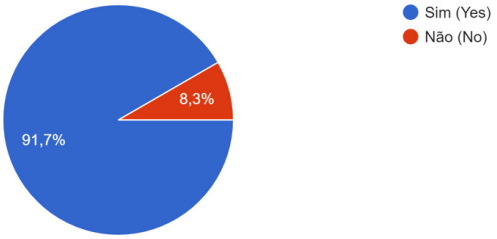
Na sua opinião, que páginas deveriam ser melhoradas? (In your opinion, which pages should be improved?)

12 respostas



Sente segurança na informação disponibilizada? (Do you feel secure in the provided information?)

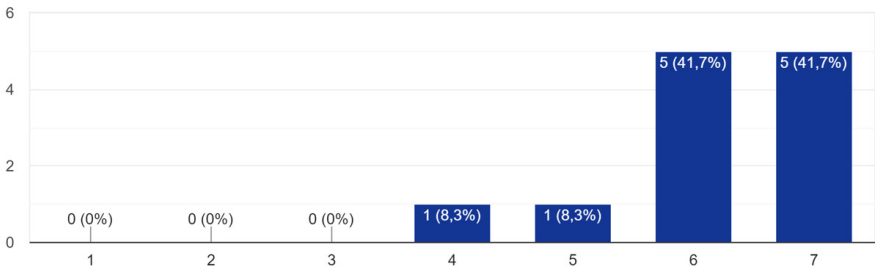
12 respostas



A.4 Design

Como classifica a apresentação da informação no relatório? (How do you rate the presentation of the information in the report?)

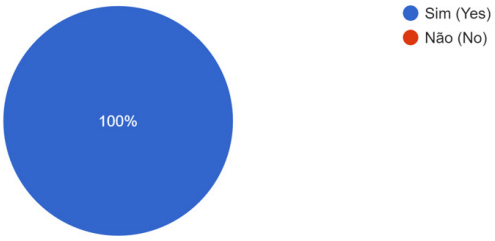
12 respostas



A.5 Benefits

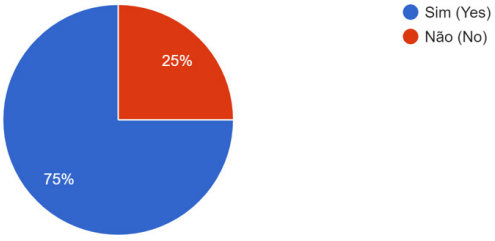
Sente que se tornou mais fácil de encontrar informação? (Do you feel it has become easier to find information?)

12 respostas



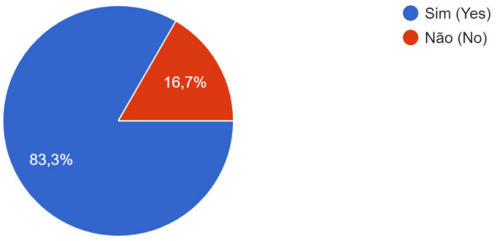
Acha que o relatório permite que trabalhe de forma mais independente? (Do you think the report allows you to work more independently?)

12 respostas



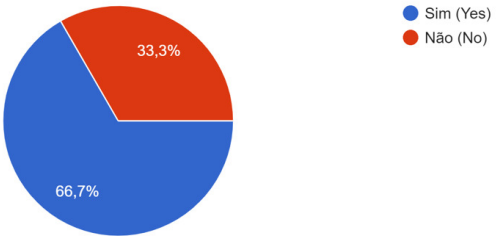
Considera que o seu processo de tomada de decisão melhorou? (Do you consider that your decision making process has improved?)

12 respostas



No geral, sente que melhorou a sua produtividade? (Overall, do you feel that your productivity has improved?)

12 respostas



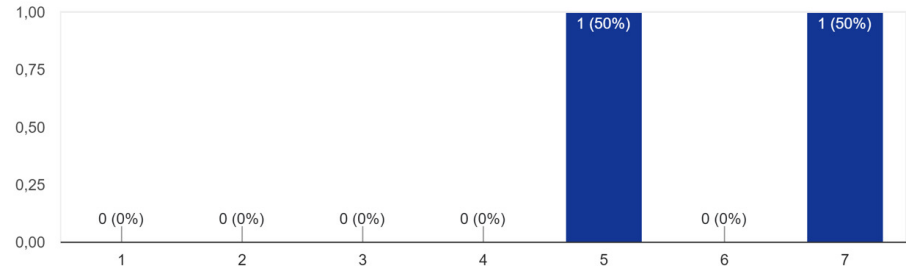
A.6 Role: CS Director

Em quais dos parâmetros apresentados sente que houve melhorias significativas? (In which of the parameters presented do you feel there were significant improvements?)

2 respostas

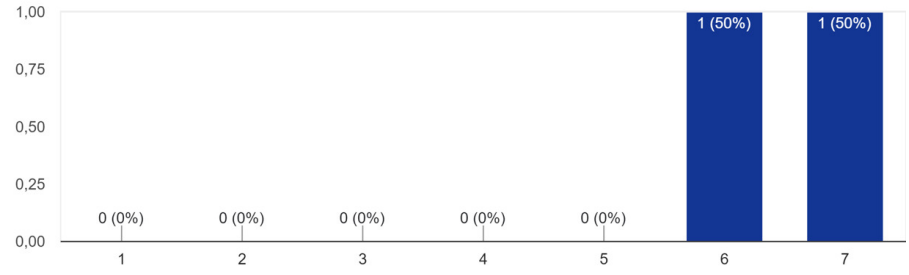
Em que medida é que a ferramenta o/a tem ajudado a monitorar o trabalho da sua equipa? (To what extent has the report helped you to monitor your team's work?)

2 respostas



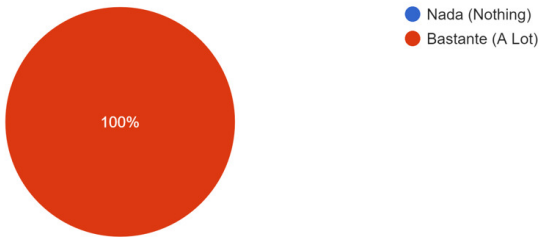
De que forma avalia, em termos de acessibilidade, o novo relatório em comparação à antiga abordagem? (How do you rate, in terms of access, the new report compared to the old approach?)

2 respostas



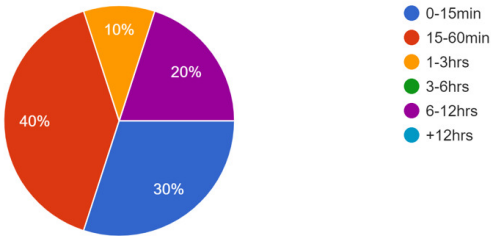
Em termos de análise sobre os dados, quão acha que a sua performance melhorou? (In terms of data analysis, how much do you think your performance improved?)

2 respostas

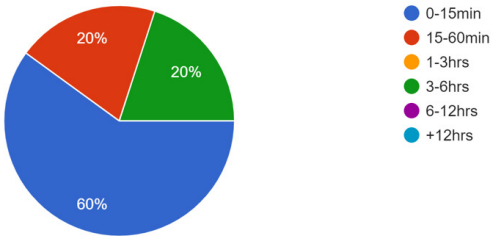


A.7 Role: CS Responsible

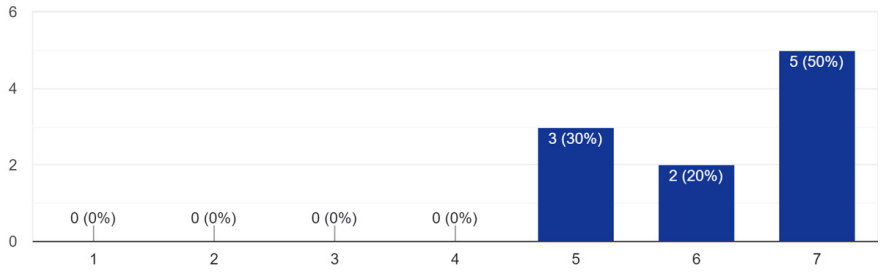
Antes da implementação, em média, por semana, quanto tempo investia a procurar e recolher dados necessários? (Before implementation, on ave...st in searching and collecting necessary data?)
10 respostas



Após a implementação, em média, por semana, quanto tempo poupou? (After implementation, on average, per week, how much time did you save?)
10 respostas

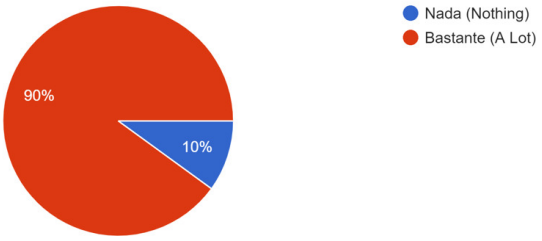


De que forma avalia, em termos de acessibilidade, o novo relatório em comparação à antiga abordagem? (How do you rate, in terms of access, the new report compared to the old approach?)
10 respostas



Em termos de análise sobre os dados, quão acha que a sua performance melhorou? (In terms of data analysis, how much do you think your performance improved?)

10 respostas



A.8 Overall Evaluation

Em geral, como avalia ferramenta BI tendo em atenção as funcionalidades e o objetivo para o qual foi implementado? (In general, how do you rate th...es and the purpose for which it was implemented?)

12 respostas