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BRING DIFFERENTIATED ANALYTICAL CAPABILITIES TO ACCOUNTING COMPANIES THROUGH BI

Duarte Cordeiro Mendes

Project Work

presented as partial requirement for obtaining the Master Degree Program in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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BRINGING DIFFERENTIATED ANALYTICAL CAPABILITIES TO ACCOUNTING COMPANIES THROUGH BI

By

Duarte Cordeiro Mendes

Project Work presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Knowledge Management and Business Intelligence

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July 2023

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Duarte Cordeiro Mendes

Lisbon, 15th July 2023

ACKNOWLEDGEMENTS

This Project Work marks the end of another significant stage of my life, full of new learning, challenges and personal and academic achievements.

I am writing to express my sincere gratitude to all the professors who, class after class, contributed to developing my knowledge. Their dedication and guidance were fundamental to my academic growth.

I would like to highlight my deep appreciation to my supervisor, Professor Vitor Santos, for all the support provided in this academic phase and his contribution to deepening my knowledge in the Business Intelligence area. His experienced and valuable guidance was essential for the success of this work.

I must express special gratitude to the entire team at MTConsulting, who generously supported me and helped me with technical issues along the way. In particular, I thank them for welcoming this project's development and agreeing to participate in this study.

Finally, I want to express my deepest gratitude to my family and friends, whose unconditional support and help were paramount throughout this journey. Your presence was a constant encouragement and a valuable support when needed. As so, to all those mentioned and those who in some way contributed to the realization of this work, my most sincere thanks. The success achieved would not have been possible without the collaboration and support of each one of you.

ABSTRACT

The accounting and financial analysis sector is a market that has been changing at a rapid pace over the years, very characterized by technological developments, as well as intense competition.

Companies in this sector have been investing more and more in new technological equipment so that there can be more efficiency in their work routines, leading to an increase in the resources available in the company.

On the other hand, the encounter awakening of an era with massive amounts of data, in which it is increasingly necessary for the information to be available on time, with a growing appreciation of predictive methods and the robotization of accounting processes. Consequently, we face a scenario that demands a paradigm shift within the accounting sector.

Therefore, the main objective of this project is to build a model that permits to provide accounting information to managers quickly and allows easy interpretation of data, thus helping in decision-making.

This project will be the target of a case study of a small company that operates in the sector. The company MTConsulting agreed to provide one of its databases in order to implement a demonstration of the conceptual model.

KEYWORDS

Business Intelligence; Accounting; Analytical accounting; Financial analysis; Dashboards; Decision making

Sustainable Development Goals (SGD):

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LIST OF ABBREVIATIONS AND ACRONYMS

AMT	Advanced Manufacturing Technologies
BAM	Business Activity Monitoring
BI	Business Intelligence
BI&A	Business Intelligence and Analytics
BPM	Business Performance Management
CEO	Chief Executive Officer
CRM	Customer Relationship Management
DB	Database
DSR	Design Science Research
DSRM	Design Science Research Model
DSS	Decision Support System
DW	Data Warehouse
EBIT	Earnings Before Interest and Taxes
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortization
EDW	Enterprise Data Warehouse
ERP	Enterprise Resource Planning
ETL	Extract, Transform, Load
IAS	International Accounting Standards
IFRS	International Financial Reporting Standards
IRC	Corporate Income Tax, Imposto sobre o Rendimento das Pessoas Coletivas
IT	Information technology
KMS	Knowledge Management Systems
KPI	Key Performance Indicators
NIF	Número de Identificação Fiscal
ODS	Operational Data Store
OLAP	Online Analytical Processing
OLTP	Online Transaction Processing
PLM	Product Lifecycle Management
SCM	Supply Chain Management
SNC	Consulte, Sistema de Normalização Contabilistica
SSIS	SQL Server Integration Services Projects
SSMS	SQL Server Management Studio
VAT	Value-Added Tax

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

Now more than ever, with the exponential growth of the development of technologies, accounting services received new tools in terms of Information Technology, Artificial Intelligence, Business Intelligence (BI), and Machine Learning that will help the branch (Pepe & direnpramodacumar, 2011). Accounting Managers with these new instruments must deliver the organisation's results quickly and clearly, to provide the business managers with the best outputs (Al-Zubi et al., 2014).

The globalization markets and the development of multinational corporations were fruits of digital progression. This progress allowed the connection of markets, enabling companies to enter the markets of several countries. Globalization and technological development led to more data circulating, data about sales, purchases, stocking, salaries, human resources, marketing, market position, competition status, and more. It used to be in paper format, but now it is in digital format, making it easier to store, access, and use, and it is less dispersed and less suppressed (Anderson et al., 2021).

With all this data in circulation, companies increasingly want to transform it, in order to extract useful and timely information to develop their business. Therefore, companies are entering a new era - the era of real-time enterprises - where managers aspire to receive information about the state of their company in real-time, to have a more perceptible decision process (Vasarhelyi & Alles, 2008).

Accountants possess the majority of data pertaining to the company's status as they are responsible for processing the financial documentation, supervising the company's accounts, and being the link between the company and the government (Freitas, 2009).

Manager Accountants aim to provide the information necessary for top managers to make economic decisions, which can be for internal or external purposes. Their tasks include mediating, identifying, posting, and communicating the company's financial information to the manager in a given period and reporting on the company's tax obligations. Therefore, accountants must deliver to their clients the most updated information possible in a concise and easy-to-read way so that the right decisions can be taken (Trigo et al., 2014).

With the development of technology, new ways of supporting accounting have been developed, especially relating to how financial documentation is recorded. The evolution of machine learning has had a big impact on this topic, as it has brought about the memorization of processes. This process made accountants have to get used to new tools, such as Enterprise Resource Planning (ERP) (Chu & Yong, 2021). Not only the way data is processed has evolved, but data visualization software has also had its development and popularity, helping users to draw better insights and have better conclusions from large datasets.

Even so, the most widely used tool for accountants is ERP, which is based on automated and integrated accounting processes. ERPs have impacted how accountants work by reducing transaction times, improving budgeting, performance measurement, forecasting and cost reduction (Wickramaarachchi & Jayasiri, 2015).

However, even with the implementation of ERP, the distribution of financial status reports has not changed. Spreadsheets are still a prevalent way for these professionals to present their results and develop their analyses (Elder, 2021). An outdated mechanism since it cannot support large volumes of data. The way accounting managers deliver the information to company managers, stakeholders, potential investors, and creditors is very archaic, with many values that make the data imperceptible to the naked eye (Trigo et al., 2014). The information is general in Trial Balances, Income Statements and Balance Sheets. Therefore, these physiognomies of presentation of the results to the clients are too complex for reading and interpretation, making managers waste much time trying to understand the data presented (Granlund & Malmi, 2002). Further to this fact, it is still unclear, in practice, how BI tools can be used in accounting firms for giving an accurate report, so this project aims to change how results are illustrated. In order to achieve this reality, the guiding research question of this project is: “How can we make the consumption of accounting data enjoyable and easier to make decisions?”.

1.2. OBJECTIVES

This project aims to create a BI model that can add differentiated analytical capabilities to accounting companies to improve their clients' decision-making.

In order to accomplish this objective, the following interim goals have been established:

- Research and literature analyses regarding the application of BI practices in management accounting;
- Identification of the information about the link between accounting and BI tools;
- Identification of all the tools that there are in the processes of the accounting field;
- Propose a BI model that suits accounting firms;
- Define a BI model that determines the concept;
- Validate the relevance, efficiency and effectiveness of the model.

1.3. IMPORTANCE AND RELEVANCE

The shift of companies to a more real-time economy means that accountants have to think of new ways to deliver results. In addition, the development of ERP has meant that accountants are less involved in the transaction process (Nawawi et al., 2020), which reduces the need for more professionals.

With these factors in mind, accountant enterprises must change their position in the market, a tool that helps accountant professionals to provide a more reliable analysis of accounting data and enables better visualization of the results will contribute to a change in the job description, making them more connected to support decision making (Tamandeh, 2016).

This tool will enable a paradigm shift in the accounting field, as accountant managers will no longer be seen as "bean counters" but as "business analytics". This BI model will allow a detailed analysis of accounting data and require accountants to develop new skills, such as analytical skills, IT skills and decision-making (H. Chen et al., 2012; Gartner et al., 2013). One of the intentions of this study is to expand the area of accounting to more of a top management consulting area, with managers accountants being partners in decision-making and focusing on providing insights about the business and new opportunities to the CEOs.

The empowerment of companies with a powerful instrument that transforms accounting information into a more straightforward form, clear reading for both top and middle managers and easy manipulation will facilitate the identification of performance gaps, implementation processes and future opportunities.

BI influences and improves the speed with which an end-user can access data and convert it into understanding or insight, improving the timing of decisions and making it more likely to have success.

The purpose of implementing such a powerful tool is to provide assistance in:

- the budgeting processes, being faster and well-structured (Nespeca & Chiucchi, 2018);
- allowing accounting managers to have less wasted time and reducing the operating costs (PAUL-SOUMIS, 2022);
- having real-time quality reports, that enable the creation of alerts of some risks that can happen in the future, identify opportunities, develop new strategies on the operational level and supervise the organization (Elder, 2021).

In the accounting market, if there is a company that has a tool with the advantages expressed above, besides providing a new service to its clients and increasing revenue, will get more added value to the organization by providing a differentiated service from the competition, allowing it to stay in the market for a few more years (Rom & Rohde, 2007).

Finally, it is assumed that developing this project will help accounting companies improve the services they deliver to their clients, giving them better forecasts and information. As accounting plays a crucial role in making organizational decisions more informed, implementation of a reliable BI tool that accurately forecasts will drive the company's development, managers will receive earlier insights about the business needs and understand which is the best path to choose.

At a scientific level, this tool will make possible the shift of the existing paradigm, making accounting no longer be seen as a “bean-counter” to a dynamic and strategic business analysis approach. So, this change could give creativity to the community to develop other tools or even a new structure to be made in the accounting field, being a door for future developments in the area.

2. METHODOLOGY

The Design Science Research (DSR) methodology, based on the studies of March & Smith (March & Smith, 1995), is the most suitable method when the study output is an artefact. In order to create a BI model that can add differentiated analytical capabilities to accounting, companies should build an Artefact since it is an object developed to solve a concrete problem of the contemporary world (Weigand et al., 2021).

2.1. DESIGN SCIENCE RESEARCH (DSR)

Design Science Research (DSR) is used to improve human knowledge by constructing innovative artefacts and producing design knowledge to develop innovative solutions to real-world problems. DSR aims to design new artefacts represented by constructs, instances, models and methods to extend the boundaries of human and organizational faculties (vom Brocke et al., 2020).

This study's development will be based on the model proposed by Peffers, Tuuanen, Rothernberg & Chatterjee. This methodology is shown in the Figure 2.1 and follows the DSR process with six steps: Identification of Problem and Motivation; Defining the objectives for the solution; Design and Development; Demonstration; Evaluation; and finally, communication (Peffers et al., 2007).

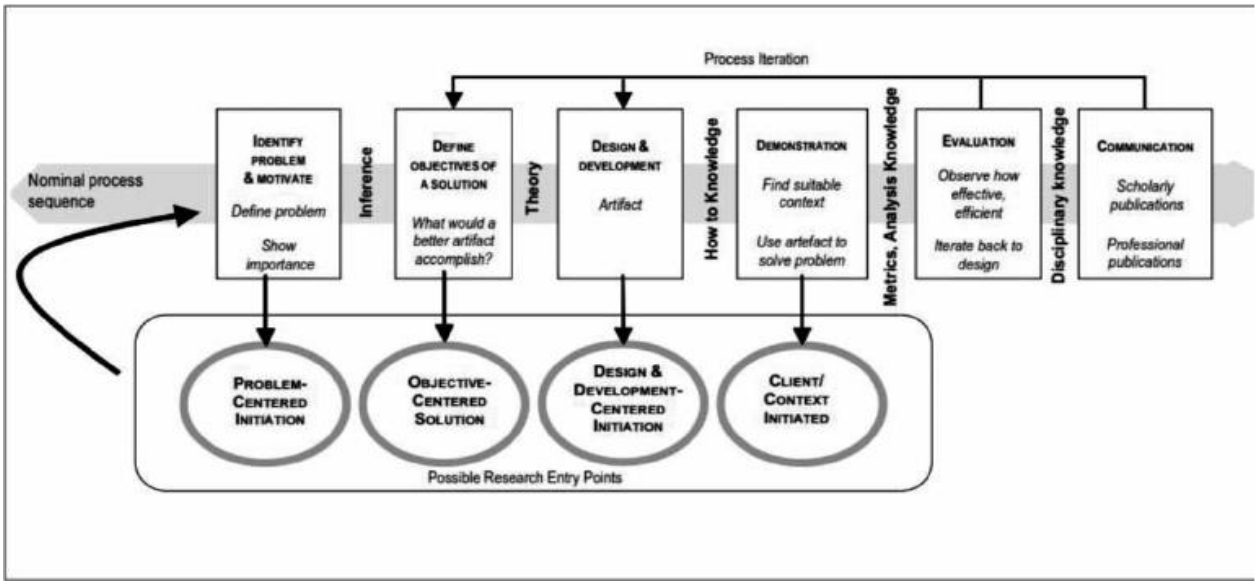

Figure 2.1 - DSRM model (Peffers et al., 2007)

The first stage, “Problem Identification and Motivation”, define the research problem and why it is essential to find a solution for the problem. The second stage is, “Define the Objectives” for a solution. Here the objective is to identify the necessary goals to develop the solution.

The following step is where the artefact is created, including establishing its intended functionality and architecture and then making the artefact. The fourth step is when the artefact is applied to an experiment and is demonstrated its application in solving the problem. The “Evaluation” stage measures the utility of the artefact in solving the research problem. Finally, communication is where all aspects of the problem and the designed artefact are communicated to the relevant stakeholders.

2.2. RESEARCH STRATEGY

To achieve this study's goal, six guidelines will be followed considering the methodology explained before. The first step is the presentation of current facts on the topic and identifying the research problem. The second step is defining the necessary objectives to find the best solution for the research problem.

The third stage “Design and Developing” the artefact, and this stage is divided into two sub-steps. Firstly, it will be carried out the literature review, where it will be identified the theoretical basis for this project. The literature review will cover the principal instrument managers accountants use, Enterprise Resource Planning. It will identify the principal benefits of connecting an ERP to a Power BI solution. Secondly, develop the Metrics and KPIs needed for Company Finances, considering the obligations in the Portuguese State, but will still be developed at the level of company evaluation, financial planning, financial investments and acceptance of credits. This will allow us to have an in-depth analysis of the data acquired from accounting.

Once the Model is created, it is crucial to demonstrate and test the artefact created in a business case to observe the usefulness and effectiveness of the model. Although the testing phase was on the previous step, the fifth is adequately evaluated. The consequences of the last two steps will clarify what conclusions can be drawn, making it possible to understand the model's potential limitations and what can be improved.

The final stage of DSR is to Communicate. Communication will be carried out through scholarship publications, journals, and DSR repositories. The DSR will include the identification of the problem and the proposed artefact as a solution, stating its importance, originality, efficiency, and contribution to the scientific research community, business, and society.

3. LITERATURE REVIEW

This chapter provides a comprehensive overview of the main topic to be developed in this project. Starting with the accounting field, including its background and context, mission, the role of analytical accounting, and adherence to international financial report standards.

Subsequently, the subject of Business Intelligence is addressed, presenting a technical perspective on the matter. This is followed by an examination of Data Warehouses, providing an explanation of the ETL process, and concluding with the utilization of Business Intelligence in the field of Accounting.

The final aspect covered in this chapter pertains to Financial Analysis, giving an overview of its usefulness for companies and an explanation of the various ratios that can be analyzed.

3.1. ACCOUNTING

Accounting has a key role in recording, categorizing, and summarizing financial transactions to provide relevant information for business decisions, it includes analyzing, verifying, and presenting financial data to internal and external stakeholders. It is a fundamental component in any organization as it provides a systematic record of financial activities, supports decision-making, and ensures compliance with applicable laws and regulations. With technological evolution, accounting has become more automated and efficient. However, the principles and concepts remain unchanged, making it a critical and dynamic area in finance and business.

3.1.1. Background & Contexts

Accounting emerged when men realized the need to classify and register his goods in a way that would allow him to easily remember the successive variations of certain magnitudes around 2000 years before Christ (Buriola & Lopes, 2019). Although accounting has existed since ancient times, the first accounting theories emerged in the 15th century through the work of Luca Bartolomeo de Pacioli, known as the father of Accounting. He did not create the current accounting system but rather documented the methods employed by merchants in Venice in accounting records, receivables, inventories, liabilities, capital, income, expenses and even suggested the utilization of a balance sheet as evidence of the information contained in the accounting records (Smith, 2018).

Luca Pacioli viewed accounting in his time as a static discipline. Its purpose was to record the financial transactions of small businesses during that era, and he saw its significance in shaping business planning and control. Hence, accounting had a societal impact and functioned as a social science with implications for people's daily lives. (Littleton, 1933).

3.1.2. Mission & Deliveries

In the middle of the 20th century, the AICPA (American Institute of Certified Public Accountants) established accounting as being *"… the act of recording, classifying and summarizing in an organized way and in terms of monetary units, the transactions and events that are, at least at least in part, of a financial nature in a way that perfumes its subsequent interpretation*". This definition of accounting was changed around the 1970s as the interest whose role is to provide numerical information, mainly of a financial nature, on entities of an economic nature, considered useful for making economic decisions. For this reason, one of the first identifications of accounting took place in the USA, not only as a mere activity of registering numbers but also with more complex functions and of providing systematized information to support decision-making (Borges et al., 2010).

Professor F. V. Gonçalves da Silva sees Accounting also as a "*System for collecting, classifying, interpreting and displaying economic data*", which has been seeking to accompany the evolution of society over the centuries, more specifically in the satisfaction of information of a financial, determined by the robustness of corporate business (Caiado et al., 2015).

Accounting is an information system that reports financial records and identifies and shares economic occurrences within an organization with those who require it (Weygandt et al., 2004).

This science is significant for corporate leaders as it decreases the unpredictability surrounding a company's financial status and performance, offering assistance in decision-making that could impact society. It also enables external investors to assess the success or potential downfall of a company they are considering investing in, allowing them to gauge its trustworthiness and legitimacy. Accounting is linked to several areas of activity, such as finance, economics, sociology, religion and marketing (Rajat, 2019).

Notably, within the realm of Accounting, there are two major branches: Financial/General Accounting, where transactions are recorded, and financial reports are generated for external use through financial statements. The other branch is Analytical/Management Accounting, which focuses on the cost of goods sold and services provided and monitoring outcomes (businesses, markets and others).

3.1.3. The role of Analytical Accounting

With the increase of companies and their complexity, it was no longer just shareholders who were interested in company information but also external investors and public-private entities, among other subjects. Parallel to this tendency began to appear in the 20th century new cost accounting concepts another name for Analytical Accounting. One of the pioneers was the French Accounting plan - which was based on the Schamlenbach plan - published in 1927 that stated that the respective accounts should organize accounting and add the cost centres.

The French accounting plan considers Analytical Accounting as a system whose objective is to analyze operating charges and determine costs and sales prices (Fortin, 1991).

The development of analytical techniques helped managers to assess the performance of ongoing operations and make plans for future operations. The arrival of computers brought new tools, such as computerized budgeting and electronic spreadsheet models, which made it easy to process large amounts of data and easily access information (Mattessich, 2006). Thus, all the crucial components were assembled for Analytical Accounting to flourish towards the close of the 20th century.

Analytical Accounting is defined as the conversion of all company processes into monetary units, aiming to calculate and control the costs of each product and determine partial results. On the other hand, Laurel states that it is "*the part of Accounting aimed at highlighting the constituent elements of costs and results that are of most interest to company management*". Finally, Professor Gonçalves da Silva sees Analytical Accounting as "*cost accounting, by this expression the classification and recording of operating expenses*" (Estrela, 2011). For these reasons, Analytical Accounting covers all aspects of cost accounting and all expenses and income relating to the company's areas (commercial, procurement and administrative). It thus allows measuring the different magnitudes of the company, facilitating decision-making by managers and management control.

Accounting has evolved and is now considered an information system geared towards calculating and determining the resources used to produce goods and services (Rom & Rohde, 2007). The information from each of the main areas of the company has to be collected and recorded from the perspective of the norms defined for each of the situations experienced in each day of activity, having to be duly structured, allowing for a delivery summary of the financial contents, in an adequate and timely manner to the various recipients - external (shareholders, financiers, customers, suppliers, tax administration) or internal (directors, department heads, among others) (Caiado et al., 2015).

Thus, Analytical Accounting's main mission is to organize financial documentation in order to be able to systematically provide information to a whole group of recipients with different backgrounds and expectations.

The means that company managers have at their disposal are limited, which means that they must be managed under the principles of economic rationality. That is, there must be a contrast between the resources obtained and used. As such, there is a need to adopt adequate methods that permanently evaluate the resources used and achieved. Financial information tended to become more compatible with responding to the diversity and complexity of manufacturing processes to support the production process, internationalization of products and the possibility of generating new employment opportunities (Caiado et al., 2015). As information becomes an increasingly strategic resource for companies, with adequate financial analysis, there is the possibility of understanding the factors that imply differences, change and consequences of the choices made by the organization's stakeholders (Hopwood, 2000). Data processing

technologies, such as BI solutions, were the main help in this area, significantly reducing the occurrence time of facts and communication.

Features of Analytical Accounting:

- Organization according to the specific needs of each company;
- Intended to serve all those responsible for the company, whatever their hierarchical position;
- It uses information from General Accounting and the documents on which it is based by reclassification or by technical accounting and statistical studies;
- It must be up-to-date and provide information on time;
- It should be organized to highlight responsibilities. The management control of the various areas of responsibility is carried out by periodically controlling achievements and forecasts to determine abnormal deviations that require timely corrective measures.

3.1.4. International Financial Report Standards

The International Financial Reporting Standards (IFRS) was originated in the European Union with the creation of the International Accounting Standards Board in 2001. It aims to ensure that accounting standards are applied consistently globally, allowing investors and other users of financial statements to compare publicly listed companies' financial performance (IFRS, 2016).

The first IFRS was in 2003, with the participation of 19 countries. Since then, over 70 countries have joined (including countries in the European Union). The purpose of IFRS was to facilitate access to financial information, specifically capital flows and capital markets, by creating a set of global performance presentation standards adopted by a group of countries at a reduced cost (Ramanna & Sletten, 2009).

The IFRS Foundation aims to give "*a high quality, internationally recognized set of accounting standards that bring transparency, accountability and efficiency to final markets around the world*" (IFRS - Why global accounting standards?).

The benefits of this coalition are eliminating cross-border investment barriers, increased transparency across different economies, improved market efficiency, better quality monitoring of company results, and reduced information costs. For these reasons, adherence to a financial reporting standard allows for greater cooperation among different countries, helping to attract new investors to the countries involved (Brown, 2011).

3.2. BUSINESS INTELLIGENCE

The term Business Intelligence emerged in 1989 within the IT community, driven by the need for organizations, both private and public, to effectively address the emerging challenges and adopting innovative operational approaches. (Lim et al., 2013). To devise swift and effective strategies, as well as execute efficient tactical operations, it is essential to possess a substantial volume of pertinent data, information, and knowledge with some of these elements being of a complex nature. In order to improve business decision-making, technological tools, applications and indicators were developed to collect large amounts of static data, manipulate them to monitor the business, analyze performance and understand why things are happening. Business Intelligence provides the capability to convert raw data into valuable insights that can assist organizational leaders in detecting performance, enhancing operational effectiveness, and identifying untapped opportunities (Yessad & Labiod, 2016).

There is no correct definition for the term Business Intelligence. Forrester defines it as " *a sort of mythologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision making*." (Analytics, 2015). The concept can also be seen as a tool that allows various organizational departments to gather timely and accurate information to support decision-making. Other professionals in the field see it as a process of detailed information analysis that allows knowledge generation (Elena & University). The definition that best fits the concept is the one that characterize it as an umbrella term that combines architectures, databases, analytical tools, allowing interactions (sometimes in real-time) with the data making historical analysis of them, which gives full organizational access. The analysis results have the potential to enhance performance, uncover opportunities, and optimize operational efficiency.

The areas where these tools are most applied are in sales and marketing analysis, financial planning and forecasting, statutory consolidation, budgeting and profitability analysis since these areas are increasingly necessary for the information to be in the right place at the right time. This punctuality is seen as a competitive advantage (Turban, 2011).

One of the great benefits of Business Intelligence is that it enables managers to make decisions based on concrete facts and not just by intuition in real time, comparing, for example, expenses to date with budget planning, sales pipeline versus forecast, available inventory, allowing the increase cross-sell to existing customers and improve performance in marketing, accounting and manufacturing (Howson, 2013).

A business intelligence (BI) system consists of four main components: a data warehouse that stores source; data, business analysis tools to manipulate and analyze data; business performance management (BPM) to monitor and analyze performance; and a user interface such as a dashboard. Business analysis tools include static and dynamic reporting, query capabilities, information discovery, multidimensional visualizations, and the ability to dive into details. In addition, advanced data mining, text and web tools, as well as other sophisticated mathematical and statistical tools, are also included (Turban, 2011).

Dashboards are one of the main tools of Business Analytics, being defined as a computational interface with reports, charts, and alert systems consolidated into an information platform to get a clear view of the business. These functions are generally used in the planning, choice and execution phases of the decision-making process and provide reports, and queries, also offering projected visualization of related future scenarios. Dashboards help to see where to improve cost efficiency, increase profit margins and gain competitive advantage.

Business Intelligence (BI) is not just a technical exercise for the information systems department. It should change how the company conducts business, improving its processes and decision-making by going through all parts of the organization. It should be noted that before implementing a BI project, it is important to assess whether there is a clear need and benefit and whether the organization's strategy and IT aligns with the initiative. The success of the BI project is influenced by factors such as business methodology, vision and planning, management support, data management and quality, and performance considerations. It is also important to have a solid database, use agile development processes, organize BI teams and specialists for success, and build a balanced solution that maximizes economies of scale.

3.2.1. Data Warehouses

3.2.1.1. Definition

In the context of Business Intelligence, the database systems used by a Data Warehouse are Online Transaction Processing (OLTP) and Online Analytical Processing (OLAP). OLTP can extract data, in addition to common sources, such as spreadsheets and personal databases, to later be analyzed and used for decision-making. An OLTP is an operational database that handles the routines of a company. It captures and stores the data related to day-to-day business functions, such as CRM, ERP, and POS (Sadoghi et al., 2017). OLTP helps automate routines and stores those same processes and all the information from it. In addition to Online Transaction Processing (OLTP), there is an Online Analytical Processing (OLAP) created to meet analytical needs effectively and efficiently, allowing the user to manipulate the data to generate information for decision-making.

The data worked on OLAP often comes from an OLTP since the latter only captures it, and organizations are faced with the need to analyze it (Reddy et al., 2010).

Organizations often have information scattered in different data repositories, making it difficult for top managers to draw conclusions from the data since it is time-consuming and laborious. The Data Warehouse (DW) emerged as a way to overcome this obstacle by allowing the access, integration, and organization of data extracted from different repositories and loaded into a staging area.

This special database is used to store historical and current business-oriented information in a summarized, consistent, clear and timely manner, aiming to help decision-making by transforming the integrated data (Sapir et al., 2008).

A DW possesses distinctive features that define its structure: it is oriented towards specific subjects, with data organized into categories; it integrates elements from diverse data sources; it encompasses a time variant aspect, incorporating historical data; and it is non-volatile, meaning that once facts are inserted, they cannot be altered or updated. Its benefits are that it allows large amounts of data to be accessed and analyzed, giving a true picture of the state of the organization as quickly as possible at a reduced cost (Inmon, 2005).

3.2.1.2. Three main types of Data Warehouses

Operational Data Store:

An operational data store (ODS) is used as a temporary database before being transferred to a data warehouse, is updated frequently, and is helpful for short-term decisions. It consolidates data from various sources and provides a real-time view of current and volatile data. The processes to transfer data to an ODS are similar to those used for a data warehouse and allow a multidimensional analysis of operational data (Turban, 2011).

Data Mart:

A data mart is a smaller subset of a data warehouse, usually focused on a specific subject or department, and can be dependent or independent. Dependent data marts are created directly from a data warehouse and can use a consistent data model and provide quality data. An independent data mart is a low-cost version designed for a specific business unit or department but does not come from an enterprise data warehouse. Some companies may build standalone data marts instead of a data warehouse (Neto).

Enterprise Data Warehouse:

An enterprise data warehouse (EDW) is a large-scale data warehouse used across the enterprise for decision support. The large-scale nature integrates data from many sources into a standard format for effective BI and decision-support applications (Kimball, 2011). EDWs are used to provide data for many types of DSS, including customer relationship management (CRM), supply chain management (SCM), business performance management (BPM), business activity monitoring (BAM), product lifecycle management (PLM), revenue management, and sometimes even knowledge management systems (KMS) (Neto).

Within EDWs, there are ERP systems designed to ensure compliance with standard processes and have a broader scope than the custom operating systems of the past. These improve data quality by reducing duplicate data entry and have a standard set of reference tables with consistent customer IDs, product codes and charts of accounts that are shared between different modules or applications. ERP implementations are not designed to provide business insights, as it is a single operating system with consistent reference data that can make business analysis easier. However, fundamental differences between operating systems and an analytics environment will be addressed later (Howson, 2013).

3.2.1.3. Data Warehouses Strategies

Kimball Methodology:

Kimball's data mart strategy is a "plan big, build small" approach, where a data mart focuses on the requests of a specific department and is also known to be a bottom-up approach. This model uses dimensional modelling, building data marts incrementally. The Star Schema allows fast and efficient access to high-volume queries and improves the processing of complex multidimensional queries (Kimball & Ross, 2002).

Inmon Methodology:

The Inmon model follows a top-down development methodology and uses traditional relational database tools to fit the needs of building a comprehensive enterprise data warehouse. Inmon's data warehouse architecture (Snowflake schema) does not preclude the creation of data marts. It provides a consistent and comprehensive view of the enterprise based on the entity-relationship diagrams of operating systems, known as a "data-based" approach (Inmon, 2005).

3.2.2. ETL Process

Organizations have large amounts of data from multiple sources, and to make it usable, it is necessary to transport this data into a common database. The ETL (Extract, Transform and Load) process has this function as it involves extracting data from various sources (for example, Spreadsheets, CRM, ERP), transforming it into a format that can be loaded into a data warehouse or data mart. The process consists of three phases. The first phase, extraction, involves getting data from different sources and putting it into a temporary storage area. In second transformation phase is the heart of the ETL process, where the data is cleaned, organized, standardized and transformed into a common data model and schema. Finally, the loading phase is where the data is loaded into the appropriate databases or data warehouses. During this

step, the data is also indexed and optimized for queries and analysis in the target system (Albrecht & Naumann).

The ETL process allows organizations to migrate data from multiple sources into a single data warehouse for decision support. However, ETL processes can be complex and require specialized tools, and there is no common management approach. In larger organizations, many ETL processes are accumulated and can be managed using a high-level approach for flexible reuse, optimization, and rapid development. Data is consolidated in a single physical store for fast and integrated access to relevant information (Howson, 2013).

3.2.3. Use of BI practices in Accounting

In today's highly competitive economy, organizations must implement ERP or similar systems. Business intelligence and analytics (BI&A) technologies facilitate data collection, analysis, and information delivery to support decision-making (Galani et al., 2010). There is a link between BI&A and accounting, with the latter expanding its scope from historical value reporting to real-time and predictive reporting. Enterprise Resource Planning (ERP) systems emerged from advanced manufacturing technologies (AMT) and the need to plan, manage and control resources through an organization-wide view. Aimed for enhancing quality, minimizing inventory levels, enhancing customer service, obtaining real-time information, and bolstering manufacturing adaptability, the focus is on facilitating the gathering and analysis of company data (Spathis & Constantinides, 2004).

ERPs are integrated, organization-wide information systems capable of managing and coordinating all of a company's resources, information, and functions from shared data warehouses. They improve decision-making and management control by providing real-time operational data relevant to management. It is a common platform that integrates the flow of information from various business units such as finance, accounting, manufacturing, and HR. ERP aims to automate business processes, share common data, and produce real-time data, thereby enabling efficient exchange of relevant data about production processes and administrative tasks (Dechow & Mouritsen, 2005).

Research has investigated the impact of different information technologies, such as Enterprise Resource Planning (ERP) systems, on managerial accounting tasks and techniques. The adoption of these systems has improved the efficiency of accounting data collection and reporting but has also had to stabilize effects on managerial accounting practices rather than significant changes. Studies have found that ERP systems can lead to better control and positively impact organizational performance (Hunton et al., 2003).

The accounting module is part of an ERP system and includes applications such as general ledger, accounts receivable and payable, fixed assets, cash management, cost control and budgeting. These applications offer the opportunity to improve business processes by integrating all functional areas of the organization, including financial and non-financial data. One study found that ERP systems are effective at performing transactions but less effective at generating reports and supporting decision-making (Booth et al., 2000).

However, the study also suggests that ERP systems can implement more advanced accounting practices, such as activity-based budgeting, product life-cycle costing, and balanced scorecards.

Author Nielsen highlights the importance of managerial accountants adjusting their responsibilities according to the availability of ERP systems and data analysis tools, which allow companies to analyze various types of information (Nielsen, 2015). Financial statements are not the most suitable for decision-making, as they are based on past data and do not provide future information needed to manage the business. Today's managerial accountants help management measure company performance and provide information for decisions based on internal and external data. They also need to forecast and assess uncertainty and risk in decision-making. They can use data analysis tools like optimization models to perform prescriptive analysis and help decision-makers deal with uncertainty (Taleizadeh et al., 2015).

Dimensional modelling provides a global view of business and subjective insight, which can enhance performance dashboards that use scorecards and data visualization to display financial and non-financial data. However, managers may place more importance on financial performance measures, and the design of dashboards must be aligned to their purpose and customized for specific users to be effective. Cardinaels and van Veen-Dirks recommend using performance markers to minimize the bias toward financial measures, while Chen argues that manager awareness of interconnected performance measures is more important than the scorecard format (Cardinaels & van Veen-Dirks, 2010; Y. Chen et al., 2016). Finally, Organ Yigitbasioglu and Oana Velcu highlight the importance of having a flexible and customizable design for performance dashboards to support managers' decisions (Yigitbasioglu & Velcu, 2012).

Research reveals that users adopt distinct decision-making strategies depending on their knowledge and cognitive abilities. The degree of knowledge is important when designing decision support systems to avoid biases in choice. Feedback and system suggestions can be useful but should be tailored according to the type of task and the user's knowledge. Too much feedback can restrict the user's choice space and lead to discounting of suggestions.

For a successful ERP implementation, the role of managerial accountants needs to change radically, turning them into business consultants. Involving management accountants in the implementation results in better outcomes and a significant change in their tasks, turning them into business partners rather than data providers (Alles et al., 2006). Successful implementation improves data quality and decision-making, allowing management accountants to focus on value-added tasks. ERP systems enable managerial accountants to provide more accurate information and support to business managers, but this may require access to more varied and voluminous data, i.e., massive data. The role of managerial accountants in an ERP environment is more like a business consultant to top management rather than a conventional managerial accountant, requiring solid business and interpersonal skills, leadership, decision-making, analytical skills, planning, and technical skills (Tamandeh, 2016).

3.3. FINANCIAL ANALYSIS

The connection of these two areas, Accounting and Business Intelligence, will allow the development of analytical methods to understand the state of the companies more easily. The function of Accounting corresponds to the systematic recording of all asset facts that have occurred, taking into account a timeline. The movements found in accounting relate to recorded facts concerning the business transaction, information regarding customer debts, debts to suppliers, acquired borrowed capital, equity, company assets, advances, and payment terms. Business Intelligence tools such as SQL server, Visual Studio, and Power BI will allow to link Accounting data to a real-time Financial Analysis.

Financial Analysis is an interpretation of accounting data revealing every aspect of financial and operational well-being. It is a study of the relationships of financial factors, having access to past data to improve decision making, such as portfolio selection, bank lending, corporate, forecasting and planning future performance. It can combine financial statements with other information to draw conclusions, and reports must follow International Financial Reporting Standards (IFRS) rules (Robinson et al., 2008).

Financial choices impact the company's cash position, which implies short-term cyclical consequences, or they can affect the company's capital structure with medium- to long-term repercussions that are difficult to reverse, making them the target of greater consideration.

Short-term decisions include managing liquid financial means, granting trade credits, customer due dates and collections, obtaining credit from suppliers, and contracting short-term financing to meet treasury needs. Medium/long-term decisions are decisions related to making investments in fixed capital, with natural repercussions:

- In the productive structure;
- In the choice of financing sources to support the investments made;
- In the definition of self-financing policies;
- In the options pursued the company's growth, from the acquisition of competitors to the merger with strategic partners

The purpose of financial analysis is to evaluate the operational and financial efficiency of the enterprise as a whole. It aids investors making informed investments and portfolio decisions, lenders and creditors determining the creditworthiness and solvency position, employee and labour unions deciding the economic status of the enterprise and making decisions in wage and salary negotiations.

The following are also considered to be objectives of Financial Analysis (Fernandes et al., 2022):

- To find out the financial stability and soundness of the business enterprise;
- To assess and evaluate the earning capacity of the business;
- To estimate and evaluate fixed assets, stock and others, of the concern;
- To estimate and determine the possibilities of future growth of the business;
- To assess and evaluate the firm capacity and ability to repay short-term and long-term loans;
- To evaluate the administrative efficiency of the business enterprise;
- Comparison of past and present results;
- This tool will assist in the evaluation of future development through marketing forecasts and budget preparation.

The company's economic activity comprises the normal development of its activity and the understanding of the operating or financial results. It is where financial activity effectively fulfils the function of managing the autonomous or induced financial flows, for example, in the structuring options of the financing capital for business development. The financial analyses follow normative frameworks in order of increasing importance, the SNC and the IAS (International Accounting Standards) (Anjos, 2023). Three main standards support the normative system:

- Relevance: Quality that information has to influence the decisions of its users, helping to evaluate past facts;
- Reliability: Quality that information must have so that the user trusts it, so it must be free of material errors and prior judgments;
- Understandability: Quality that information must have to be readily understood by users of financial information. Standard integration of Business Intelligence tools contributes to its better realization.

There are two main documents used for the financial analysis, Balance Sheet and the Income Statement (Profits and Loss Statement). The Balance Sheet, which reflects the standard structure of assets and liabilities controlled by the organization (Bobryshev et al., 2014). Assets refer to the resources that the organization has under its control and that can generate future economic benefits. At the same time, liabilities correspond to the obligations the entity has to meet, resulting from past events. Thus, the Balance Sheet represents the applications and origins of funds, where Assets represent the applications of Capital and Liabilities the origins of Capital, both owned and borrowed. The Income Statement is another document that helps to understand the company's economic situation but differs from the Balance Sheet in that it shows how the results - whether profits or losses - were achieved in a given period. It allows an assessment of the economic performance, showing the return on sales and the invested capital represented on the balance sheet.

The best method used is the financial ratios to determine the financial position of companies, identify patterns and especially identify positive and negative trends (Rashid, 2018). The ratios are among the most widely used techniques in economic analysis. They make it possible to compare the organization's performance against others in the same industry and establish its evolution over time, taking the dimensionality factor of the organization out of the equation. Studies show that calculating financial ratios makes it possible to predict stock returns or even credit defaults and is effective in selecting investments and predicting financial difficulties (Bobryshev et al., 2014). The information these metrics provide helps retain shareholders and attract new investors (Rashid, 2018). The importance of ratio analysis lies in the fact that it enables the financial analyst to evaluate historical performance, verify the current financial situation of the company, as well as to obtain valuable information to predict future results, giving insights such as:

- The internal microeconomic interactions of a company that help analysts to forecast revenues and the unrestricted circulation of money;
- The financial elasticity of the company, that is, the ability to obtain funds needed to expand the business and meet commitments, even in unforeseen cases;
- The management capacity;
- The evolution of the company and industry over time;
- The similarity with other companies in the same sector or relevant industries.

However, ratios also have some limitations, particularly if the company operates in multiple areas, making it difficult to find comparable ratios within the industry that can be used for comparison purposes. The need to verify that the results of the ratios are consistent is also a limitation since one set of ratios may indicate a difficulty that the organization is experiencing, and another may indicate otherwise. Finally, another limitation is that ratios cannot be used alone, i.e. even if they are applied to help assess the potential growth or risk of the company, an analysis of the operations within the company must be done, the external economic conditions must also be taken into consideration since these are often the justification for the values shown in the ratios, and finally how the industry sector is where the company is located.

The ratio method has major analysis groups, which help structure the financial information, combining indicators and other financial information.

Financial Situation Analysis: The financial ratios allow you to quantify the relationships between the various items on the balance sheet, thus allowing you to assess the company's financial situation in the short and medium/long term. These ratios help analyze the company's ability to meet its obligations and commitments and include measures such as Working Capital, Solvency, Financial Autonomy, Financial Independence, General, Reduced and Immediate Liquidity and Working Capital Requirements.

Economic Situation Analysis: Quantifies the relationships between the headings of the Income Statement. It enables understanding the company's efficiency in using its resources (assets), analyzing the production structure, the company's economic viability, analysis of different margins and others. The main ratios are Sales Volume, Gross Margin, Free Cash, Net Cash, Operating Results, Net-Results, Gross Value Added and Productivity.

Risk Analysis: Assesses the economic and financial risk of the company, being linked to the variability of results linked to its structure, depending on factors such as sales price, market share, investment policies, productivity, and fixed costs. Subject to these factors, it is impartial to use the following ratios to analyze the risk situation, Economic Dead Point, Operating Safety Margin, Financial Dead Point, Financial Safety Margin, Economical Leverage, Financial Leverage, Combined Leverage, Economical Leverage Effect and Financial Leverage Effect.

Profitability Analysis: Profitability ratios quantify the relationships between the items on the Balance Sheet and the Income Statement, to assess the company's ability to generate good results to maintain capital and repay the capital employed. Some ratios used to assess a company's profitability include Return on Sales, Return on Assets, Return on Equity, Sales Contribution Margin, Effect of Fixed Costs, Effect of Financial Results, Tax Effect, Asset Turnover, and Financial Structure.

Business Functioning Analysis: This analysis evaluates the financial impacts of management decisions related to the operating cycle. Allows for measuring the efficiency with which the company uses its assets throughout this process. The ratios used in this analysis include Average Payment and Receipt Times, Average Inventory Storage Times and Average Cost of Borrowed Capital.

4. MODEL PROPOSAL

The chapter in question is a synthesis of the previous chapters, taking into account that it is based on the knowledge acquired about the theme of Analytical Accounting, compiled with the elements that make up the Business Intelligence systems. It is feasible to establish a robust foundation for the attempt to develop a conceptual model that links the Data Warehousing tools to the financial indicators present in Accounting to enable better decision-making by managers.

4.1. REQUIREMENTS AND NEED FOR INFORMATION

In the continuation of this topic, the procedures to be adopted for the creation of the artefact will be described, such as the description of the needs for the creation of this model, specification of the requirements of the conceptual model, the definition of analyzes that will be presented and, finally, the identification of the Business Intelligence components that should be integrated into the model.

As previously indicated, the objective of this project is to allow the delivery of the financial information, which is found in accounting, in a more accessible way, making it easier for those who will have to consult it to draw conclusions. Thus, the focus is on being a new tool to support the management system, which seeks to provide a new approach to financial analysis.

1. **Need for a New Paradigm:**

The accountant's job is increasingly being overtaken by the new technological tools that have been developed. In addition to making the work easier, it is also making the need for accountants unnecessary since the automation of the entry of accounting documentation reduces the workload significantly. For this reason, accountants need to move away from their comfort zone - which is the entry and delivery of tax obligations - and start developing more decision-support activities for the managers of the companies they have as clients.

2. **Financial Analysis Model:**

To perform financial analysis, it is necessary to make a good structuring of the company's items that will be analyzed to provide management support that allows identifying opportunities and risks that may arise. For this reason, analyses will be conducted from the following perspectives:

a. Analysis by Customer:

The manager should know the sales volume of his business, which customers contribute the most to growth, and which customers are overdue with payments. Identify ratios such as the average receivables term for the manager to know, on average, how long it takes to receive money from your customers.

b. Analysis by Supplier:

Just as it is important to understand sales volume, it is also important to understand purchasing volume. In addition, having a notion of the debt to suppliers is important because purchases are not always paid immediately, and it is necessary to know which suppliers still have outstanding accounts. The identification of ratios such as the average payment term allows the manager to know, on average, how long it takes to pay their suppliers. Serving as an indicator, it can be utilized when considering the engagement of a new supplier, providing evidence of their commitment to fulfilling obligations.

c. Analysis by Cost Centers:

The manager has the possibility at the accounting level to divide his income and expenses by categories through Cost Centers, not only dividing the expenses as the name indicates but also the receipts. Therefore, the manager must have an adequate analysis of the items present in each Cost Center, comparing categories with what was budgeted and even at the level of the weight of spending on invoicing using the formula presented in equation F1.

$$\text{(F1)}\ \ Cost\ Margin\ = \frac{Cost\ Center\ Cost}{Cost\ Center\ Revenue}$$

d. Analysis by Autonomous Tax Clearance:

At the level of Portuguese finance, where the study will primarily focus, Autonomous Taxes is a penalty that companies have in the taxation of personal expenses (representation expenses and car expenses) or undocumented (Mesquita, 2014). Managers need to predict how much this amount will accrue to Corporate Income Tax (IRC). In order to avoid any unexpected tax liabilities at the end of the year, it is essential to continuously monitor these expenses during the tax period. Therefore, F2 demonstrates how autonomous taxation is calculated, while F3 provides a general indication of the proportion of total expenses allocated to autonomous taxation.

$$(F2)\ Autonomous\ Taxation\ =\ Accepted\ expenses\ for\ Autonomous\ Taxation\ *\ Tax$$

$$(F3)\ Weight\ of\ Autonomous\ Taxation\ in\ Total\ Charges\ Accepted\ = \frac{Autonomous\ Taxation}{Accepted\ expenses\ for\ Autonomous\ Taxation}$$

Table 4.1 shows the autonomous taxation rates applied in Portugal, and the rates vary depending on the country. These values are the ones that will be used in the creation of the model, and can be changed in case the companies are not based in Portugal.

Description of the charge	Tax
Charges with A. V. Vehicles <27500€	10%
Representation expenses	10%
Allowances for Costs/KMs	5%

Table 4.1 - Table of Autonomous Taxation Rates(Códigos Tributários e Legislação Fiscal Complementar - Código do Imposto sobre o Rendimento das Pessoas Coletivas, 2023)

e. Analysis by Corporate Income Tax (CIT) assessment:

Another important factor for managers is to know how much tax they have to pay or receive from State at the end of the year. For this reason, it is necessary to have a forecast throughout the year.

Therefore, based on the values recorded in Accounting to date, a monthly or quarterly statement of the amount of CIT payable should be made, allowing the manager during the year, for example, to know what he can do to avoid paying more tax at the end of the period by adopting policies that make the company have more tax-deductible expenses.

The formulas mentioned from F4 to F8 below illustrate the complete calculation process required to determine the final amount of CIT at the end of the year. This process goes through the quantification of various categories until it is possible to find the definitive amount the taxable person has or does not have to pay. From now on, when discussing the dimensions utilized in the model, the IRC (*Imposto sobre o Rendimento das Pessoas Coletivas*) terminology will be employed instead of CIT (Corporate Income Tax) to enhance comprehension, given that the model was applied to a Portuguese company.

$$(F4)\ Accounting\ Profit\ =\ Total\ Income\ -\ Total\ Expenses$$

$$(F5)\ Taxable\ Profit\ =\ Accounting\ Profit\ +\ Total\ Expenses\ Not\ Accepted\ -\ Total\ Tax\ Benefits$$

$$(F6)\ Taxable\ Base\ =\ Taxable\ Profit\ -\ Tax\ loss$$

$$(F7)\ Tax\ Liability\ =\ Taxable\ Base\ *\ 17\%\ +((\ Taxable\ Base\ -\ 25000)\ *\ 21\%))$$

$$(F8)\ Corporate\ Income\ Tax\ =\ Tax\ Liability\ +\ Benefit\ deductions\ from\ collection\ +\ Municipality\ Fee\ +\ Autonomous\ Taxes$$

Note 1: In Tax Liability, when the Taxable Base is higher than 25000 it's applied to the 21% tax.

Note 2: Municipality Fee when the Taxable Profit is higher than 0 applies the Municipal tax.

f. Financial Situation Analysis:

Analysis of the Economic Situation: When it comes to the Economic Situation Analysis the ratios that will be used to understand if the company is using its resources correctly are Sales Volume (at current prices) Sales Volume (at constant prices) Free Net Means, Gross Margin and the Rate of Change in Turnover.

a) Sales Volume (Constant Prices): For a more correct analysis of the sales figures, this should be deflated (Anjos, 2023).

b) EBITDA: The calculation formula F9, corresponds to the excess of operating income over operating costs. In broad terms, it is equivalent to operating cash flow.

$$(F9)\ EBITDA = Sales\ and\ services\ provided\ +\ Operating\ subsidies + Variation\ of\ inventories\ in\ production\ +\ Work\ for\ the\ entity\ itself - CMVMC\ -\ FSE\ -\ Personnel\ costs\ +/-\ Impairments +/-\ Provisions\ +\ Other\ income\ -\ Other\ costs$$

c) EBIT: It is an indicator that denotes the minimum economic break-even point of a company. It reflects the company's results before financial and tax aspects and can be obtained directly from the income statement. The formula for this indicator is referred to in F10.

$$(F10)\ EBIT\ = EBITDA\ -\ Expenses\ with\ depreciation\ and\ amortization$$

d) Net Income: It is a global indicator of the company's absolute profitability (F11), which takes into account all policies and effects in force. When this indicator is positive, it contributes to increasing the company's book value and strengthening its financial autonomy.

$$(F11)\ Net\ Income\ = EBIT\ -\ Financing\ Expenses\ -\ Income\ Taxes$$

Risk Analysis: The manager has to have the proper knowledge if the company is at financial or economical risk. With that intention there are the following ratios: Economic Degree of Leverage (Operational Degree of Leverage), Financial Degree of Leverage, Weight of Debt and the Economic Returns on Assets.

a) Financial Leverage Ratio: Measures the company's ability to maintain its net income in the face of changes in its operating results (Mota et al., 2020). High values in the ratio F12 imply greater economic risk and uncertainty about future Earnings Before Taxes. If these results are negative, the value of the ratio should be zero, which results in infinitely high risk (Anjos, 2023).

$$(F12)\ Financial\ Leverage\ Ratio\ = \frac{EBIT}{Net\ Income}$$

b) Debt Ratio: This is an indicator that evaluates the proportion of available resources in the company destined to the payment of financial costs. This ratio represents the percentage of the gross resources generated by the company that can cover the financial charges – as it can be seen in F13.

$$\text{(F13)}\ \ Debt\ Ratio\ = \frac{Financial\ Charges}{EBITDA}$$

c) Profitability Analysis: This analysis shows the manager whether his organization can generate results that at least support the invested capital and its maintenance. Indicators such as Sales Profitability, Asset Rotation, Sales Tax Profitability and Return on Equity are applied.

d) Profitability of Sales: This metric allows us to evaluate the gross profit per unit sold and reflects the company's efforts in cost control, contributing to an analysis of the profitability of the business (Anjos, 2023). If the Profitability of Sales increases faster than the Gross Margin, it means there are improvements in controlling operational costs, such as administrative expenses. On the other hand, a declining value on F14 can be an indicator of deteriorating control over operating costs (Robinson et al., 2008).

$$(F14)\ Profitability\ of\ Sales\ = \frac{EBIT}{Sales\ at\ Constant\ Price}$$

4.2. ASSUMPTIONS

As exposed in the previous chapters, the framework for the development of a Business Intelligence system is composed of the following phases: identification of different data sources and data mapping according to business needs; ETL (Extract, Transform and Load) process of the data previously identified for a Data Warehouse; and report development.

Therefore, the architecture of the Business Intelligence system that will be implemented will have the following elements:

Data Sources: data originates from various information sources with different storage formats. There has to be a selection of the various data sources, characterize and select those that best fit the business needs.

ETL Process: With the data sources established, the data must be transformed and cleaned to extract it into a database with only the necessary information to create the required reports. In the case of an Analytical Accounting model for accounting firms, and considering that the database is taken directly from the ERP Accounting system, the ETL process has as its primary foundation to pass only the tables necessary to run the reports to a new database.

Data Warehouse: After processing the data, it is loaded into it.

Dashboards: after the data is loaded into the Data Warehouse, it is possible to present it effectively and in real-time through various visualizations developed according to the organization's needs.

4.2.1. Definition of Dimensions:

According to the needs presented in Chapter 4.1. it is possible to identify the essential dimensions of the conceptual model. It is important to mention that according to each company, some dimensions can be added and others removed. The dimensions and analyses were carefully considered in light of the database structure's capabilities. By leveraging the inherent strengths and functionalities of the database, the dimensions and analyses were designed to maximize efficiency and effectiveness.

Following that, the dimensions recommended for the dimensional model are introduced. The proposed framework for each dimension, including the attributes and their corresponding descriptions, can be found in Tables 0.8 to 0.16 in the "Annexes" section of this document.

1. **Clients Dimension:**

The Clients Dimension is presented as "Dim_Clientes" and presents the data of the firm's clients. This table has the information regarding the customer name, customer address, zip code, country, VAT number and debit amount, i.e. balance in the customer's account.

2. **Suppliers Dimension:**

The Suppliers Dimension is displayed as "Dim_Fornecedores". The table contains information regarding the suppliers, namely, supplier name, supplier country, tax number (NIF) and balance in the supplier account.

3. **Movements Dimension:**

This dimension ("Dim_Movimentos") has the information regarding the accounting account where the movement occurred, the year, month and day, the journal in which the action occurred, the nature (debit or credit movement), the fiscal number (NIF) and the amount. This table is found with as a hierarchy.

This table was taken from the ERP of Accounting in order to show only the movements of the Clients and Suppliers, so that later on it can be calculated which clients and suppliers have more impact on the organization's business.

This dimension has the following hierarchy:

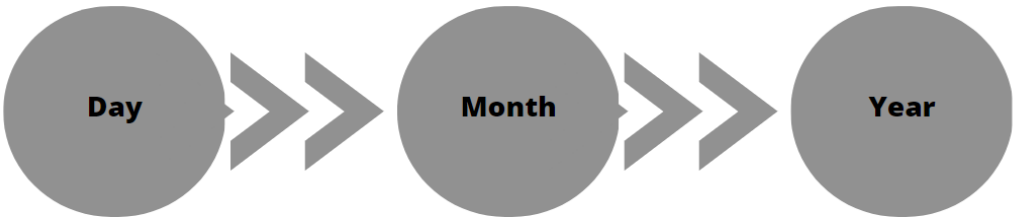

Figure 4.1 - Hierarchy Dimension Date "Dim_Movimentos"

4. **The Cost Center Dimension:**

Presented as "Dim_CentrodeCusto", it contains information regarding the categories in which the expenses and income were entered. This table has the cost centre's ID, the year it was moved and then the months of the year.

5. **Center Cost Plan Dimension:**

The Plan Center Dimension is presented as "Dim_PlanoCentro" in this table and has the cost centre ID, as in the previous table mentioned, but also the cost centre description. This table is linked to the previous table by the IDs so that later on the dashboards, it will be possible to link the two to show the results.

6. **Profitability Analysis Dimension:**

The Profit and Loss Dimension is presented as "Dim_DemonstracaoResultados" in this table. The data of the accounts, that belongs to the Profit and Loss Statement, is inserted. This table has the following attributes, SNC account, year and months of the year (which contain the values).

7. **Autonomous Taxation Dimension**

The Autonomous Taxation Dimension is presented as "Dim_TributaçoesAutonomas", in this table, the accounts that enter the accounting for Autonomous Taxation are filtered. This table has the following attributes, SNC account, year and months of the year (which contain the values).

8. **IRC Dimension**

This dimension is a direct connection to the source, and no alterations have been made to it. Due to the fact that not all values are present in the Primavera database, they need to be manually inserted from external sources.

9. **Tax Rate Dimension**

Like the preceding dimension, this dimension exclusively presents details regarding the rate applied to various categories of autonomous taxation within the corporate tax code and it's just importing the excel file. In the provided case study, the Portuguese code was utilized. However, it is possible to modify the rates to those of a different nationality without affecting the functionality of the file.

4.2.2. Dimensional Model Scheme

The Figure 4.2 shows a snowflake schema. This schema was proposed for the Data Warehouse of this project and it is composed by ten Dimensions. The choice of the schema was based on the fact that it is a direct connection of the tables of the Data Warehouse with the database of the Accounting systems that are well structured. This schema compressed the data source's complexity to facilitate the end user's access and reading of the data by the end user.

The table Dim_CentrodeCusto is linked to Dim_PlanoCentro in order to access the descriptions of each Cost Center and to be able to be categorized to the part of the table with the values. Furthermore, with the aim of having a key that connects the two tables, it was decided to CONCATE in both tables (*Plano Centros* and *Centros de Custo*) the Year with the cost centre account creating the attribute "SK_CentrodeCusto" and "SK_PlanoCentro". In this way, a unique attribute was created making it possible to connect those two tables. For the purpose of organizing the months in ascending order, an attribute was created to indicate the number of the month of the year. This attribute is present not only in these two tables but also in "Dim_DemonstraçãoResultados" and "Dim_TributaçoesAutonomas".

The "Dim_PlanoCentro" table had the attribute "PC_CentroDescrição" decomposed into three parts, thus separating the main Cost Center from the different categories and the distinction between gains and expenses. With the various cost centers separated, and their categories, it is possible to make a more detailed analysis of each one of them.

Therefore, it is essential to highlight some links that are present in this Data Warehouse. The Dim_Movimentos is linked to Dim_Clientes and Dim_Fornecedores, being connected by the attribute of the NIF number (VAT number in Portugal), thus enabling the calculation of the amount spent with each supplier and the gain for each customer. In addition, for the development of the graphs in the report, it was necessary to convert the numbers of the months to their respective names. This conversion was made for a new attribute named "Movimentos_Meses".

On the table Dim_TributaçoesAutonomas is linked to a table with the table Tax Rates values. This link was made to access the rates of each cost movement since the attribute "TaxRate_Tax" in the table "Dim_TributaçoesAutonomas" has the identification number that concerns the autonomous taxation rates.

Finally, the IRC table is a direct Excel connection, containing the categories used for calculating the tax. However, a separate table was created, "Métricas IRC", which shows the various metrics necessary to be created to achieve the final result of the tax. It is possible to find the formulas used in the Table 0.17 in the annexes.

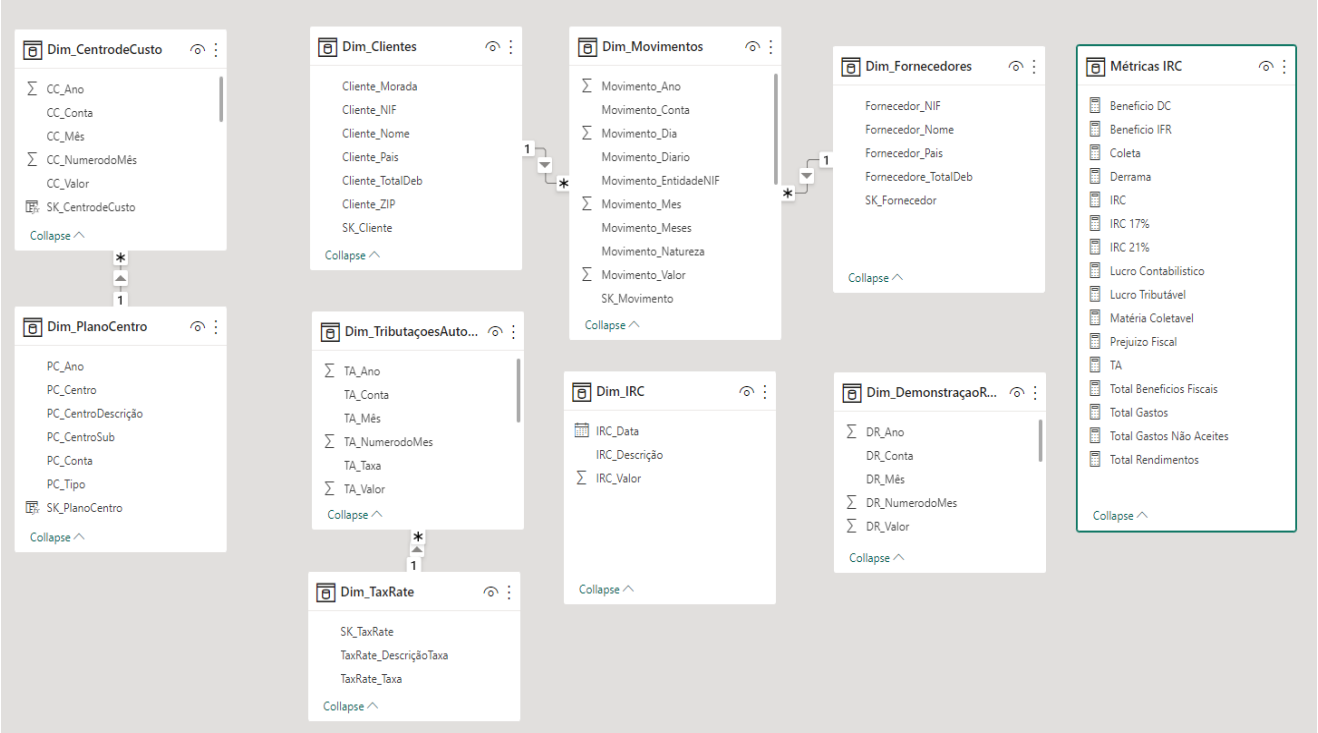

Figure 4.2 - Dimensional Model

4.2.3. Dashboard Design:

It has the ultimate goal of enabling a new way to show companies their accounting results. The creation of dashboards is essential, thus creating a more optimized way to deliver the correct information to the right users at the crucial moment of decision-making, improving efficiency and increasing bottom-line results.

In the present project, the decision was made to utilize dashboard reporting due to its ability to offer real-time, detailed data. This approach enables a structured analysis of the information and presents performance visually through the use of charts, graphs, and tables.

The dashboards will show the indicators introduced in Chapter 4.1, and six dashboards will be generated with the following aspects: Analysis by Customer, Analysis by Supplier, Analysis by Cost Center, Analysis by Autonomous Taxation, Analysis by IRC and, finally, Analysis by Income Statement. These analyses are based on the companies' generic needs considering the financial information that can be found in Accounting.

On the other hand, it is imperative to point out that the elements to be integrated into dashboards should follow uniform rules to facilitate end-user use. Thus, it is essential to define in advance the background, formatting rules, display types, filters, colours, and font style to be used to ensure the integrity, credibility and clarity of the objects presented in present and future dashboards.

5. CASE STUDY

This chapter uses a case study to apply the conceptual model proposed above. MTConsulting is an Accounting and Financial Management company with more than ten years of experience. With a client portfolio of over 100 clients, providing support to various sectors of activity, its primary goal is to boost business growth and success, offering personalized services to companies in different sectors. Having the company's ideologies aligned with that part of the project, it kindly provided one of its databases for the execution of this research project.

For confidentiality reasons, the name of the Database provided by the consultant cannot be identified, which will be called "Company XPTO". "Company XPTO" has been in the local accommodation market since 2021, owning several apartments in the Greater Lisbon area. To control the transactions made in the company, the company named its Cost Centers "Parque das Nações," "Cascais," "Lisboa," and "Carcavelos," based on the areas of Lisbon where it operates. Each cost centres are divided within them between the categories of Earnings and Expenses, which are further decomposed into subcategories.

The company also showed interest in having a monthly forecast of IRC and Autonomous Taxation updated to be able to control and predict how much it would have to spend from its profits to pay future tax charges at the end of the year. Initially, research will be conducted to identify the best tools to implement the Business Intelligence system. Next, Company XPTO's data sources will be identified and described, and the proposed dimensional model will be adapted to meet the company's measured needs.

The development of the case study will also go through the implementation of the ETL process, which will allow for the extraction, data cleaning, and development of metrics regarding Company XPTO. Finally, the dashboards implemented with Company X's data will be presented.

5.1. SOFTWARE

According to a study published by Gartner on April 5, 2023, the Business Intelligence and Analytics platforms with the best market positioning are those from Microsoft.

As shown in Figure 5.1, Microsoft platforms are positioned as the leader, being suitable for completeness of vision and highest in the ability to execute (Gartner Reprint, 2023).

Figure 5.1 - Magic Quadrant for Analytics and Business Intelligence Platforms April 2023

Therefore, this project will use the tools provided by Microsoft to implement the Business Intelligence system:

- SQL Server Management Studio 2019 (SSMS): This software will be used to store the data from the Data Warehouse.
- SQL Server Integration Services Projects (SSIS): This software integrated within Visual Studio will be used to perform the ETL process, operating in the extraction of data from the company's respective information sources and integrating them into the appropriate destinations, these data having been transformed and cleaned for the Data Warehouse
- Power BI: This software will have the purpose of creating the previously predefined metrics, processing the data in a way that the end user can easily access. Finally, it will generate reports in which dashboards will be created, presented, and managed.

5.2. CHARACTERIZATION OF DATA SOURCES:

MTConsulting has its leading accounting, management and financial movement control software - Primavera. Primavera software is a business management solution developed by the Portuguese company Primavera BSS. It is widely used by companies from different sectors, offering comprehensive functionalities, such as financial management, accounting, and human resources. Primavera helps companies optimize processes and make strategic decisions with an intuitive and customizable interface.

Being Company XPTO a client of MTConsulting, its financial information storage software is Primavera, and the database is in Primavera's SQL Server systems. This way, it was given access to the database .bak file with all the information about the financial movements, making it easier to automate the data extraction process for the new Data Warehouse.

Next, it was highlight the data that will be extracted from the company's operating system and that will serve as the basis for the development of future analyses:

- Movements of Accounts Payable and Accounts Receivable accounts in the various Accounting journals;
- Accumulated Values of Accounts;
- Accumulated Values of Cost Centers Accounts and the respective Cost Center Plan.

On the other hand, the Primavera system implemented does not have the option to calculate the IRC payable/refundable, so it was not possible to know information directly. Therefore, Excel file contains the items and values that allows the tax calculation and analysis of its fluctuations over the years.

The Excel of the IRC was not the only Excel file used, since it is necessary to know the adhering rates to match the expenses accepted for autonomous taxation. That is, each expense accepted for autonomous taxation falls into a category, and each category has a rate corresponding to the percentage value that will be applied to the expense, to measure the final tax that the State will make to increase tax revenue.

Finally, it is essential to mention that the current system of Company XPTO was only completely structured in 2021, so the data presented in the analysis is from January 2021 to April 2023.

In the end, in Annexes – “Annexes A - Structure of data source tables”, you can find the main parts of the tables used from the data source. Not all attributes were placed since there were tables with a large dimensionality, and the information was irrelevant to this project.

5.3. DATA INTEGRATION AND PROCESSING

5.3.1. Dimensional Data Model

The structure suggested in Chapter 4.3.3 will be the basis for implementing the dimensional data model. This model will consist of a snowflake schema, composed of eight dimensions, as described in that chapter.

It is crucial to emphasize that the dimensions and facts were previously defined based on the general needs identified. This resulted in creating a concrete model that served as the basis for the conceptual model.

Therefore, the Data Warehouse's proposed structure is adequate for Company XPTO, requiring no changes or adaptations to be successfully implemented.

5.3.2. ETL Process

After implementing the dimensional model, the ETL process is already ready to be implemented.

The data will be extracted from the Primavera data source and inserted directly into the Data Warehouse without going through a Staging Area. There is no need for a Staging Area because there is no fact table, and the data is practically mirrored from source to destination. In addition, whenever there is an update of the data, it is necessary to export from Primavera the .bak file with the new data. The data that already existed in the Data Warehouse can be changed, in case there have been changes in accounting movements - changes that may have come from errors in accounting or even changes suggested by the Customer.

The ETL process performed in the SQL Server Integration Service included connecting the data sources and their destination, cleaning the destination tables, and finally loading the transformed data into the Data Warehouse.

5.3.2.1. Connect the data:

The setup for linking the data sources and destinations in the ETL process was performed during this stage. Subsequently, within the "Connection Managers" section, the OLE DB connections for both the data source (PR144144144) and the data destination (AccountingDW) were added.

5.3.2.2. Cleaning the tables:

The intention of not re-inserting the same data into the table can avoid overwriting. By this means, it created a container that will have inserted into it several SQL Tasks that delete the data from the different tables in the model. This step holds great significance as our objective is to avoid loading redundant information into these tables, which can lead to complications and ultimately result in process failure.

5.3.2.3. Loading Data into the Data Warehouse

In this step, a container was created to establishing a connection with the preceding container to have a sequence in the processes to be executed, i.e. when debugged it will first clean the tables and only then load data into them.

- Dim_Clientes: The process of filling in this dimension is really simple and straightforward, since both the source table and the database table have a similar structure, as it can be seen the connection in Figure 5.2. In addition to the mapping process, two SQL Tasks were created to eliminate duplicate Client values and change the ID of the "*Clientes Indiferenciados*" from "VD" to "9999999", making it possible to impute data without interfering with the primary key.

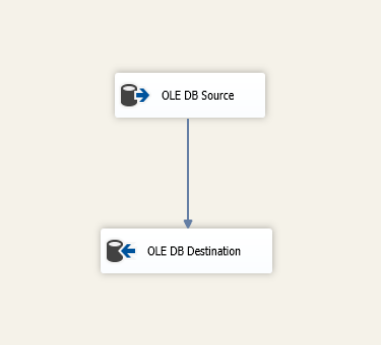

Figure 5.2 - Dim_Clientes ETL Process

- Dim_Fornecedores: As with the previous table and in the Figure 5.3, the process of filling in this dimension is straightforward and the same as shown above since both the source table and the database table have a similar structure. The differences are that in this dimension, three SQL Tasks are used. One that eliminates the duplicated values of the Suppliers, another that changes the ID of the "*Fornecedores Diversos*" from "FVD" to "9999999", being possible to make the imputation of the data without having interferences with the primary key and change the values with null TINs to the same as the supplier's ID.

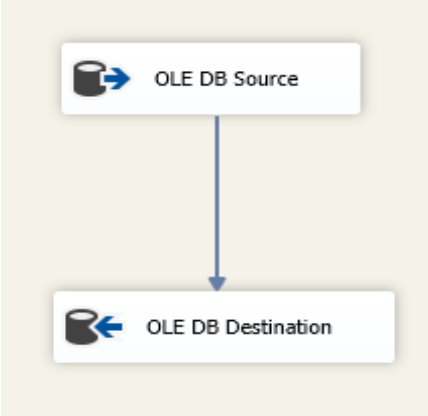

Figure 5.3 - Dim_Fornecedores ETL Process

- Dim_CentrosdeCusto: In the process of Figure 5.4, a "Derived Column" was already added to calculate the balance of the value between Debits and Credits in each month. Data mapping is carried out only subsequent to the implementation of this transformation. In this dimension, all the positive values were passed through a SQL Task to facilitate the future creation of metrics and data reading.

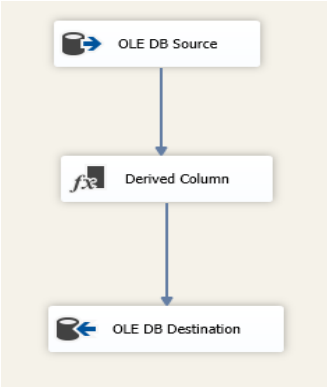

Figure 5.4 - Dim_CentrosdeCusto ETL Process

- Dim_PlanoCentro: Importing the data into this table was simple. It is just a direct link, as can be seen in Figure 5.5, because the table and the database table have the same structure and terminology.

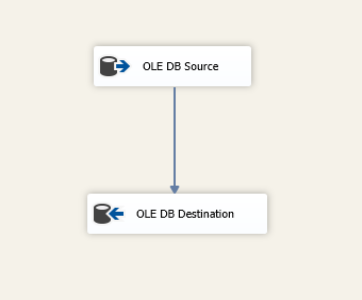

Figure 5.5 - Dim_PlanoCentro ETL Process

- Dim_Movimentos: For this table, the process has already resorted to the use of more SSIS tools, namely a "Derived Column" to remove from the source movements table only the accounts “2211” (Suppliers) and “21111” (Customers), and extract the results of the journals "41", "51", "30", "31", i.e., to remove where the Purchases, Sales, cash outflows and inflows are moved. The "Derived Column" was added to a "Conditional Split" to only output the results with values and exclude the nulls from the above conditions. Then it was linked to a "Union All" since it had two expressions, one for the "Accounts" and another for the "Journals". Finally, the "Union All" was linked to the destination and the values were mapped. This whole process can be seen in figure 5.6 below.

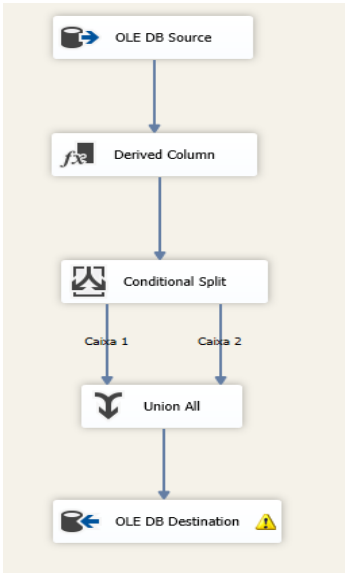

Figure 5.6 - Dim_Movimentos ETL Process

- Dim_TributaçoesAutonomas: The process of integrating the data in this table was more complicated - as illustrated in figure 5.7.

  Starting by using a "Conditional Split" to remove the accounts that were recognized, to date, as expenses accepted for autonomous taxation. Then for each of the outputs, a "Derived Column" was added, which transformed the number of that account into the name pretended to be, making it easier to visualize the information. To have an aggregation of all the "Derived Columns", a "Union All" was added that was followed by another "Derived Column", that created a column for the ID of the rate to be applied and the balance of each month, (that is the difference between the Debits and Credits). Finally, the mapping was done.

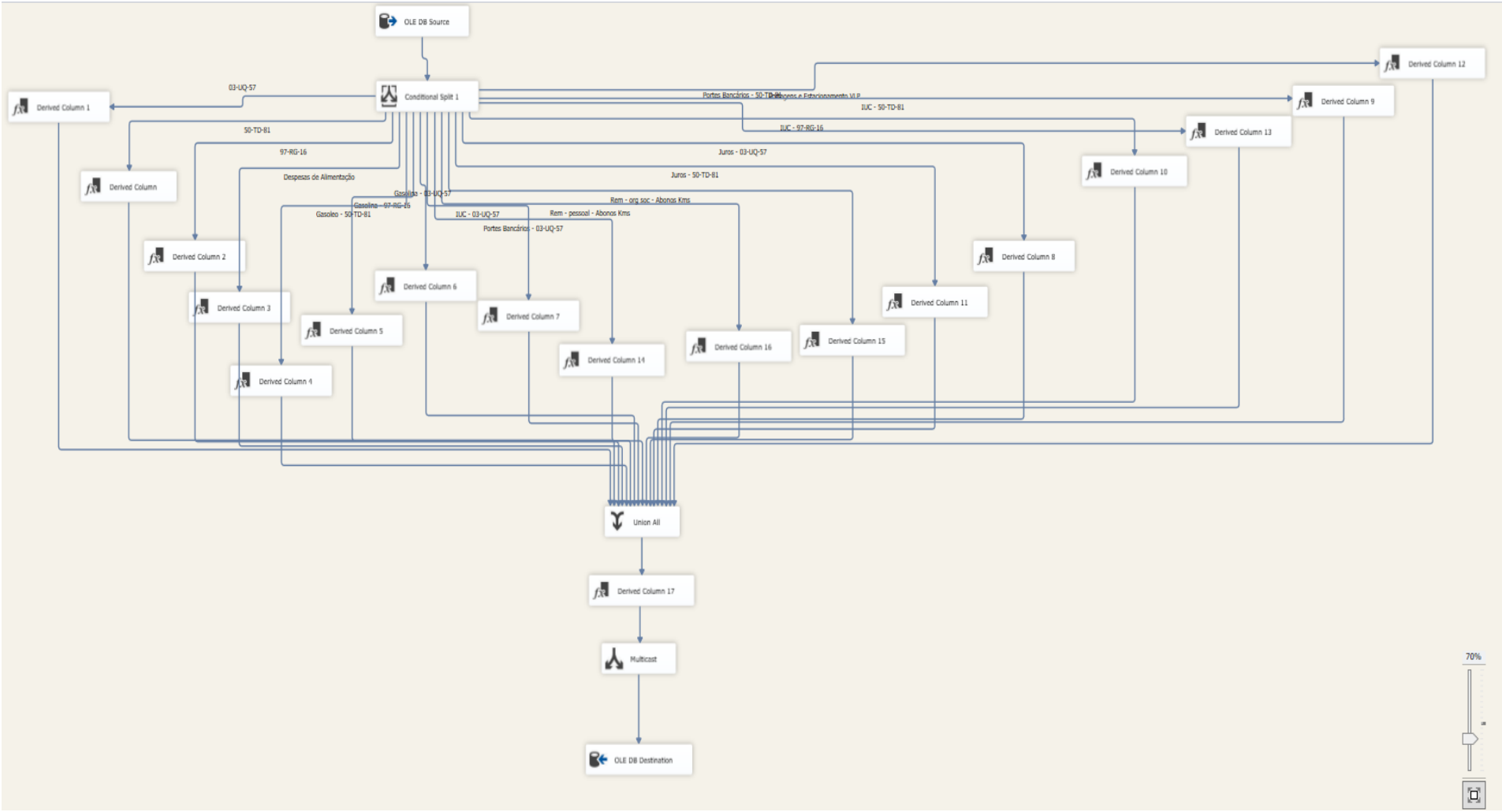

Figure 5.7 - Dim_TributaçoesAutonomas ETL Process

- Dim_DemonstraçaoResultados: The process was the same as above for this dimension, with only two exceptions. First, the accounts accepted for forming the Profit and Loss Statement, namely the Income and Expense accounts, were removed. Furthermore, since there is an import of Expenses and Income, the method of balancing the accounts on a monthly basis cannot be done in the same way, and so for all the Expense accounts (Class 6) the formula applied was the difference of Debits by Credits and for the Income accounts (Class 7) it was the inverse difference, Credits by Debits. The entire process carried out to transform the data into the new table can be seen in Figure 5.8

In the whole ETL process, eighteen SQL Tasks were created. These queries were used in the cleaning, processing and extracting of data to allow them to be loaded into the Data Warehouse correctly, making them easier to access and use. An example was the one mentioned in the Customer Dimension for the substitution of one of the values:

```
UPDATED Dim_Clientes
SET BK_Clientes = “9999999”
WHERE BK_Clientes = “VD
```

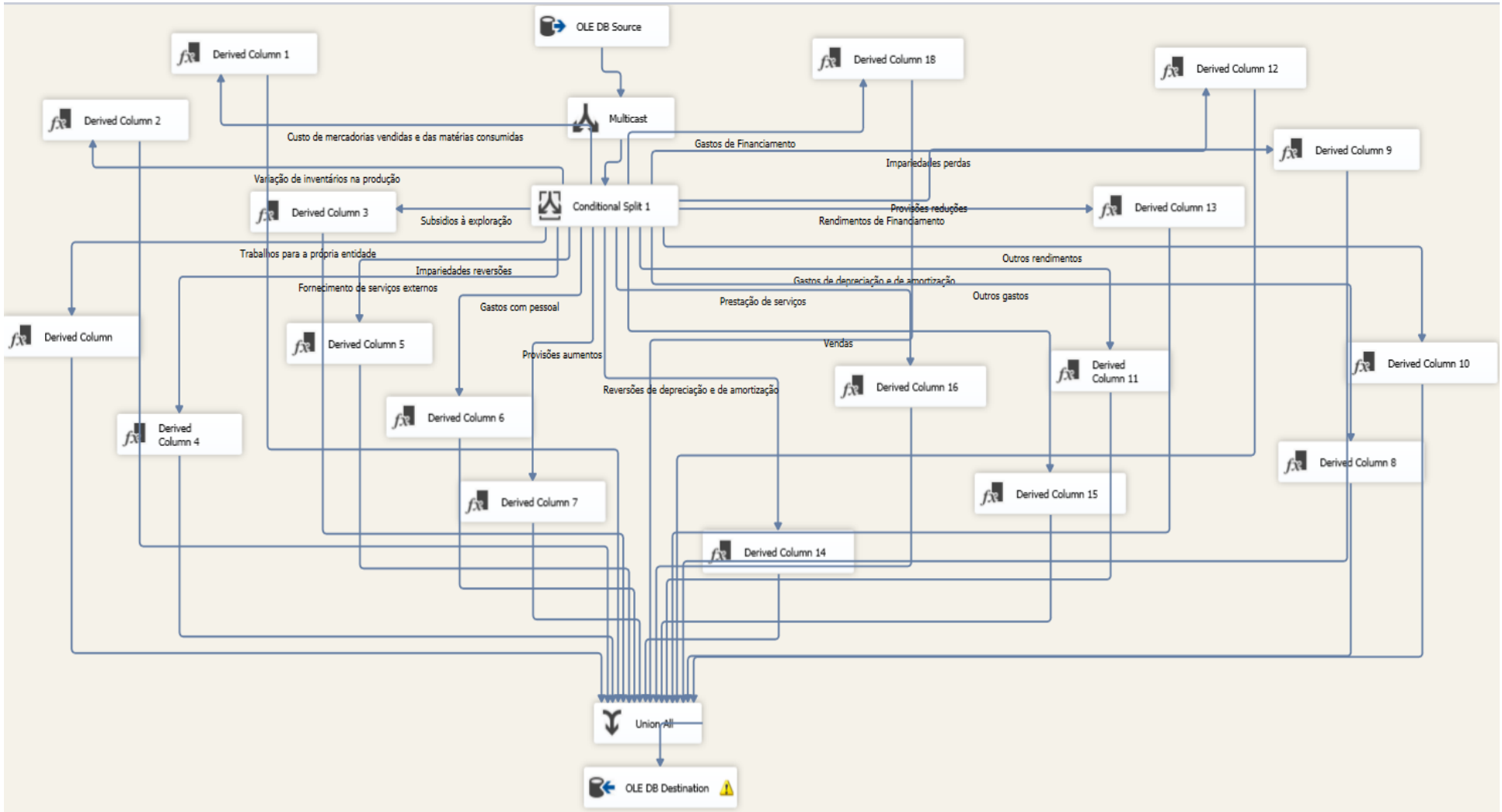

Figure 5.8 - Dim_DemonstraçaoResultados ETL Process

5.3.3. Metrics Development and Data Visualization

The last phase is the design and conception of the dashboards, which will be created taking into account the previously defined directives. As already mentioned, six dashboards will be implemented, which will be presented below, and contemplate the following aspects: analysis by the supplier, analysis by the client, analysis by cost centre, analysis by autonomous taxes, analysis by corporate income tax and analysis of the income statement.

5.3.3.1. Analysis by Supplier Dashboard:

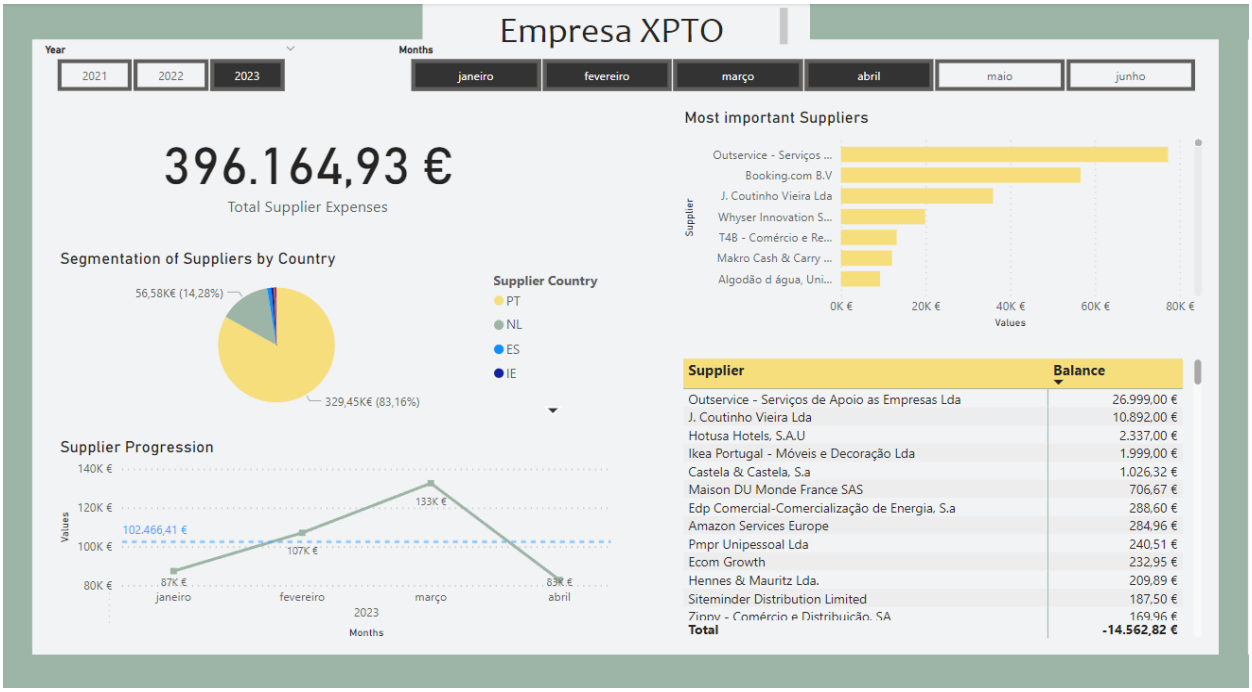

Figure 5.9 - Dashboard Supplier Analysis

Supplier analysis showed in Figure 5.9 is the first theme of the reports to be addressed since it provides indicators and views that approach the data more detailedly.

In the analysis of this dashboard, at the top, you will find slicers for selecting the time you wish to analyze. Note that the selected period in the image above is the first four months of 2023. Next, you can find, on the left side, a card with the indicator of total expenses made with suppliers, resulting from the calculation of the difference between the values of credits and debits present in the journal 41 (purchases), so that you can deduct the credit notes from the total value calculated in the suppliers account.

On the lower right corner is a matrix table with the balances of each supplier, that is how much the XPTO Company still owes each supplier. It is a metric calculated by using the previous metric and subtracting it from a new one that gave the amounts already paid by the company to suppliers.

The remaining dashboard is composed of the following charts:

- Pie Chart: shows where the leading suppliers of XPTO Company are located, highlighting Portugal as the main country that provides services to the company.
- Line Chart: this visualization shows the annual variation of the expenses with suppliers and has a little blue line showing the average spent as a reference.
- Clustered Bar Chart: finally, this chart shows which suppliers most influence Empresa XPTO's business until the date marked in the filters.

5.3.3.2. Analysis by Clients Dashboard

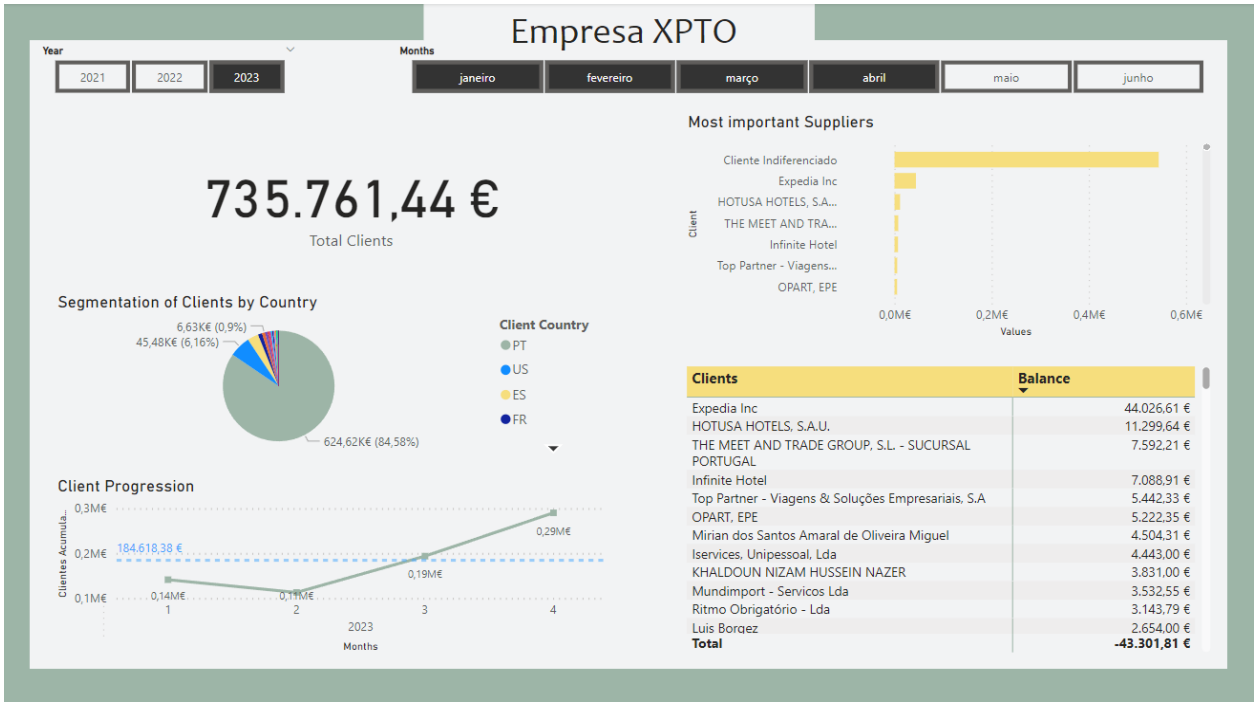

Figure 5.10 - Dashboard Clients Analysis

The analysis by the customer in Figure 5.10 is the other theme of the reports to be addressed, as it provides indicators and views that approach the data in a more detailed way regarding the customers' behavior with the company.

With the supplier's dashboard, at the top, you will find slicers for selecting the time you wish to analyze, using the same time frame as the previous dashboard.

As in the last dashboard, you can find, on the left side, a card with the indicator of total earnings made with customers, resulting from the calculation of the difference between the values of debits and credits present in the diary 51 (sales), so that you can take from the total amount calculated in the customer account the credit notes issued. In the bottom-right section is a matrix table with the balances of each customer, that is, what are and how much the customers still owe to Company XPTO a metric calculated by using the previous metric and subtracting it by a new one that gave the amounts already paid by customers to the company.

The remaining dashboard is composed of the following charts:

- Pie Chart: shows where the main XPTO Company Customers are located, highlighting Portugal as the main country where the company's customers come from.
- Line Chart: this visualization shows the annual variation of receipts with clients and has a little blue line showing the average received as a reference.
- Clustered Bar Chart: finally, this chart shows which are the clients that most influence the business of XPTO Company until the date marked on the filters.

5.3.3.3. Analysis by Cost Centre Dashboard

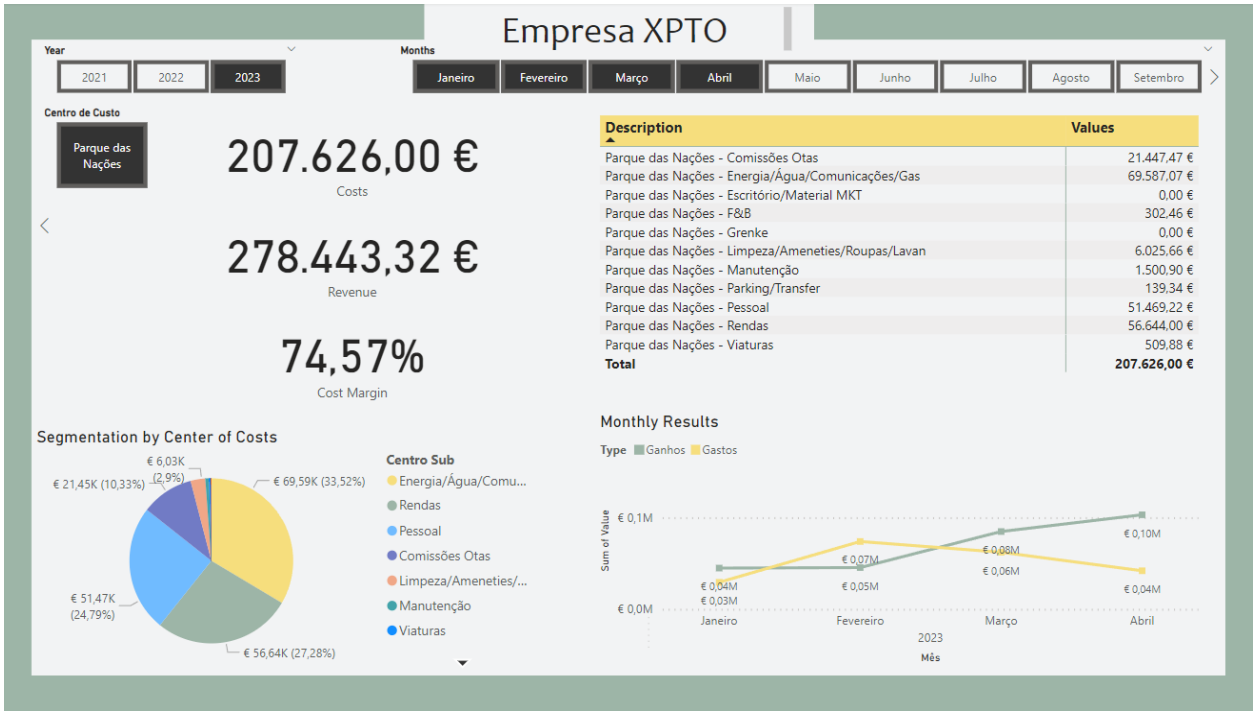

Figure 5.11 - Dashboard Cost Centre Analysis

The third dashboard shows analysis by cost centres. Thus encompassing the categorization of all expenses and income moved in the company, as a result provides a more general and systemic image of the company's situation, from the economic point of view.

In addition to the slicers that enable us to select the desired period, this dashboard - in Figure 5.11 - also features a slicer on the left side that allows us to choose the specific cost center for analysis. In the case of XPTO Company, there are four cost centres, namely “Parque das Nações”, “Cascais”, “Lisboa” and “Carcavelos”.

The report is presented on the left side with three cards with the three main indicators of this analysis: the costs, the revenues and the cost margin. In this case, it indicates how much the costs represent the gains.

The rest of the panel consists of the following graphics:

- Pie Chart: It allows you to see which cost centre items have the most weight in total expenses. Revenues are not shown since their only category is "Sales".
- Matrix Table: This view shows the value of each cost centre item, considering the date selected in the slicer.
- Line Chart: This chart shows the variation of Gains and Expenses throughout the year and how the two lines behave about each other, thus being able to identify the intersection points.

5.3.3.4. Analysis by Autonomous Taxation Dashboard

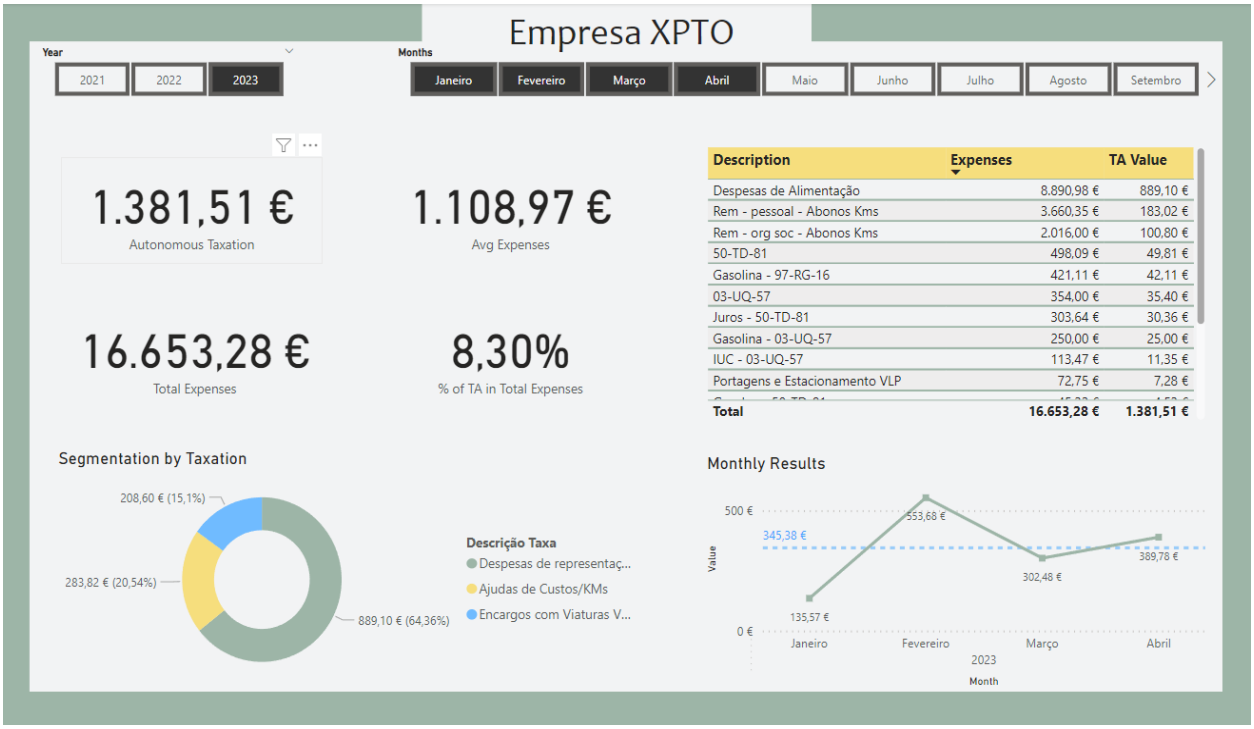

Figure 5.12 - Dashboard Autonomous Taxation Analysis

In the Figure 5.12, like in the previous ones, you will find a report where the slicers are in the upper part to select the time period you want to analyze.

The analysis by autonomous taxation allows the company manager to have prior knowledge of how much tax the company manager will have to pay at the end of the year and gives him an idea of the main charges that contribute to the high taxed amount.

In terms of visualizations, this report contains four cards with the key metrics of this analysis, which are the amount payable for autonomous taxation, the amount of expenses accepted for autonomous taxation, the average of expenses with autonomous taxation and the weight of autonomous taxation in the total amounts obtained for its calculation.

In the upper right corner is a table matrix with the total amount of expenses for each item considered for taxation and the amount of this total removed as a charge, i.e. how much the XPTO Company has to pay in autonomous taxation for each category.

In addition to these visuals presented, there are two more:

- Pie Chart: This chart allows you to see which category has the most significant weight in taxation according to the autonomous tax rates.
- Line Chart: Finally, this visualization shows the annual change in autonomous taxation and has a small blue line to show taxation expenses throughout the year.

5.3.3.5. Analysis by Collective Income Tax Dashboard

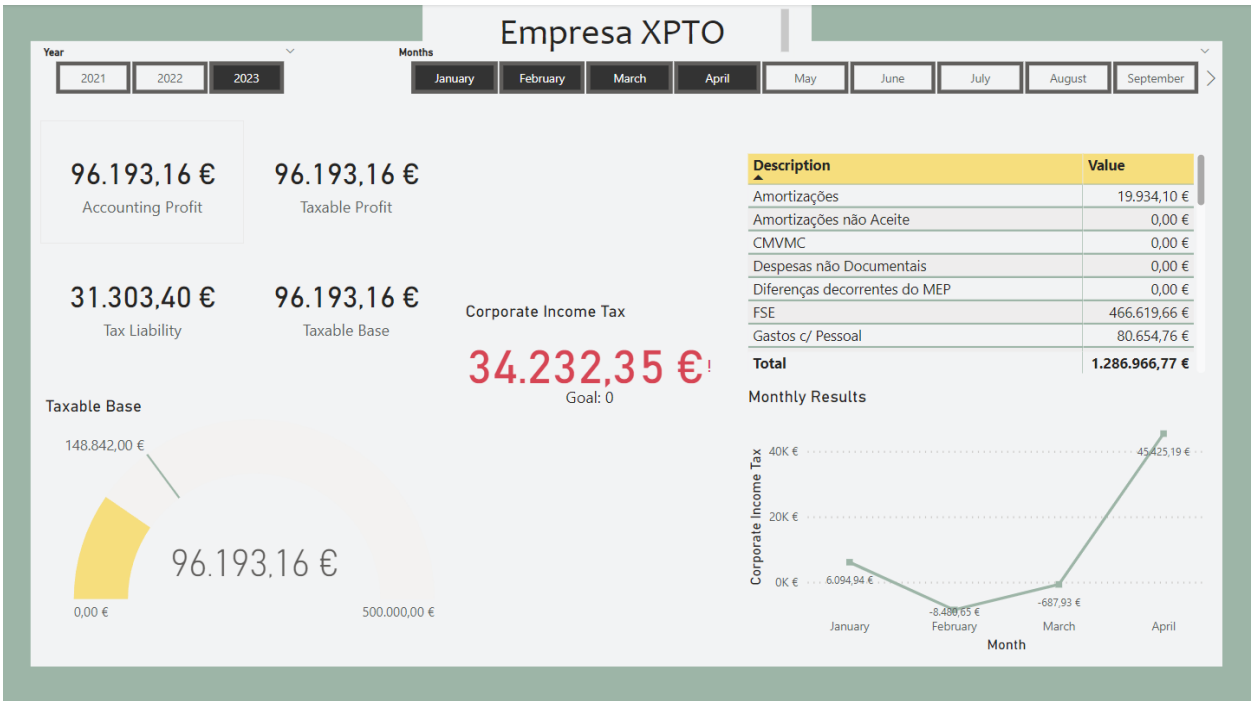

Figure 5.13 - Dashboard Collective Income Tax Analysis

The fifth dashboard informs Company XPTO about its contribution status regarding corporate income tax, until April 2023 - as can be seen, by the slicers applied above in Figure 5.13.

The report consists of four cards showing the metrics defined in Chapter 4: Accounting Profit, Tax Liability, Taxable Profit and Taxable Base.

The remaining information has a gauge in the lower left corner. It shows how much of the Taxable Base was already considered and has as its target value the Taxable Base value from last year. The maximum was a value considered achievable, but it is not intended, since it would imply the payment of more taxes.

On the right side are two visuals, a matrix table that shows the descriptions and the values of the items accepted to calculate the final tax payable. Below this table is a line chart showing the variation over the year of the final tax to be paid by XPTO Company.

Finally, at the center of this report is a visual KPI, which is composed by of the amount of corporate income tax to be paid/received. In this example, a value of 0 was assigned as a goal, and this means that for Company XPTO, the ideal is not to pay nor receive tax, since if they had to receive tax, it would simply write off the value of the following years in case it had to pay tax. Therefore, values below 0 are positive, and the visual is green since it has no tax to owe but to receive. On the other hand, values above 0, the graph shows the colour red and alerts the company's tax situation to the managing partner, in a more more visually way.

5.3.3.6. Dashboard Analysis by Profit and Loss Statement

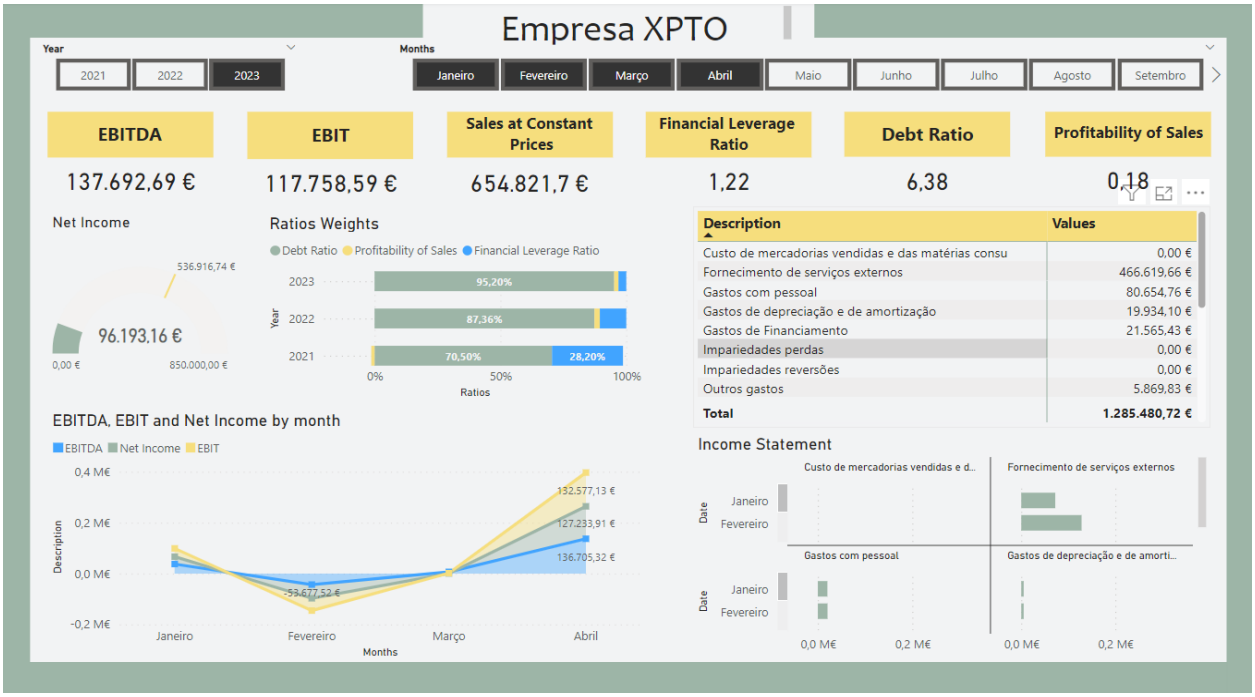

Figure 5.14 - Dashboard Profit and Loss Statement Analysis

The final dashboard showcased in Figure 5.14 aims to present the Profit and Loss Statement file more dynamically, allowing you to extract more information with less time.

This dashboard maintains the same structure as the previous ones, with the time slicer at the top. Just below the temporal slicers, there are six cards, which show the results obtained with the calculation of the metrics mentioned in Chapter 4, thus giving the company's manager, quickly and effectively, information about EBITDA, EBIT, Sales at Constant Price, Financial Leverage Ratio, Debt Ratio and Profitability of Sales without having him to do the calculations himself.

Below the line of cards with the metrics are the remaining visuals. On the left side there are present: a gauge chart, as well as the last dashboard - which shows the value of the company's Net Income, aiming to reach last year's value and having as a more optimistic goal a much higher value - a bar chart 100% stacked - which has the weights of the measures of Financial Leverage Ratio, Debt Ratio and Profitability of Sales, allowing the manager to see the overall weight of these in the business - ; and also a chart of stacked areas that shows the annual evolution of EBITDA, EBIT and Net Income.

Finally, on the right side are two graphs, a matrix table displaying comprehensive information from the data used in the Income Statement, and a description of the item and values. Below this table is a clustered bar chart, which shows the evolution of each of the items of the Income Statement throughout the year and allows the manager to understand which items have more impact on Net Income.

6. EVALUATION

In this chapter, the goal is to evaluate the developed artifact, taking into consideration the previously established objectives, in order to determine whether they were achieved or not.

The project began with identifying the problem related to how accounting firms communicate financial information to their clients in order to find the best solution. In this sense, several objectives to be achieved were initially established, along with the definition of the methodology to be followed.

Next, a literature review was performed that allowed the theoretical framework of the subject under the study of Accounting in general, its development for Analytical Accounting, taking into account the information it provides for the creation of financial analysis and its interrelationship with the area of Business Intelligence, which through the unification of the various knowledge acquired was possible to achieve the necessary understanding for best practices to deal with the problem.

After obtaining the required theoretical knowledge and identifying the demands related to the disclosure and performance of the reports provided by accounting professionals, it was created a conceptual model that adhered to the problem identified. It should be noted that the conceptual model developed was designed based on generic information that recipients of accounting information would like to have improved. Still, it can be extrapolated to other organizations and fully customizable to each information recipient's needs, constituting yet another objective of this project.

Concerning the dimensional data model developed, it was shown that it met all the requirements, allowing for the analysis of the various aspects that the accounting systems contain (e.g. CIT, customers, supplies) in the other financial indicators (e.g. EBITA, Net Income, CIT payable/receivable, autonomous taxation amount) over the years. Furthermore, the conceptual model also proved to be easily adaptable to other organizations that use Primavera software for their accounting records. With the case study applied to a company following the guidelines of the Portuguese Accounting Standardization System, providing that applying the model to a database tracking other national accounting systems would be possible.

Regarding the execution of the project, the selection of the software to be used also played a crucial role. The tools chosen proved to be suitable for the implementation of the model.

The ETL process was a challenge in this project, as it was necessary to take relatively specific information from the data source and perform a set of complex transformations to achieve the desired end result.

Finally, the data visualization through dashboards and the development of the selected metrics were designed based on the specific needs of the users of the accounting information, namely the companies' managers.

This model makes information - that used to be static, difficult to read, and with an extensive analysis process - into information that can be quickly read and understood by all the model's end users. In addition, the dashboards were designed to be interactive, with the possibility of selecting various filters and time series.

The result is a data repository that meets the readers' needs, allowing companies to access data information at the right time, to the right people, and to draw conclusions about the state of the business quickly.

7. CONCLUSIONS

7.1. SYNTHESIS OF THE DEVELOPED WORK

This project was presented with the main objective of building a model that would allow the development of reports that facilitate the reading of the information in Accounting, using Data Warehousing techniques, for companies of all sizes and operating in any sector.

After the development of the conceptual model, the artefact was applied to a case study using the database present in an Accounting and Consulting company, allowing the development of the proof-of-concept. This small firm operates in the Accounting sector and allowed us access to the database of a company that operates in the local accommodation sector. Like other companies in the sector, they must improve their services and differentiate themselves from the competition. Thus, the possibility arises to develop a new way to deliver financial information to their customers.

The project was organized following Peffers' Design Science Research approach, adopting, in this case, a focused perspective on the issues at hand, which became the starting point for the investigation. Therefore, the application of the design science research methodology in this project followed a process composed of six main steps: identification of the challenge and justification; definition of the solution's objective; creation and development; demonstration; evaluation; and communication.

The project's final output is the Data Warehouse and the dashboards implemented, which are considered to have met the defined objectives and the needs that will begin to emerge in the market. As accounting is a crucial aspect across sectors of activity, the development of this tool aligns with the sustainability goals of promoting economic growth. By providing companies with insights into their strengths and weaknesses, it supports innovation efforts by enabling managers to make informed investment decisions and transition to more sustainable practices. Moreover, it has a significant impact on consumption and production as it empowers managers to address inefficiencies and promote responsible consumption and production patterns.

In summary, the project achieved a satisfactory success rate, enabling the presentation of financial results more conveniently and agilely, exceeding previous needs. This model allows business managers to make decisions and establish strategies based on accurate, real-time information.

7.2 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORK

Despite the positive aspects mentioned above, the goal of this chapter is to address the limitations encountered throughout the project and offer recommendations to improve the implemented model in future work.

Firstly, it is essential to point out that the need to extract the database for updating the results is a repetitive process and that the implementation of the model in the cloud allowed the data to be updated by the second, thus making the system fully effective in giving the information in real-time.

On the other hand, for the model to provide credible and accurate information, accounting entries must be made correctly and maintain a line of uniformity, such as keeping the same journal for registering purchases, following the same order concerning cost centres, and being sensitive to not duplicating customers and suppliers.

For future work, the in-depth study of predictive methods for this model would be advantageous as it was an area that received limited focus throughout this project.

Finally, further exploration and use of the tools derived from Primavera would allow the development of more in-depth analyses and give the manager a better view of the state of his company and where the opportunities and risks lie. For this to happen, it is necessary for the company representatives and the "bookkeeper" to provide the system with as much data as possible using the different available modules.

In summary, it is essential to maintain the model continuously, ensuring the accuracy and correctness of information from various sources. This will allow more accurate forecasts to be created. In addition, it is crucial to continue investing in the automation of the model, reducing the need for manual interventions by the user.

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ANNEXES

Annexes A - Structure of data source tables

Attribute	Description	Surrogate Key
Ano	Year in which the cost center was moved	YES
Centro	Cost Center ID	YES
Moeda	Currency in which the amounts were traded (EUR)	YES
Mes00CR	Amount transacted per month 00 on Credit	
Mes01CR	Amount transacted per month 01 on Credit	
Mes02CR	Amount transacted per month 02 on Credit	
Mes03CR	Amount transacted per month 03 on Credit	
Mes04CR	Amount transacted per month 04 on Credit	
Mes05CR	Amount transacted per month 05 on Credit	
Mes06CR	Amount transacted per month 06 on Credit	
Mes07CR	Amount transacted per month 07 on Credit	
Mes08CR	Amount transacted per month 08 on Credit	
Mes09CR	Amount transacted per month 09 on Credit	
Mes10CR	Amount transacted per month 10 on Credit	
Mes11CR	Amount transacted per month 11 on Credit	
Mes12CR	Amount transacted per month 12 on Credit	
Mes13CR	Amount transacted per month 13 on Credit	
Mes14CR	Amount transacted per month 14 on Credit	
Mes15CR	Amount transacted per month 15 on Credit	
Mes00DB	Amount transacted per month 00 to Debit	
Mes01DB	Amount transacted per month 01 to Debit	
Mes02DB	Amount transacted per month 02 to Debit	
Mes03DB	Amount transacted per month 03 to Debit	
Mes04DB	Amount transacted per month 04 to Debit	
Mes05DB	Amount transacted per month 05 to Debit	
Mes06DB	Amount transacted per month 06 to Debit	
Mes07DB	Amount transacted per month 07 to Debit	
Mes08DB	Amount transacted per month 08 to Debit	
Mes09DB	Amount transacted per month 09 to Debit	
Mes10DB	Amount transacted per month 10 to Debit	
Mes11DB	Amount transacted per month 11 to Debit	
Mes12DB	Amount transacted per month 12 to Debit	
Mes13DB	Amount transacted per month 13 to Debit	
Mes14DB	Amount transacted per month 14 to Debit	
Mes15DB	Amount transacted per month 15 to Debit	

Table 1 - Cost Centre table structure

Attribute	Description	Surrogate Key
Ano	Year in which the cost center was moved	YES
Conta	Account number of the National Plan of Accounts moves	YES
Moeda	Currency in which the amounts were traded (EUR)	YES
Mes00CR	Amount transacted per month 00 on Credit	
Mes01CR	Amount transacted per month 01 on Credit	
Mes02CR	Amount transacted per month 02 on Credit	
Mes03CR	Amount transacted per month 03 on Credit	
Mes04CR	Amount transacted per month 04 on Credit	
Mes05CR	Amount transacted per month 05 on Credit	
Mes06CR	Amount transacted per month 06 on Credit	
Mes07CR	Amount transacted per month 07 on Credit	
Mes08CR	Amount transacted per month 08 on Credit	
Mes09CR	Amount transacted per month 09 on Credit	
Mes10CR	Amount transacted per month 10 on Credit	
Mes11CR	Amount transacted per month 11 on Credit	
Mes12CR	Amount transacted per month 12 on Credit	
Mes13CR	Amount transacted per month 13 on Credit	
Mes14CR	Amount transacted per month 14 on Credit	
Mes15CR	Amount transacted per month 15 on Credit	
Mes00DB	Amount transacted per month 00 to Debit	
Mes01DB	Amount transacted per month 01 to Debit	
Mes02DB	Amount transacted per month 02 to Debit	
Mes03DB	Amount transacted per month 03 to Debit	
Mes04DB	Amount transacted per month 04 to Debit	
Mes05DB	Amount transacted per month 05 to Debit	
Mes06DB	Amount transacted per month 06 to Debit	
Mes07DB	Amount transacted per month 07 to Debit	
Mes08DB	Amount transacted per month 08 to Debit	
Mes09DB	Amount transacted per month 09 to Debit	
Mes10DB	Amount transacted per month 10 to Debit	
Mes11DB	Amount transacted per month 11 to Debit	
Mes12DB	Amount transacted per month 12 to Debit	
Mes13DB	Amount transacted per month 13 to Debit	
Mes14DB	Amount transacted per month 14 to Debit	
Mes15DB	Amount transacted per month 15 to Debit	
NaturezaOR	Natureza do Movimento Débito ou Crédito	

Table 2 - Accumulated Accounts table structure

Attribute	Description	Surrogate Key
Data	Transaction Date	
Descrição	Description of the IRC calculation heading	
Valor	Amount carried over	

Table 3 - IRC table structure

Attribute	Description	Surrogate Key
Cliente	Customer identification number	YES
Nome	Company or customer name	
Fac_Mor	Company headquarters address	
Fac_Local	Company headquarters location	
Fac_Cp	Company headquarters postal code	
Fac_Cploc	Postal code location of company headquarters	
Fac_Tel	Company phone number	
Fac_Fax	Company fax number	
Desconto	Discount applied to customer	
TipoPrec	Price type applied to the customer	
TipoCred	Customer credit type	
LimiteCred	Customer credit limit	
TotalDeb	Customer's total debt	
NumContrib	Customer tax number	
Pais	customer country	
TipoCli	Client Type	
AvisosVenc	Number of customer expiration notices	
ModoPag	Customer payment method	
CondPag	Customer payment condition	
Moeda	Currency used by the customer	
ModoExp	Customer shipping mode	
Vendedor	Seller associated with the customer	
Zona	Customer-associated zone	

Table 4 - Client table structure

Attribute	Description	Surrogate Key
Centro	Account ID of the National Chart of Accounts moves	YES
Descricao	Name of the Cost Center corresponding to the ID	
TipoConta	Cost Center Category	
Ano	Year in which the cost center was moved	YES
Inactivo	State of the Cost Center	
DataCriacao	Cost Center Creation Date	

Table 5 - Cost Center Plan table structure

Attribute	Description	Surrogate Key
Conta	Account number used to record the transaction	
ValorAlt	Alternative transaction value	
Mes	Month in which the transaction took place	
Dia	Day of the month the transaction took place	
Diario	Transaction related journal code	
NumDiario	Journal number related to the transaction	
Documento	Transaction document type code	
NumDoc	Transaction document number	
ContaOrigem	Source account related to the transaction	
Lote	Transaction batch number	
Descricao	Transaction description	
Valor	transaction amount	
Natureza	Nature of transaction (Credit or Debit)	
Iva	Amount of Value Added Tax (VAT)	
Selo	Stamp value used in the transaction	
QuantidadeSelo	Quantity of seal used in the transaction	
Fluxo	Transaction related flow type	
TipoConta	Transaction related account type	
Entidade	Entity associated with the transaction (NIF)	
Recapitulativo	Indication if the transaction is a recapitulative record	
TipoEntidade	Type of entity related to the transaction	
Modulo	Module used to record the transaction	
Moeda	Currency used in the transaction	
Estado	Transaction status (open, closed, cancelled, etc.)	
ClassOrgan	Transaction-related organizational classification	
ClassEcon	Economic classification related to the transaction	
ContaOrc	Budget account related to the transaction	
Terceiro	Third party involved in the transaction	
TipoTerceiro	Type of third party related to the transaction	
MesRecolha	Collection month associated with the transaction	
TipoOperacao	Type of operation related to the transaction	
ReflexaoAnalitica	Indication if the transaction has analytical reflection	
Cambio	Exchange rate applied to the transaction	
Utilizador	Name of the user responsible for recording the transaction	
DataGravacao	Date and time the transaction was recorded	
Ano	Year in which the transaction took place	
Serie	transaction series	
TipoEstado	Transaction state type	
Id	unique transaction ID	YES
Linha	Line number related to the transaction	
Pendente	Indication if the transaction is pending processing	
IdCabec	Transaction Header ID	
ValorOrigem	Original transaction amount	
CambioOrigem	Transaction original exchange rate	
EmpresaOrigem	Transaction originator company	

Table 6 - Movements table structure

Attribute	Description	Surrogate Key
Tributação	Tax rate number	YES
Descrição Taxa	Description of autonomous taxation rate category	
Taxa	Applied fee	

Table 7 – Tax Rate table structure

Annexes B - Structure of data destination tables

Attribute	Description	Surrogate Key
SK_CentrodeCusto	Unique key that identifies a cost center.	YES
CC_Ano	Year referring to cost center data.	
CC_Conta	Account associated with the cost center.	
CC_Mês	Month referring to cost center data.	
CC_Numerodo Mês	Month Number corresponding to the month of the cost center.	
CC_Valores	Values related to the cost center.	

Table 8 – "Dim_CentrodeCusto" table structure

Attribute	Description	Surrogate Key
SK_PlanoCentro	Unique key that identifies a cost center plan.	YES
PC_Conta	Account associated with the cost center plan.	
PC_CentroSub	Subcenter related to the cost center.	
PC_CentroDescrição	Description of the center related to the cost center plan.	
PC_Centro	Main Center related to the cost center plan.	
PC_Tipo	Plant plan type (for example, expenses or income).	
PC_Ano	Year referring to cost center plan data.	

Table 9 – "Dim_PlanoCentro" table structure

Attribute	Description	Surrogate Key
SK_Cliente	Unique identifier for the client.	YES
Cliente_Nome	Name of the client.	
Cliente_ZIP	ZIP code of the client's address.	
Cliente_Pais	Country of the customer.	
Cliente_NIF	Tax identification number of the client.	
Cliente_TotalDeb	Total debt of the customer.	

Table 10 – "Dim_Clientes" table structure

Attribute	Description	Surrogate Key
Fornecedor_NIF	Tax identification number of the supplier.	
Fornecedor_Nome	Name of the supplier.	
Fornecedor_Pais	Country of the supplier.	
Fornecedor_TotalDeb	Total debt of the supplier.	
SK_Fornecedor	Unique identifier for the supplier.	YES

Table 11 - "Dim_Fornecedores" table structure

Attribute	Description	Surrogate Key
SK_Movimento	Movement identifier or key.	YES
Movimento_Conta	Account associated with the movement.	
Movimento_Ano	Year of the movement.	
Movimento_Mes	Month of the movement.	
Movimento_Dia	Day of the movement.	
Movimento_Diario	Category where the movement was recorded (e.g. sales = 51)	
Movimento_Natureza	Nature or type of the movement (debit or credit).	
Movimento_EntidadeNIF	Tax identification number (NIF) of the entity associated with the movement.	
Movimento_Meses	Name of the month associated with the movement.	

Table 12 - "Dim_Movimentos" table structure

Attribute	Description	Surrogate Key
TA_Conta	Account associated with the autonomous taxation.	
TA_Ano	Year of the tax.	
TA_Taxa	ID of the tax.	
TA_Mês	Month of the tax.	
TA_NumerodoMes	Number representation of the month.	
TA_Valor	Value or amount of the tax.	

Table 13 - "Dim_TributaçoesAutonomas" table structure

Attribute	Description	Surrogate Key
SK_TaxRate	Tax ID or unique identifier for the tax.	YES
TaxRate_DescriçãoTaxa	Description of the tax rate or tax type.	
TaxRate_Taxa	Tax rate or percentage.	

Table 14 - "Dim_TaxRate" table structure

Attribute	Description	Surrogate Key
DR_Conta	Account name from the profit and lost Statement.	
DR_Ano	Year of the financial record.	
DR_Mês	Month of the financial record.	
DR_NumerodoMes	Numeric representation of the month (e.g., January = 1).	
DR_Valor	Value or amount associated with the financial record.	

Table 15 - "Dim_DemonstraçaoResultados" table structure

Attribute	Description	Surrogate Key
IRC_Data	Date of the IRC entry.	
IRC_Descrição	Description of the IRC rubrics	
IRC_Valor	Value or amount associated with the IRC entry	

Table 16 - "Dim_IRC" table structure

Attribute	Formula
Beneficio DC	IF(([Beneficio IFR] > (0.7 * CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"IFR"})), CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"IFR"})*0.7,[Beneficio IFR])
Beneficio IFR	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"IFR"}) * 0.1
Coleta	Métricas IRC'[IRC 17%] + 'Métricas IRC'[IRC 21%]
Derrama	IF([Lucro Tributável]>0, [Lucro Tributável]*0.015,0)
IRC	[Coleta]+[Beneficio DC]+[Derrama]+[TA]
IRC 17%	[Matéria Coletavel]*0.17
IRC 21%	IF([Matéria Coletavel] > 25000, ([Matéria Coletavel] - 25000)*0.21,0)
Lucro Contabilistico	[Total Rendimentos] - [Total Gastos]
Lucro Tributável	[Lucro Contabilistico] + [Total Gastos Não Aceites] - [Total Beneficios Fiscais]
Matéria Coletavel	[Lucro Tributável] - [Prejuizo Fiscal]
Prejuizo Fiscal	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"Prejuízos Fiscais"})
TA	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"Tributação Autónoma"})
Total Beneficios Fiscais	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"Remuneração Convencional do Capital Social", "Majoração Gastos Creches","Majoração Passes Sociais", "Quotizações Empresariais"})
Total Gastos	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"CMVMC", "FSE","Gastos c/ Pessoal", "Amortizações", "Perdas Por Imparidade", "Perdas por redução JV", "Outros Gastos", "Gastos
Total Gastos Não Aceites	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"Multas/Coimas", "Amortizações não Aceite","Despesas não Documentais", "Impostos Diferidos", "Diferenças decorrentes do MEP", "Juro
Total Rendimentos	CALCULATE(SUM(IRC[IRC_Valor]), IRC[IRC_Descrição] IN {"Vendas", "Prestação de Serviços","Subsidios à exploração", "Outros Rendimentos", "Reversões" })

Table 17 - "Métricas IRC"