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Decision Support System as Solution of Business Intelligence for Retail Organisations in Information Technologies Market

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Decision Support System as Solution of Business Intelligence for Retail Organisations in Information Technologies Market

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Dedicatory

The project is dedicated to my family, as without which I would not possess the energy to complete, especially my lovely wife that recently brought my delightful newborn girl to the world.

Abstract

Today successful inventory management is a dynamic activity and a balance between the use of basic techniques which are easy to use and give consistent results, and sophisticated techniques which can give better control if used correctly. The inventory manager has to focus on the simple essential requirement "creating the most profit for the organisation through the best customer service" (Wild 2002). This requirement is detailed as excellent forecasting, low inventory, sales value and small operating costs (Wild 2002).

For the high level of service, the manager expects to have the accurate and timely information that it's required to make informed decisions (Imhoff, Galemmo, and Jonathan 2003). Therefore, nothing better than a Business Intelligence (BI) system based on Data Warehouse (DW) dimensional modelling concept conceived by Doctor Ralph Kimball, who is mainly responsible for the widespread use of multidimensional data marts to support online analytical processing. Understanding the full implications and applications of the BI system in inventory management is a gradual process, but worth the effort because of the tremendous benefits.

This document explains and details the implementation of a Decision Support System based on the Microsoft Power BI solution to support inventory classification and forecasting, to assist the work of an inventory manager. In practice, several technologies and approaches for the development of a DW were studied, as well as BI solutions to present the information to the inventory manager. It was also elaborated a study of the methodologies for inventory classification and categorisation, as well as algorithms to automate these analyses. Finally, all the knowledge obtained was applied in developing a seamlessly integrated DW. Also, a set of dashboards and indicators were created to assist the inventory manager decision making.

Keywords: Decision Support Tool, Data Warehouse, OLAP, Business Intelligence, Inventory Management.

Resumo

Hoje em dia a gestão correta de inventário é uma atividade dinâmica, onde é necessário encontrar um equilíbrio entre o uso de técnicas básicas, fáceis de usar e que resultam em resultados consistentes, e as técnicas sofisticadas que podem dar melhor controlo se forem corretamente usadas. O gestor de inventário deve-se focar num requisito essencial simples "maximizar o lucro para a organização através de um melhor serviço ao cliente" (Wild 2002). Este requisito pode ser descrito como uma excelente previsão de necessidades, baixo valor de inventário, vendas de valor e baixos custos operacionais (Wild 2002).

Para atingir um nível elevado de serviço, o gestor procura obter informação correta e oportuna que necessita para tomar decisões informadas (Imhoff, Galemmo, and Jonathan 2003). Desta forma, nada melhor que um sistema BI baseado no conceito de modelo dimensional DW desenvolvido pelo Doutor Ralph Kimball, um dos principais responsáveis pelo uso difundido de data marts multi-dimensionais para suportar o processamento analítico *on-line*. Compreender as implicações e aplicações completas do sistema de BI na gestão de inventário é um processo gradual, mas o esforço necessário traz maiores benefícios.

Este documento explica e detalha a implementação de um Decision Support System (DSS) baseado na solução Microsoft Power BI com objetivo de apoiar a classificação e previsão de inventário. Na prática, foram estudadas várias tecnologias e abordagens para o desenvolvimento de um DW, além de soluções de BI para a apresentação de informações ao gestor de inventário. Foi também elaborado um estudo sobre as metodologias de classificação e categorização de inventário, bem como algoritmos para efetuar essas análises. Por fim, todo o conhecimento obtido foi aplicado no desenvolvimento de um data warehouse perfeitamente integrado. Foi ainda criado um conjunto de painéis e indicadores para auxiliar na tomada de decisão do gestor de inventário.

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Firstly, I would like to thank my advisor, Professor Dr Paulo Oliveira, from the ISEP - Instituto Superior de Engenharia do Porto of the Instituto Politécnico do Porto. Professor Dr Oliveira was always accessible whenever I came across a problem or had a question about my project. He consistently allowed this Thesis to be my work but guided me in the right direction whenever he thought I needed it.

I also would like to thank the organisation that I work for, for letting me use the data for the development of the Thesis, brought not only a more eminent substance but also kept a higher motivation.

Contents

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List of Acronyms

AHP	Analytic Hierarchical Process.
AS	Analysis Services.
B2B	Business to Business.
B2B2C	Business to Business to Consumer.
B2C	Business to Consumer.
BA	Business Analytics.
BI	Business Intelligence.
CIF	Corporate Information Factory.
CRM	Customer Relationship Management.
DAX	Data Analysis Expressions.
DB	Database.
DBMS	Database Management System.
DM	Data Mart.
DM	Dimensional Modeling.
DSS	Decision Support System.
DW	Data Warehouse.
EDW	Enterprise Data Warehouse.
ERP	Enterprise Resource Planning.
ETL	Extract Transform Load.
FFE	Fuzzy Front End.
FNS	Fast, Normal and Slow.
IS	Integration Services.
IT	Information Technology.
KPI	Key Performance Indicator.
MCIC	Multi-Criteria Inventory Classification.
MOLAP	Multidimensional On-line Analytical Processing.
OD	Operational Database.
ODBC	Open Database Connectivity.
OLAP	Online Analytical Processing.
PoC	Proof of Concept.
ROLAP	Relational On-line Analytical Processing.
SA	Staging Area.
SCD	Slowly Changing Dimension.

SKU	Stock Keeping Unit.
SS	Star Schema.
SSAS	Microsoft SQL Server Analysis Services.
SSDT	Microsoft SQL Server Data Tools.
SSIS	Microsoft SQL Server Integration Services.
SSMS	Microsoft SQL Server Management Studio.
SVOT	Single Version Of Truth.
TOPSIS	Technique for Order of Preference for Similarity.
VED	Vital, Essential or Desirable.

Chapter 1

Introduction

> "*If you always do what you always did, you will always get what you always got.*"
>
> *- Albert Einstein*

The strategic decision-making[1] in a dynamic business environment is a reality for today organisations, but as referred by Richards et al. 2019, the use of systems for corporate-level decision-making is not as prominent.

However, organisations have used data to make informed decisions since the early 1900s, but the volume of data available in today's organisations has led to the creation of advanced analytic functions that Richards et al. 2019 refers as Business Analytics (BA). Based on this model, corporate management practices could be viewed as strategic-level processes enabled by the Business Intelligence (BI) system.

Moreover, Richards et al. 2019 stated that because many of the decisions are considered to be "programmable", and that business rules are sometimes built into the BI system to speed up the decision-making process. The importance of Decision Support System (DSS) as a BI tool in inventory management, including forecasting and categorisation, is unquestionable, as Wang and Xiao Xia 2015 refers, in addition to making processes faster, these systems help to systematise procedures and thus give greater visibility on the prioritisation of actions.

For an organisation that operates in a specific market for commercialisation of technological products, inventory management and forecasting demand can be a difficult task, mostly because of the fast evolution of technology and consequently of the market. Kampen, Akkerman, and Pieter van Donk 2012 state that, knowing how and when to act in time is just important as other management related tasks, leading the company to success on a medium or long term.

The remainder of this Chapter has been structured as follow: the next Section 1.1 gives a synthesis of the context, an explanation of the problem to solve in Section 1.2, the main objectives are described in Section 1.3 and the expected results in Section 1.4. It's also described the work methodology and planning in Section 1.5. It ends with Section 1.6 that shapes the thesis structure.

1.1 Context

This project uses real and actual data from a Portuguese organisation. It has seven retail stores and an online store, where each store has its rotation models, inventory and specificities related to physical spaces, such as the size of stores and exhibition locations. For the online store that doesn't have to manage stock, it uses a demand model, that consumes the inventory of the headquarters warehouse to supply their orders.

[1] Decision-making is a cognitive process that results in the selection of choice between several alternatives.

The organisation in context, act mainly in Business to Consumer (B2C)[2] market, but the Business to Business (B2B)[3] and the Business to Business to Consumer (B2B2C)[4] were areas with significant growth in 2018.

This organisation works on the retail market of products related to technology, a market that is constantly evolving and where inventory devaluation is a common threat, requiring careful and regular analysis. Also, the inventory has a real daily cost to the organisation, due to the cost of storage and financial capacity. However, the lack of stock can also mean the sacrifice of sales. According to Wang and Xiao Xia 2015, the objective is to supply the right quantity at the right time, to optimise the maximum inventory value and minimising excess or shortage.

The role of inventory management, as described by Wild 2002, is the activity which organises the availability of items to the customers. It coordinates the purchasing to meet the market needs. It also includes the supply of sales items, new products, consumables, spare parts, obsolescent items and all other supplies. Inventory enables a company to support the customer service in situations where the purchase of the items is not able to satisfy the demand. Lack of satisfaction could arise, either because of the speed of purchasing is too protracted, or because quantities cannot be provided in virtue of the absence of stock.

Nowadays, on the subject organisation, the process of analysis is made by one person that is responsible for all the management of the inventory. So it's only made and used by this person. Being a straightforward established process, as it uses only Excel (Microsoft 2019b) and a limited set of data resources, that limits not only the added value but also the possibilities of expanding the analysis. The method that supports decision-making for managing inventory and predicting demand uses a tool called PRIMAVERA Office Extensions (PRIMAVERA Business Software Solutions 2019a) that allows access to data from the database indirectly, through static views or tables previously created in the company Enterprise Resource Planning (ERP) software Primavera (PRIMAVERA Business Software Solutions 2019b). This tool works as an add-on for Microsoft Excel that receives or updates each table or view directly to a new sheet in a workbook.

With sales of more than 40 million euros annually, it's required to have a complete and efficient solution for supporting decision-making and evaluation of key performance indicators.

1.2 Problem

One of the disadvantages of the actual analysis is the impossibility to store historical information. For example, if we have a view with the sales of last seven days, this data it's always updated to reflect the transactions of the latest seven days since the update, and the data before it, it's lost. The process of creating new views is not ideal because it requires the development of a list within the ERP software, a feature that has some limitations in its creation and thus limits the feasibility of creating new indicators or new types of analysis. Also, there isn't a validation of the integrity, validity or actuality of the data.

As it uses Excel, it's also affected by the limitation of 1,048,576 rows, as declared by Microsoft Corporation 2018, and the slowness when calculates formulas and updates indicators and charts. The actual analysis includes eight charts and takes more than sixty minutes on average to prepare and update. There is also a 4GB limitation in Excel related to data in memory to work with, as stated in Microsoft Corporation 2019.

The excel file with the analysis is stored locally on a computer, and it's only available to the person responsible for the process. No one else has access to it.

[2] Business model where the organisation sells directly to the end customer.

[3] Business model where the organisation sells to other organisations.

[4] Business model where organisation reach new markets and customers by partnering with consumer-oriented product and service businesses.

The analysis is carried out in an almost unfounded way. The process is practically manual and mainly based on the intuition and knowledge of the person in charge of the process, which makes this process prominent to Human failures in almost every step.

Also, as referred by Chaudhuri and Dayal 1997, the use of operational databases result in unacceptable performance and limited possibility of understanding trends or making predictions as the operational databases stores only current data.

As a structured and concise form of analyses does not exist, it's difficult within the organisation concerned, to analyse the consequences of the lack of real support in the study of forecasts of demand and on poor management or inventory categorisation. This topic should be the main focus of the Thesis, showing the importance of a DSS in an organisation that deals with inventory.

1.3 Objectives

With this thesis is intended to evaluate and analyse the problem described in Section 1.2 to obtain a correct and optimised solution.

Therefore, develop a system aimed to assist in informed decision-making as a form of a DSS. In the concept of BI a back-end solution as the Data Warehouse (DW) and a front-end solution to interact and inform the target user.

According to Kimball and Ross 2016, some of the reasons for developing a DW are:

- Need to gather in one place all the historical data;
- Keep of historical records;
- Restructure of the data and rename of tables and fields, so it makes more sense to the users;
- Use master data management to consolidate many tables;
- Users running reports directly against operational systems, causing performance problems;
- Easy to use data warehouse allows users to create their analysis without having to get IT involved;
- Improved data quality by cleaning up imported data into the data warehouse.

Moreover, Kimball and Ross 2016 also adds that organisations that have implemented DW and BI systems have generated more profit than companies that haven't invested in these systems.

Consequently, the development of a DW is one of the main objectives for the Thesis, as a subject-oriented, integrated, time-variant, nonvolatile collection of data to support strategic analysis, serving as a collection point for the needed data stored in various operational systems and then as a distribution point for sending this data to BI tools (Imhoff, Galemmo, and Jonathan 2003).

Also, describing and systematising the development process of a DW, according to the recommended methodologies evaluated on the State of the Art in Chapter 4. Then, among the existing methods for the development of DW, assess the most appropriate to be applied to the problem in question.

Developing a DW consolidating data from many heterogeneous internal and external sources, with Online Analytical Processing (OLAP) capabilities that allow supporting the multidimensional data models and operations.

Finally, the study and evaluation of methods of forecast demand in the literature on similar approaches as the subject one, and identify and interpret forms of managing and categorisation of inventory. Allowing for the implementation of correct and efficient models to the BI system results in the final objective of acquiring a system capable of efficiently supporting decision-making within inventory management.

1.4 Expected Results

Conduct a Proof of Concept (PoC) that demonstrates the validity and usefulness of the DSS developed and, consequently, the DW, by generating a set of performance indicators that support the decision-making on the process of inventory management, like forecasting and inventory categorisation. The efficiency of the update and process of gathering results is also one of the improvements to achieve, reducing significantly the time spent on these operations.

There are multiple benefits for a BI tool correctly implemented, some of these benefits come directly, but others may be indirect and not immediate (Nogués and Valladares 2017).

1.4.1 Direct Benefits

Resource optimisation: Normally when the need of a BI system appears it's because of the lack of real support in decision-making or this support is limited, as the excel analysis that is performed by the organisation. The BI solution should provide the required information directly, saving them with a useful format or even schedule a job to receive these reports on a timely basis (Nogués and Valladares 2017).

Cost saving: From the resource optimisation previously commented, the organisation gets cost-saving, especially on human resources that are invested in the current manual analysis process. Also, with the more advanced capabilities of the system, it is possible to obtain an effective cost analysis reporting, providing with multiple points of action to optimise processes and operations (Nogués and Valladares 2017).

Single Version Of Truth (SVOT): One of the main benefits in having a reference system that aggregates all the data for everyone analysis, is that everybody uses the same system, so all your departments get the same figures, instead of having multiple Excels with manual extractions that occur on manual modifications or personal considerations (Nogués and Valladares 2017).

Single information responsible: With a BI system, it's required to define a responsible or department that is the single point of contact for all the information. There will a centralised information delivery process. (Nogués and Valladares 2017).

Self-service analysis: It allows that business users can generate reports from themselves, without the need of third parties to do so (Nogués and Valladares 2017).

Detailed analysis capacity: With a robust data model comes data integrity, verified lookup tables, full dimensions and the hardware able to respond to the demand of the BI system, allowing the analysis of the information at the most detailed level (Nogués and Valladares 2017).

1.4.2 Indirect Benefits

Sales Increase: With more detailed and reliable reports, it's easier to find common patterns in the organisation customers. This way, it is possible to focus the marketing strategies on those customers that have determined patterns. Having the possibility to analyse through many product characteristics that can enable the increase in sales results (Nogués and Valladares 2017).

Cost reduction: With the BI system, it is possible to improve the cost controlling process. With the required information, it's feasible to analyse all current costs in the organisation, such as operational costs, human resources, renting and leasing, financial costs, employee expenses and departmental costs. (Nogués and Valladares 2017).

Customer loyalty: Evaluate the response to marketing campaigns with fidelity cards; it's possible to validate the evolution of customer acquisitions (Nogués and Valladares 2017).

Product affinity: Analyse which products are related to the customers preferences, allowing for a more oriented cross-selling[5] strategy (Nogués and Valladares 2017).

Customer Segmentation: As referred before, the possibility to analyse the customers not only based on their purchases but also their specific characteristics. Customer Relationship Management (CRM) is a great source of customer metadata, such as age, city, address, net income and number of children. With segmentation based on metrics, it's possible to create clusters of clients like the number of products acquired, preferred categories, most used payment method, preferred distribution channels, related gross sales and most often purchase periods (Nogués and Valladares 2017).

Quality analysis: Focusing the analysis in customer product feedback, reviews or repair processes, allows a detailed view on the quality of the products sold. Also, the control of on-time repair resolution and delivery of the products, enable the increase in customer loyalty.

Employee productivity analysis: It'd be more accessible to the organisation to define objectives and analyse their achievements by using BI resources to obtain data on sales force effectiveness, number of offers per employee, gross sales value, number of loss deals, resources consumed per employee, training performed or worked days.

1.5 Work Methodology

The methodology of research for this Thesis consisted in finding authors with relevance in every subject studied, then searching their most relevant articles and prioritising their newer publications. Publications in scientific journals or conferences such as "International Journal of Operations & Production Management" and "International Conference on Industrial Engineering and Engineering Management" were preferable.

Within the development of the DW, the methodology of Dr Ralph Kimball, as one of the precursors of DW concepts and systems for transactional data analysis, brings some advantages to this project. As described in Kimball and Ross 2016, using an approach to data warehouse design described as bottom-up where the dimensional data marts are first created to provide reporting and analytical capabilities for specific business areas seems more appropriate. These data marts are eventually integrated to others to create a bigger DW. So the DW ends up being segmented into several logically self-contained and consistent data marts, rather than a big and complex centralised model. With the first data marts created, it's possible to generate business value, and the method lends itself well to an exploratory and iterative approach of building data warehouses.

Regaring the writing was chosen the language LaTeX, a system for typesetting documents widely used throughout Science and Engineering. As support throughout the writing, the book Griffiths and Higham 2016, also for assistance techniques of writing and structuring the report it was used the presentation from Pereira 2018.

1.5.1 Planning

Several articles and surveys are available regarding the creation of DSS to assist managing inventory and forecasting, not only for Information Technology (IT) in specific but for other types of business. As such, the proposed research took the form of what's best on the existing research subject. Also, all of the meetings with the project supervisor were registered and can be consulted in appendix B.

[5] Action or practice of selling an additional product or service to an existing customer. Source: Wikipedia

Thesis Schedule

Harvey 2001 believed that it's vital to provide focus to the project resources through the prioritisation of assets and time, but this prioritisation and planning is one of the main challenges when developing a new project.

For scheduling and time management of the Thesis, a Gantt Chart as presented in Figure 1.1, was an useful tool to ensure that the time distribution is according to plan, as studied in Harvey 2001.

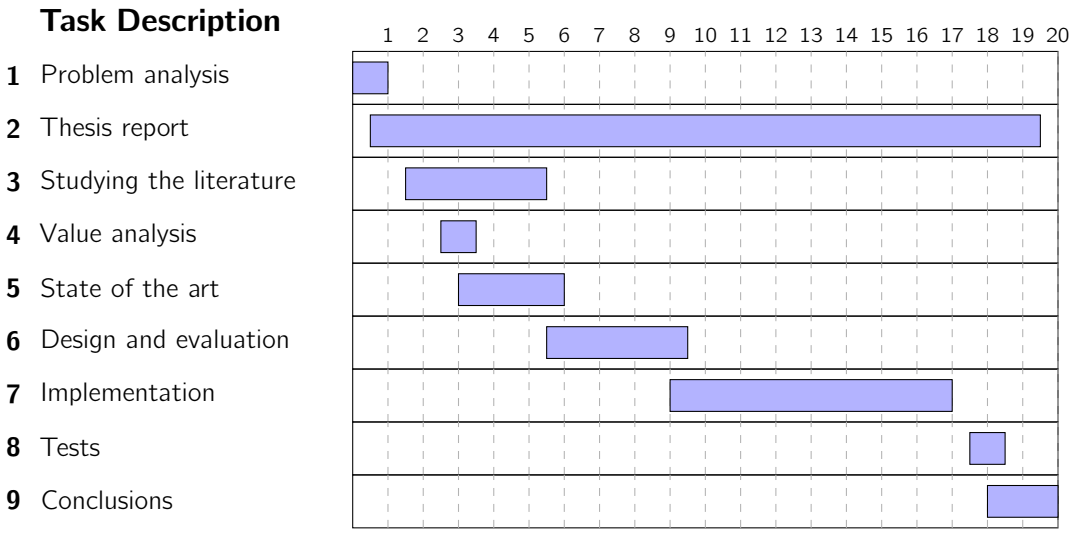


Figure 1.1: Project time schedule in week intervals

1.6 Thesis Structure

Chapter 1 is an introduction that provides the user with the context and the perception of the problem. Also, it's described in a macro form the objectives and the expected results for this solution. The Chapter ends with the work methodology, planning and this Thesis structure description. Chapter 2 describes the objective and contextualise some details such as the purpose, proposed requirements and evaluation methods for the solution. Chapter 3 presents the reader to the value analysis of this project, focusing on the solution added value. Chapter 4, introduces the reader to the most recent stage in the development of the DSS with the essential process of Extract Transform Load (ETL), DW architecture, BI tools and inventory management algorithms, incorporating the newest ideas and features. The design and development approach is described in Chapter 5 and following the defined guidelines the implementation process is detailed in Chapter 6.It ends with the final conclusion in Chapter 7.

Chapter 2

Context

"*Processed data is information. Processed information is knowledge Processed knowledge is Wisdom.*"

- Ankala V. Subbarao

This Chapter works as a context that offers the reader a more detailed view of the purpose of this solution in Section 2.1, the proposed requirements are described in Section 2.2 and the Section Section 2.2.1 describes the evaluation methodology of the requirements. There is also a Section 2.2.2 that refers to concepts, technologies and theories available, giving almost an introduction to Chapter 4. The Chapter ends with a solution life-cycle, that describes the implications of the solution failure when on production, system failure prediction and notification of the manager on Section 2.3.

2.1 Purpose

The intention is to conceive a DSS that would allow support on the decision-making of recurring and systematic situations related to inventory management. The solution should not only comply with all the analysis made by the organisation but to unlock new BA possibilities.

An autonomous DW that supplies the BI tool, to provide further security for the inventory's manager when deciding where, when and how to act, as indicated by Richards et al. 2019.

The Section 2.2 offers a more detailled view on the proposed requirements.

2.2 Proposed Requirements

DW is one of the most important concepts that come with a BI solution. DW is the foundation of traditional BI systems, and it is the place where the data to analyse is stored, usually maintained on a database system. The concept of a DW is that you can collect data from multiple sources, clean it, ensure its integrity, ensure consistency, and ensure completeness to have a reliable BI solution (Kimball and Ross 2016). Therefore, one of the first requirement is to build a process that extracts, applies the needed corrections and loads the valuable information to a DW that supply the BI reporting tool.

The following objectives were generated based on the knowledge acquired by the organisation's inventory manager:

- Updated information (One day old at maximum);
- Filtered outputs;
- Overall look over the stock and globally or per-store sales;
- Actual average margin;

- Visual ratio/KPI to evaluate the sales for each store;
- Rapidly aggregation of stock based on one or more categorisations, with meaning to the manager;
- Forecast and predict demand at Stock Keeping Unit (SKU) level.

With the use of inventory analysis algorithms, it is possible to properly evaluate the inventory, not only in terms of classification but also for forecasting demand. Only with this correct evaluation, it is possible to obtain significant indicators, which would allow the manager to support his decision.

The actual analysis includes eight dashboards, each one with a distinct graph, and each one has the following information:

- Top ten brands in stock by Store;
- Days of inventory divided by business model;
- Inventory categorisation with 5 classes from the high rotation to not moving stock;
- Inventory value by warehouse/store;
- Inventory quantity by warehouse/store;
- Inventory value by business model;
- Distribution of "non-moving" inventory by Store;
- Demand forecast by brand/product.

For the process of correct inventory management, it is required to have other indicators. First, Wild 2002 described the need for setting some parameters, such as purchase order quantity, safety stock, stock targets, company strategy. Then, some of the techniques that allow the creation of statistical or judgemental[1] indicatores and measures. All these measures can be developed both for categorisation and forecasting.

In the following Section 4.2.2 identifies Judgemental and Statistical methods in detail.

Judgemental knowledge models:

- VED (Vital, Essential and Desirable)
- AHP (Analytic Hierarchy Process)
- TOPSIS - Distance modelling (Technique for Order of Preference by Similarity to Ideal Solution)

Statistical knowledge models:

- Pareto analysis for control
- ABC analysis
- Stock Cover or Days of Stock
- XYZ classification
- FSN classification (Fast, Slow or Non-moving)

Wild 2002 assumes that one of the essential tools is that historical data allows the infer of trends and obtain predictions. However, as Petropoulos et al. 2018 indicates that sometimes the use of statistical models may not be satisfactory all alone, but used in conjunction with judgemental models, it offers better results.

[1] Judgemental forecasting methods incorporate intuitive judgement, opinions and subjective probability estimates. (Petropoulos et al. 2018)

2.2.1 Evaluation Methodology

According to Lamy et al. 2010, the DSS should be evaluated in two steps, the first one under controlled conditions, and second, evaluating it in real use. These tests are divided into two distinct methods in order the validate and detect possible errors in the solution:

1. Static method

   With the use of knowledge of an expert, it is possible to obtain an initial validation.

2. Dynamic method.

   A complete set of comparative and qualitative tests can determine whether the DSS outputs are erroneous or not.

Therefore, as validation of the developed DSS, it is used both methods as described before. The expert can evaluate the solution as a static method of approval, but also a comparative test with the old used analysis as a dynamic test.

2.2.2 Concepts, Technologies and Theories

The research has as support, some scientific papers and books that serve as a framework for Chapter 4.

DW, in the view of Chaudhuri and Dayal 1997, is a collection of decision support technologies, aimed at enabling the knowledge worker (executive, manager, analyst) to make better and faster decisions.

Kampen, Akkerman, and Pieter van Donk 2012 describes two distinct processes used in the inventory management approach, forecasting demand and categorisation of inventory. This type of analysis is transverse to all type of business that has inventory and production. However, distinct areas have different specificities that must be taken into account in the construction of models, so that these analyses have relevance to the organisation.

Wild 2002 recognises the central role of inventory management, as being appointed to coordinate various aspects of inventory management into one supply activity.

Stock control:

- purchasing
- forecasting
- planning inventory against company targets
- stock allocation and delivery promising
- monitoring and controlling service and inventory.

For this process to flow, there are some essential inventory techniques to use like categorisation, determining safety stocks, negotiating supply patterns, avoiding the slow-moving stock.

2.3 Solution's Life-cycle

As the solution life-cycle, some thoughts about the implication of a possible failure in operation, possible tests that allowed to foresee errors.

2.3.1 Implication of Solution's Failure

As we are not talking about a critical system for the organisation functioning, the implications in the case of failure are relatively low. However, in a way to maintain the solution credibility, there's the possibility to add mechanisms of failure report in different steps of the process.

2.3.2 Components Tests

Kimball and Caserta 2013 states that it is essential to create and deliver documented failure recovery procedures. If the load process fails, users could have access to it or data that is not up to date. A plan must be in place to avoid failure before the production environment unleashes to users. Also, running tests on data in production (historical and incremental) to ensure data was successfully loaded.

Chapter 3

Value's Analysis

"*The best way to predict the future is to invent it.*"

- Alan Kay

Rich, Mba, and Holweg 2000 considered that the Value Analysis is a process, as opposed to a simple technique because it is both an organised approach to improving the profitability of product applications and it utilises many different techniques to achieve this objective. This profit appears in the form of knowledge, that composes the Thesis subject.

3.1 Fuzzy Front-End Process

In the process of innovation and value proposition, one of the first techniques used is Fuzzy Front End (FFE), generally regarded as one of the most significant opportunities for improvement of the overall innovation process, as stated by Koen et al. 2002. FFE is distributed in five Front-End elements to support innovation in a sustained manner, as Opportunity Identification, Opportunity Analysis, Idea Generation & Enrichment, Idea Selection, Concept Definition;

3.1.1 Opportunity Identification

The opportunity identified for the development of this Thesis was due to the almost lack of reliable and robust indicators to assist in decision making on the subject company, such as inventory management and forecasting needs.

3.1.2 Opportunity Analysis

The use of intelligence algorithms is comprehensive throughout the management process, since the more assertive and efficient is the knowledge of the inventory, the better it's possible to perceive its distribution and what actions to take. The inventory has a real daily cost to the companies, not only because of storage costs but also because of the constant threat of devaluation. However, the lack of inventory can also lead to lower sales. Ideally, there is a need to supply the right quantity at the right time, optimising the inventory value and quantities.

3.1.3 Idea Generation & Enrichment

There are many analytical algorithms for inventory management and forecasting needs, but the most commonly used ones are ABC analysis that was developed based on the Pareto principle, which demonstrates that much of the profit comes from a small group of items. Categorisation XYZ is

also a well-known strategy to create clusters of products that allows the focus on the most profitable ones; Both of these methods were described by Kampen, Akkerman, and Pieter van Donk 2012, but many others may be applied, or even a combination of methods for a multi-criteria approach, as seen by Chen, Li, and Liu 2008.

In the qualitative classifications, Chu, Liang, and Liao 2008 indicates that the Analytic Hierarchical Process (AHP) applies to several Multi-Criteria Inventory Classification (MCIC) studies since it allows to incorporate several criteria, however, the disadvantage of comparisons between pairs of criteria is subject to considerable subjectivity. More recently, Cherif and Ladhari 2017; Kaabi and Jabeur 2016 presented hybrid approaches with good results, which have emerged by combining the AHP method with the Technique for Order of Preference for Similarity (TOPSIS) decision method.

3.1.4 Idea Selection

As there is no recipe to know what's the best analytical algorithms, a detailed analysis in Chapter 4, aids to perceive the more valuable ones.

3.1.5 Concept Definition

In addition to making processes faster, these systems help systematise procedures and thus give more visibility on the priority of actions to take.

Kampen, Akkerman, and Pieter van Donk 2012 argues that two different processes can apply in the management approach, forecasting and inventory categorisation. This type of analysis is transverse to any business that requires inventory management. However, distinct areas have different specificities that must be taken into account in the construction of models, so that these analyses have relevance to the organisation.

3.2 Value Proposition

As referenced by Osterwalder 2003, the value proposition is an overall view of product and service that altogether represent value for a specific customer segment. With the proposition, it's expected to deliver a value promise of the final solution to an inventory manager in the IT business.

Solution's Value
Chaudhuri and Dayal 1997 stated that data warehousing is a collection of decision support technologies, aimed at enabling the knowledge worker (executive, manager, analyst) to make better and faster decisions.

Thus, the value of the solution is the validity and usefulness of the developed DSS and, consequently, the respective data warehouse, by generating a set of performance indicators that support the decision-making on forecasting and classification management. The tool gives the manager easier and quicker access to relevant data about the inventory but also greater confidence in the presented data and consequently, into decisions to exert.

Chapter 4

State of art

"It is better to be high-spirited even though one makes more mistakes than to be narrow-minded and all too prudent."

- Vincent van Gogh

This Chapter conveys the reader to knowledge and theories that have been established on topics, like DW, OLAP, ETL and BI, framing the most modern and usual techniques exposing their advantages and disadvantages.

Also, the collection and review of the state of current knowledge in the subject fields, was made through the work of recognised academics and researchers.

Chaudhuri and Dayal 1997 described the typical architecture for DW in three tiers, as represented in the Figure 4.1. Therefore, this Chapter was divided into two Sections, the Section 4.1 related to the DW and OLAP representing the tier 1 and 2 stages and a second Section 4.2 that describes the tier 3 clients related to querying and reporting. This way, offering a way of organised knowledge.

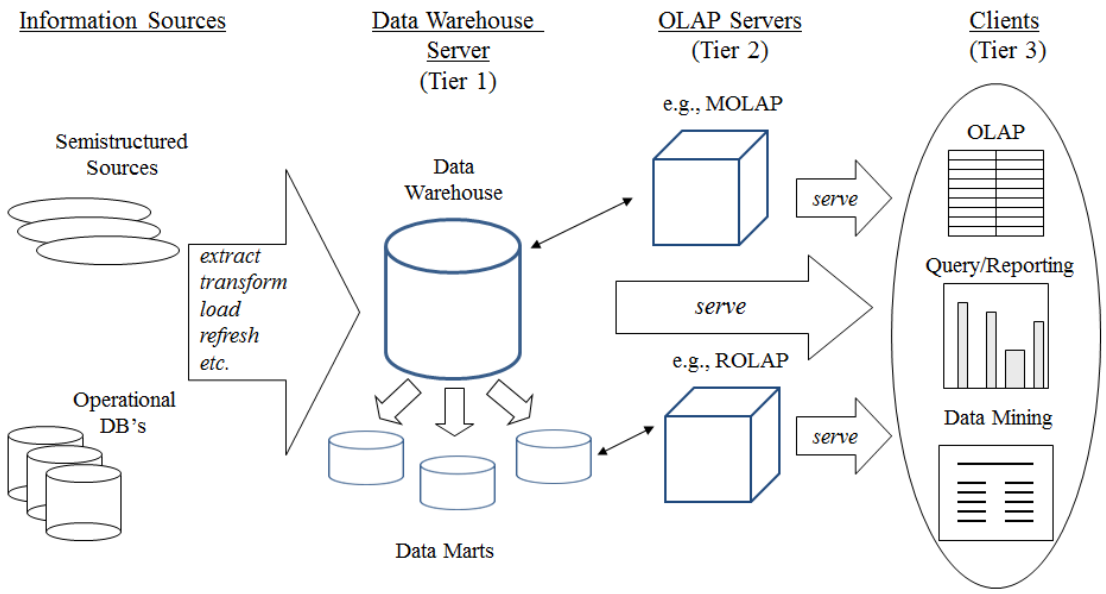


Figure 4.1: Data Warehousing Architecture.
Source: Chaudhuri and Dayal 1997

4.1 Data Warehouse & On-line Analytical Processing

Chaudhuri and Dayal 1997 refers to a DW as a subject-oriented, integrated, time-varying, non-volatile collection of data that is maintained separately from the operational databases, allowing OLAP support and assist organisational decision making.

The OLAP operations give the possibility to increase or decrease the level of aggregation, give more or less detail to data, also along with dimension hierarchies, selection and projection and re-orienting multidimensional view of data, as verified by Chaudhuri and Dayal 1997.

DW can be implemented on standard or extended relational Database Management System (DBMS), defined by Relational On-line Analytical Processing (ROLAP) servers or Multidimensional On-line Analytical Processing (MOLAP) servers. The ROLAP servers assume that data is in relational databases, and support extensions to SQL with efficient implementations of methods of multidimensional data model and operations. On the other hand, the MOLAP servers directly store multidimensional data in special data structures and implement OLAP operations over these special data structures, as Chaudhuri and Dayal 1997 stated.

The process of creating a valid Data Warehouse is complex and not easy to achieve, as Chaudhuri and Dayal 1997 described, requiring extensive business modelling. Thus, some organisations develop Data Mart solutions, which are departmental subsets focused on selected subjects and allow the faster roll out but may lead to complex integration problems in the long run.

For the study of material related to DW/BI it was used as reference some of the most relevant authors in the topics, as Imhoff, Galemmo, and Jonathan 2003; Kimball and Caserta 2013; Ross and Kimball 2013.

Ross and Kimball 2013 define some requirements for the DW/BI system, that should be taking in concern on the design process.

- The DW/BI system must make information easily accessible;

  Prioritise that the contents of the DW/BI must be understandable, meaningful through processes and vocabulary for the business users. Also, it should be easy and simple to use and fast response times.

- The DW/BI system must present information consistently;

  For credibility, the data must be thoroughly cleaned, with quality and consistency assured.

- The DW/BI system must adapt to change;

  Must be designed to handle inevitable changes in needs, business conditions, data and technology.

- The DW/BI system must present information in a timely way;

  Raw data recorded in a timely way, is available within hours, minutes or even seconds.

- The DW/BI system must be a secure bastion that protects the information assets;

  The information stored in the DW must be secured and protected.

- The DW/BI system must serve as an authoritative and trustworthy foundation for improved decision making;

  Have the right data to give the correct support on decision making.

- The business community must accept the DW/BI system to deem it successful.

  The business community must embrace the DW/BI, for that the system must meet all of the above requirements.

All of the requirements are important, but the last two are the most important of all, they usually are the most overlooked as well, Ross and Kimball 2013 added.

Despite technological advances linked to Big Data and Cloud solutions, Kimball's architecture definitions and OLAP solutions remain current, especially for high request executions (Bhatnagar et al. 2018; Makele and Doss 2018).

4.1.1 Dimensional Modeling

Dimensional Modeling (DM) is part of the Business Dimensional Life Cycle methodology explained in Ross and Kimball 2013, which includes a set of methods, techniques, and concepts for use in DW design.

Ross and Kimball 2013 defends the DM as the preferred technique for presenting analytic data because it addresses two simultaneous requirements:

- Deliver data that's understandable to the business users;
- Deliver fast query performance.

The DM aggregates several techniques that allow simplifying the databases, so in this process, the DM uses the concepts of facts to store performance measurements, and dimensions related to a descriptive context. Facts are usually, but not always, aggregated numerical values and dimensions are groups of hierarchies and descriptors that define the facts.

Four-Step Dimensional Design Process

Before starting the dimensional modelling process, it's required to understand the needs of the business, as well as the realities of the underlying source data. Setting the requirements helps to understand the objectives based on key performance indicators, compelling business issues, decision-making processes, and supporting analytic needs. At the same time, uncovers data realities by doing high-level data profiling to assess data feasibilities (Kimball and Caserta 2013).

Following the Kimball and Ross 2016 guide for designing the dimensional model, there are four key decisions to make or respond during the design:

1. Select the business process;
   Understanding and defining the business process helps to correctly design the architecture for the DW.
2. Declare the grain;
   The level of grain constrains the detail in the future analysis, so it must be thought in order to achieve the properly declaration.
3. Identify the dimensions;
   Set of structures that categorise facts and measures to enable answers to business questions. Allows the definition to which questions the system can answer.
4. Identify the facts.
   A fact can be a value, or measure, that represents information about the entity or managed system. These facts will provide the searched information.

The answer to these questions guides the whole process of building the architecture.

ETL Architecture

According to Chaudhuri and Dayal 1997, designing and rolling out a data warehouse is a complex process, requiring a set of activities:

- Define the architecture, do capacity planning, and select the storage servers, database and OLAP servers, and tools.
- Integrate the servers, storage, and client tools.
- Design the warehouse schema and views.
- Define the physical warehouse organisation, data placement, partitioning, and access methods.
- Connect the sources using gateways, Open Database Connectivity (ODBC) drivers, or other wrappers.
- Design and implement scripts for data extraction, cleaning, transformation, load, and refresh.
- Populate the repository with the schema and view definitions, scripts, and other metadata.
- Design and implement end-user applications.
- Roll out the warehouse and applications.

The ETL process consists on three stages, starting with the extraction of data from the multiple sources, followed by the transformation step, which includes data quality activities like described in the Section 4.1.1 and other transformations that give more meaning to the result. The last process after extracting, cleaning and transforming, data must be loaded into the warehouse. As accounted by Chaudhuri and Dayal 1997, additional preprocessing may still be required: checking integrity constraints; sorting; summarising, aggregation and other computation to build the derived tables stored in the warehouse; building indexes and other access paths; and partitioning to multiple target storage areas. Not only to populate the warehouse, but also must allow the system administrator to monitor status, to cancel, suspend and resume a load, and to restart after failure with no loss of data integrity.

Data Quality

For Chaudhuri and Dayal 1997, the process of data cleaning is essential, the DSS uses the data in the DW, and for that, it's expected to be correct. The DW depends on multiple sources like the least controlled and inconsistent data from operational servers. Therefore some processes and tools help to detect data anomalies and correct them, offering a high payoff to the solution.

Chaudhuri and Dayal 1997 describes some corrections are required in inconsistent field lengths, inconsistent descriptions, inconsistent value assignments, missing entries and violation of integrity constraints.

For Kimball and Ross 2016 the long term solution to data quality involves two significant steps: First we have to diagnose and tag the bad data so that we can avoid being misleading while making decisions; and second, the need to implement discipline when possible, such as on the sources to improve their business practices so that better data enters the overall data flow.

In data-quality techniques, Kimball and Caserta 2013 defines that extends from examining individual field definitions at the database level (column property enforcement) to reviewing field-to-field consistency (structure enforcement), and lastly to business-rule specific tests on data (data and value rule requirement). The final stage of data-quality processing (adjusting and removing duplicates) is the most far-reaching since, in this phase, we resolve variations across separate data sources.

Star Schemas Versus OLAP Cubes

Ross and Kimball 2013 state that, Star Schema (SS) is related to dimensional models implemented in relational database management, and those dimensional models implemented in multidimensional database environments is OLAP.

Moody and Kortink 2000 considers the SS as a fundamental building block, that consists of one large central table called fact table, and several small tables called dimension tables, that radiate from the central table, as in Figure 4.2.

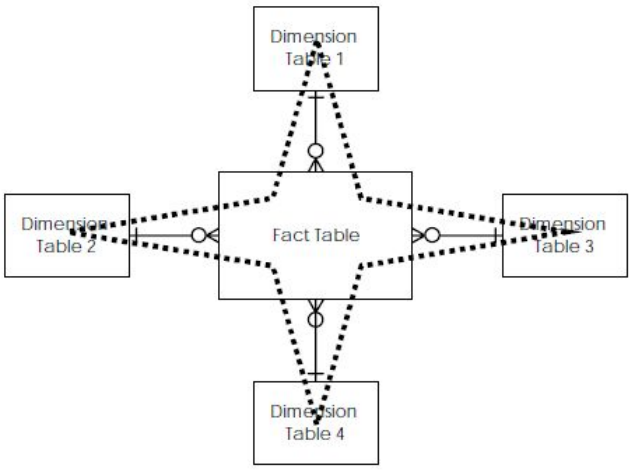


Figure 4.2: Dimensional model relational databases - Star Schema.
Source: Moody and Kortink 2000

Ross and Kimball 2013 considered that SS and OLAP are intimately related and that these data structures have proven in the last 30 years to be the one's business users can understand.

Ross and Kimball 2013 also concludes that SS is most appropriate for large data sets, with many millions or billions of numerical measurements, or many millions of members in a customer entity or a product entity. On the other hand, OLAP cubes are most appropriate for smaller data sets where analytic tools can perform complex data comparisons and calculations. Ross and Kimball 2013 adds that in almost every OLAP cube environments it's recommended that first source the data into a SS and then use wizards to transform data into the OLAP cube.

Fact Tables for Measurements

Ross and Kimball 2013 defines a fact as a business measure, and a fact table, in a dimensional model, stores organisation process events in the form of performance measurements. Because of the typically large amount of data in these measurements, it must concentrate on a single centralised repository, so that ensures the use of consistent data throughout the enterprise.

Dimension Tables for Descriptive Context

For the dimension tables, Ross and Kimball 2013 specify that are integral companions to a fact table. The dimension tables contain the textual context associated with a business process measurement event. They describe the "who, what, where, when, how, and why" associated with the event and play a vital role in the DW/BI system. Because they are the source of virtually all constraints and report labels, dimension attributes are critical to making the DW/BI system usable and understandable.

Slowly Changing Dimension

To deal with changes in dimension attributes over time, you need to use a thin mechanism to keep the data correct and up-to-date. Ross and Kimball 2013 stated that there are seven types of strategies to account this Slowly Changing Dimension (SCD) attributes, but the most common ones are the type 1, 2, 3 and hybrid solution.

SCD Type 1 is the change that does not store history in the dimension; that is, there is no modified registry versioning. SCD Type 1 is the simplest type since there is no specific control to update the data, with only the overlap.

SCD Type 2 is the most commonly used technique for dimensional updates. In this type of SCD is added a new record with the changes, always preserving the previous data. In this way, the fact table records point to the corresponding version in the dimensions according to the reference date.

SCD Type 3 allows the system to keep the modifications in the same register. This technique works by adding a new column in the dimension table, where the update is stored, keeping in the old column the previous value.

SCD Type Hybrid (also known as SCD Type 6) combines all previous SCDs. The Hybrid method makes it very flexible for updating dimensions, but at a great cost of complexity.

Awareness of Fact Tables

After defining the dimensions, the next step in the process is to make keys for the fact table. This step requires to identify the numeric facts that populate each fact table row. Closely related to the business users of the system, since this is where they get access to data stored in the data warehouse. Therefore, most of the fact table rows are numerical, additive figures such as quantity or cost per unit (Kimball and Ross 2016).

Kimball's DW/BI Architecture

Doctor Ralph Kimball methodology, or as is also know Kimball lifecycle, is an approach that presents common mistakes on DW/BI development (Kimball and Caserta 2013).

Conceived originally in the 1980s, was referred by Kimball and Caserta 2013 as the Business Dimensional Lifecycle because this name reinforced three fundamental concepts:

- Focus on adding business value across the enterprise.
- Dimensionally structures the data delivered to the business via reports and queries.
- Iteratively develops the solution in manageable lifecycle increments rather than attempting a Big Bang deliverable.

The Kimball Lifecycle approach detailed in Figure 4.3.

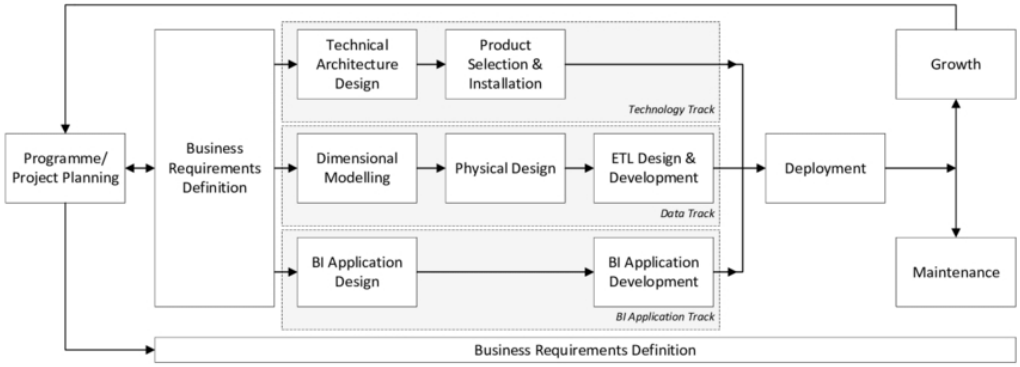


Figure 4.3: Kimball Lifecycle diagram.
Source: Kimball and Caserta 2013

Some of the considerations of Doctor Ralph Kimball approach on Data Mart strategy described in Kimball, Reeves, et al. 1998, classified as the most common one, is that it should begin with a simple data mart that is subject to increase in the future. This way, it's relatively inexpensive and easy to start the implementation. Nevertheless, it generates a separate ETL process for each data mart, getting costly redundant data and processing efforts. Also, it can be used as a proof of concept for data warehousing and perpetuate the "silos of information" problem. However, the need for an overall integration plan is required.

The development of the Kimball's DW/BI Architecture according to Ross and Kimball 2013 as seen in Figure 4.4, results in four separate and distinct components as Operational source systems, ETL system, Data presentation area, Business intelligence applications.

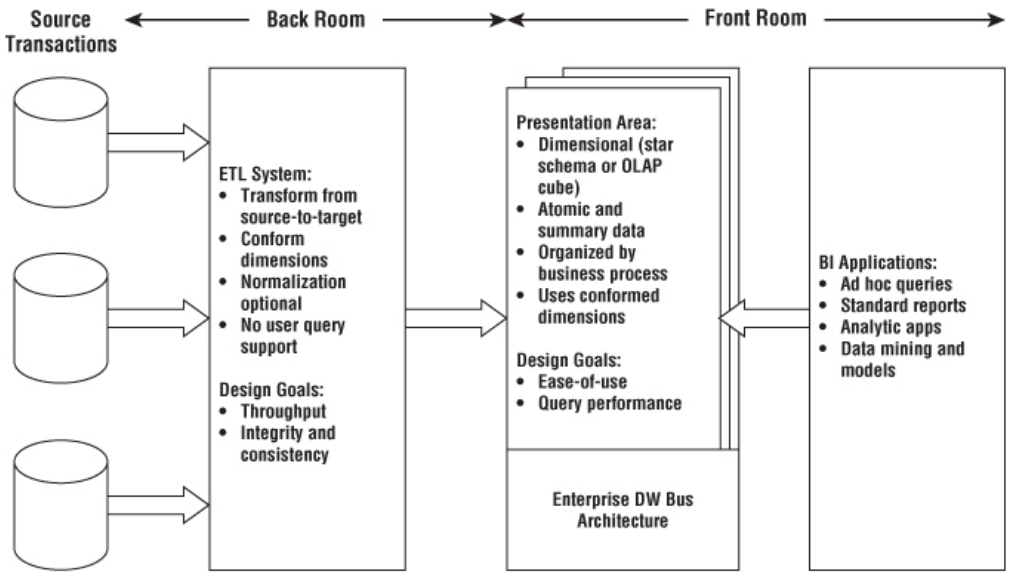


Figure 4.4: Core elements of the Kimball DW/BI architecture.
Source: Ross and Kimball 2013

- Operational Source Systems;

  Defined by the operational systems that record the business transactions, with little or non-control over the data of these operational systems. The main priority is processing performance and availability.

- Extract, Transformation, and Load System;

  Consisting of a work area, instantiated data structures and set of processes it's defined as a fundamental piece of the overall DW/BI.

- Presentation Area to Support Business Intelligence;

  Where data stored and made available for direct querying to provide resources for analytical BI applications.

- Business Intelligence Applications.

  The final major component is the BI application, with a range of capabilities, provided business users to leverage the presentation area for analytic decision making.

As stated by Ross and Kimball 2013, there is some strategic significance of each component to avoid confusing their role and function.

Other DW/BI Architectures

There are some other solutions for developing DW/BI systems, and the Corporate Information Factory (CIF) approach is one of the most successful alternatives as described in Imhoff, Galemmo, and Jonathan 2003. CIF architecture component, as seen in Figure 4.5, promise help to better prepare the IT department for the eventual conversion or demise of the ageing legacy data marts.

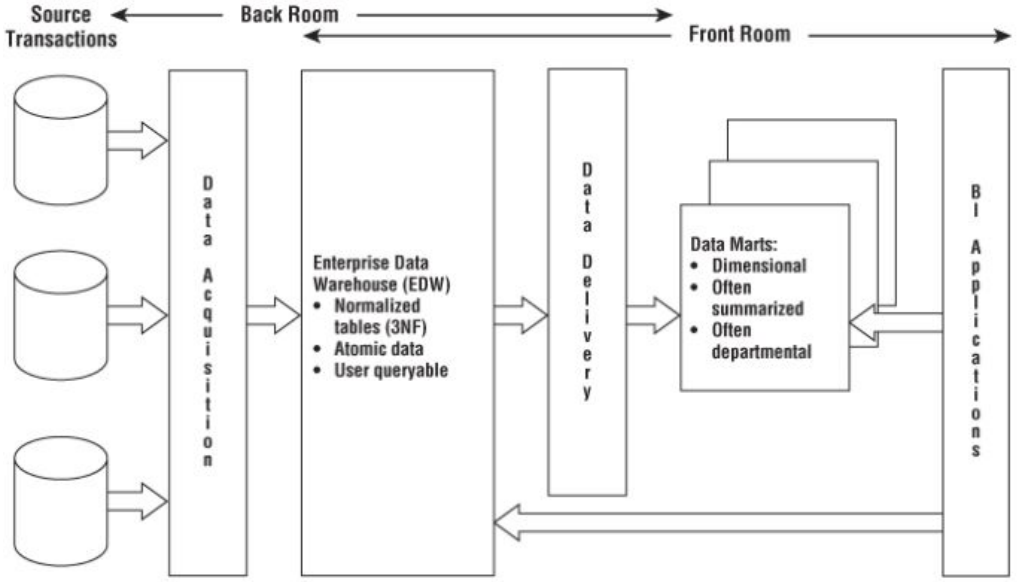


Figure 4.5: CIF - Corporate Information Factory architecture.
Source: Ross and Kimball 2013

The CIF approach differentiates from Doctor Ralph Kimball, as for the creation of the Enterprise Data Warehouse (EDW) sets as necessary a process of normalisation, rather than optional. It also advocates enterprise data coordination and integration, but CIF normalised EDW fills this role, whereas the Kimball architecture stresses the importance of an enterprise bus with conformed dimensions.

Even that CIF approach include some departmental data marts the business users often access the EDW repository due to its level of detail or data availability timeliness. Also being dimensionally structured, the resultant analytic databases presents structures organised around business processes and populated with granular details.

Agile Considerations

Nowadays, as covered by Ross and Kimball 2013 the industry related to DW/BI has significance on agile methodologies for development. The focus on manageable sized increments of work that completes within time-frames, and even some core rules of agile methodologies align with Doctor Ralph Kimball best practices, such as focus on delivering business value; Value collaboration between the development team and business stakeholders; Stress ongoing face-to-face communication, feedback, prioritisation with the business stakeholders; Adapt quickly to inevitably evolving requirements; Tackle development in an iterative, incremental manner;

Still, some approaches conflict with the Doctor Ralph Kimball ideology, as the lack of planning and architecture. Here the solution could be the bus matrix that provides a framework and master plan for agile development, plus identifies the reusable standard descriptive dimensions that provide both data consistency and reduced time-to-market delivery.

Thus, Ross and Kimball 2013 recommends agility, when appropriate, however building isolated data sets should be avoided. "As with most things in life, moderation and balance between extremes are almost always prudent."(Ross and Kimball 2013)

4.2 Business Intelligence

This Section presents the outlook on the tools to perform querying by users, report writers, and other analytical BI applications, but also the best practices on methods and algorithms for managing inventory.

4.2.1 Business Intelligence Tools

The correct definition for BI according to Nogués and Valladares 2017 is "Business intelligence is a set of theories, methodologies, architectures, and technologies that transform raw data into meaningful and useful information for business purposes.", and this Section relates to the last segment of the process, the iteration with the end-user, for whom the information is useful.

Nogués and Valladares 2017 defines that BI platforms focused on user auto-service allow them to investigate the insights of the data, by adding investigation capabilities that facilitate the task of getting relevant information from our data, such as drilling, paging, filtering, selecting, and crossing information from multiple sources.

Most of this end-user BI tools operate through dashboards that allow the user to get organised and concentrated information ready to consume. However, according to Nogués and Valladares 2017, some rules must be followed.

- Starting from top left;

  Just like as we usually read, the dashboard should follow the rule of starting in the top left, so the logic of the dashboard can be easily understandable.

- Joining Related Information;

  Trying to have all the related information in a single dashboard is frequently impossible. Therefore, an effort implies to have a complete analysis inside a single screen containing the majority of relevant information.

- Focus on Relevant Data;

  As the dashboard as limited space available, the information should be the most possible concentrated, the focus in relevant and only in those Key Performance Indicator (KPI) that offer more added value to the decision-making process.

- Formatting Recommendations / Corporate integration;

  Following formatting guidelines from the organisation often help with the acceptance, like colours and even including the company logo. Making the dashboards blend with the organisation strategy.

- Related Data Alignment;

  All the data included in the dashboard should be aligned and consistent across types of graphs or other indicators.

- Conditional Formatting;

  Use of conditional formatting to remark that some data is more relevant than the rest.

- Intensity vs Colour;

  The use of different colours to identify different levels of relevant data is somewhat misstated, so it's preferred most of the time to use different intensities of the same colour.

- Visibility of Data.

  Not to use an excess of framework structure, rectangles, lines, figures, and images that can disturb the user and cause loss of attention on the crucial data.

Key Performance Indicators

To measure the organisation performance, it's necessary to define a set of KPI that later populates the Dashboards by the form of graph, table or other visual indicators. Nogués and Valladares 2017 make aware that it's necessary to choose the meaningful KPI by their relevance of metric. In this specific task, the KPI uses indicators from models of inventory management, studied on the next subsection 4.2.2.

Business Intelligence Software

In the BI software, it's divided into two groups, the back-end BI, software that works the ETL process and DW creation, the other group it's going to be called front-end BI, software that interacts with the end-user of the DSS.

Business Intelligence back-end Software

The BI back-end software or DW software is a tool that assists in the processes of data extraction, normalisation, cleaned of redundancy and transformed for consistency. This process is mostly known as ETL. Nowadays, there is a growth on tools that take charge of all the process of business intelligence from back-end to front-end, replacing the systems with platforms, origin new tools as data and analytics platforms instead of database management systems.

Some examples of tools in this data and analytics platforms category are:

- Teradata;

  Teradata is a company that provides software cloud and hardware-based for data warehousing, business analytics, and consulting services.

  `https://www.teradata.com/`

  Teradata promotes Teradata Vantage as the only solution for what it calls "pervasive data intelligence". Teradata Vantage unites the Teradata Database Management System with its Aster analytics thereby empowering a wide variety of advanced methods to be used for planning and analysing data at speed and scale.

  Teradata Vantage blends analytic capacities and engines to present a scalable, agile platform for access to a variety of descriptive, predictive and prescriptive analytics; efficient decision making; machine learning capacities; visualisation tools and more, deployed across public clouds, on-premises, on optimised or commodity infrastructure, or as-a-service. Hence the company's usage of the term "pervasive data intelligence" (Teradata 2019).

- IBM Integrated Analytics System;

  IBM Integrated Analytics System focus is products designed for rapid analysis of data volumes scaling into petabytes.

  `https://www.ibm.com/analytics/netezza`

Formerly known as Netezza, the IBM Integrated Analytics System is IBM's answer to Data Warehouse solutions. Once again this solution is presented as a hybrid between data management analytics solution and massively parallel processing, integrating access, query and examine data functions across your data warehouse and analyse data using the built-in IBM Data Science Experience solution.

- SAP Business Warehouse;

  With the BI tool SAP Netweaver Business Intelligence, it performs data analysis, reporting and data warehousing.

  `https://www.sap.com/products/business-warehouse.html`

  SAP Business Warehouse is available in numerous ensembles with different instruments for companies of various dimensions. The analytics platform of the product can quickly discover and share insights to make better decisions. Also, has In-built drag and drop interface for developers and end-users. It offers self-data analysis without requiring much technical knowledge. The product's business intelligence and analytics feature include APIs, alerts, application integration, auditing, customise and interactive reporting, data manipulation, life-cycle management, real-time analytics, real-time monitoring, real-time reporting, single sign-on, visual analytics, web analytics.

- Amazon Redshift.

  Cloud-based data warehouse service, part of the cloud computing platform Amazon Web Services.

  `https:/aws.amazon.com/redshift`

  Amazon Redshift is a fast, fully distributed, petabyte-scale data warehouse solution that makes it uncomplicated and cost-effective to efficiently analyse all your data using your existing business intelligence tools. It can begin small and increase as required, being presented as a low-cost solution when compared with other data warehouse solutions.

Table 4.1: BI back-end software comparison.
Source: `https://selecthub.com/`

	Teradata Vantage	**IBM Integrated Analytics System**	**SAP Business Warehouse**	**Amazon Redshift**
COMPANY	Teradata	IBM	SAP	Amazon
COMPANY TARGET SIZE	Small, Medium and Large	Small, Medium and Large	Medium and Large	Small, Medium and Large
PRICING	Medium	High	Medium	Low
DEVICES SUPPORTED	Mac, Windows and Linux	Mac, Windows and Linux	Mac, Windows and Linux	-
DEPLOYMENT	Cloud and Local	Cloud and Local	Cloud and Local	Cloud
BENEFITS	90x faster performance for queries and analytic software applications Efficient, linear scaling of data storage and querying to 100s of terabytes Richer data science-based analytics than were possible or practical with SQL alone Fast, natural development of rich analytic applications, reducing code by more than 90%.	You can uncover insights more quickly and more easily from all types of data—even big data—and on multiple platforms and devices. With self-service and built-in expertise and intelligence, you have the freedom and confidence to make smarter decisions that better address your business imperatives. If cost and deployment are a concern, IBM offers software as a service option for business analytics.	Native apps for iOS and Android, with features like charts, visualizations and reports. Distribute content throughout a large organization. Twenty-five data connectors such as SAP HANA, Apache Hadoop Hive, Cloudera Impala, Amazon EMR Hive, Apache Spark, IBM IDS and more. Integrates with Microsoft Office products such as Excel for large-scale data analysis and Powerpoint to share visualizations. APIs and tools from SAP ecosystem to build sample applications, extensions, and open integration with SAP products.	Fast query performance by using columnar storage technology to improve I/O efficiency and parallelizing queries across multiple nodes. PostgreSQL JDBC and ODBC drivers. Integrations to Amazon S3, Amazon DynamoDB, Amazon Elastic MapReduce, Amazon Kinesis or any SSH-enabled host. Automated most of the common administrative tasks. Continuous, incremental and automatic backups. Simpler disaster recovery. Encrypt data using hardware-accelerated AES-256 and SSL.

Other solutions include Microsoft offerings that make it pleasant to create a DW.

Microsoft SQL Server Management Studio

Microsoft SQL Server Management Studio (SSMS) is an integrated environment for managing any SQL infrastructure, from SQL Server to Azure cloud SQL Database. SSMS provides tools to configure, monitor, and administer instances of SQL. SSMS can be used to deploy, monitor, and upgrade the data-tier components used in applications, as well as build queries and scripts.

Using SSMS to query, design, and manage your databases and data warehouses, wherever they are - locally, or in the cloud (Microsoft 2019e).

Microsoft SQL Server Data Tools

Microsoft SQL Server Data Tools (SSDT) is a modern development tool for building SQL Server relational databases, Azure SQL databases, Analysis Services data models, Integration Services packages, and Reporting Services reports. With SSDT, it's possible to design and deploy any SQL Server content type using the Visual Studio interface (Microsoft 2019d).

Microsoft Visual Studio Analysis Services

As part of the SSDT, the Microsoft Visual Studio Analysis Services provides project templates and design surfaces for building data models hosted in SQL Server Analysis Services (Microsoft 2019a).

This project is going to concentrate on Microsoft tools, like Microsoft SQL Server Management Studio, Microsoft SQL Server Data Tools, Microsoft Visual Studio Analysis Services.

All of the none Microsoft dedicated to DW tools present added value to the solution, but all of them have a high and unsustainable cost for the realisation of this project. In this way, the objective was to use tools used in the course of the master's degree, has it's possible to have free access as a student.

Business Intelligence front-end Software

Regarding the BI front-end software, there are many options, since the emergence of big data in 2007 the market is showing significant growth in the last years, as stated in `https://financesonline.com`[1].

Also, `https://financesonline.com` indicates that some of the most commonly used tools in the front-end BI area nowadays, are: Sisense; Looker; Hotjar; ReportPlus; QlikView; Tableau; SAP BusinessObjects Lumira; SAP Crystal Reports; SAS Business Intelligence; Datadog; IBM Cognos; Microsoft Power BI; Grow.com. Nogués and Valladares 2017 shows even more solutions, as Microstrategy Desktop that it's referred to as a traditional BI tool with 20 years of experience. The market leaders in this area are Microsoft, Tableau, Qlik and others as Figure 4.6 shows.

[1]Website that is specialised in Software Rankings and Comparisons of Business software.

Figure 4.6: Quadrant for Analytics and Business Intelligence platforms.
Source: Gartner February 2019

Thus, for this study, three options were chosen, within the most important ones at the moment.

- Sisense;

  Elected by the website Finance Online in `https://financesonline.com` as the best software for BI data analytics.

- Microsoft PowerBI;

  One of the best solutions by the website `https://financesonline.com` that offers a fully functional free solution.

- QlikView.

  Nogués and Valladares 2017 cites as one of the best BI solutions with an advanced look and feel.

Sisense

Finance Online considered Sisense as the best BI tools in 2018, with the capability of unifying all the data into appealing dashboards (Figure 4.7) via drag and drop interface. Some of the most significant organisations using Sisense are Sony, ESPN, Comcast, and NASA (Sisense 2019).

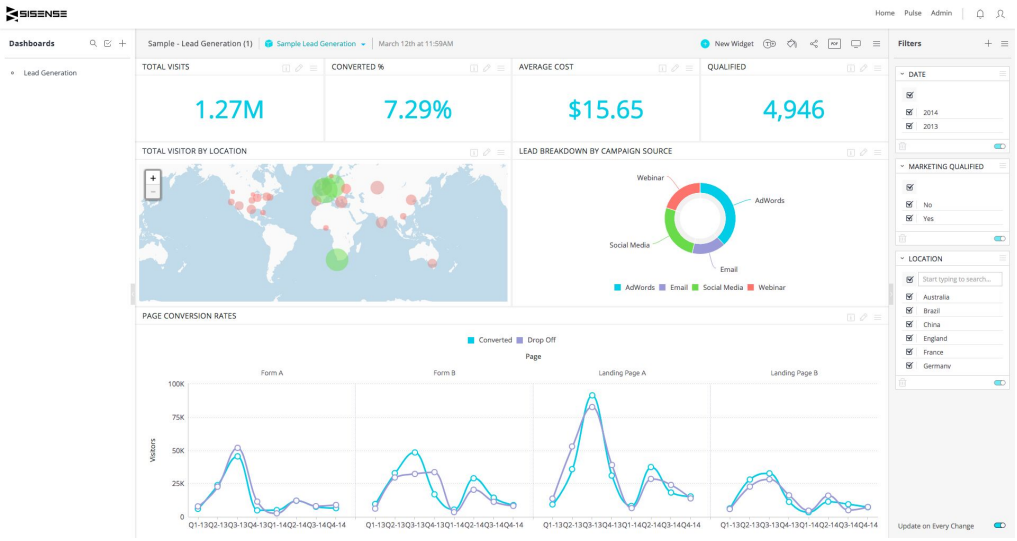


Figure 4.7: Sisense dashboard example.
Source: Sisense 2019

Overview of Features

As a BA is easily accessible for each member of the organisation, giving the possibility to share the insights with the team, partners, and clients. With a top tier solution, it uses multi-core processors, 64 bits systems to maximise performance (Sisense 2019). The features that are most important in the Sisense solution are:

- End-to-end BI software: Database, ETL, Analytics, Visualisations;
- In-Chip analytics engine, substantially faster than in-memory;
- Insights augmented by machine learning anomaly detection;
- Shareable dashboards and insights using bots, alerting, Internet of Things;
- Non-programming/SQL writing business query;
- No restrictions on data size.

Customer target
This solution is mainly oriented for large and medium business (Sisense 2019).

Pricing model
Offered as a paid solution with an annual subscription plan offered on a quote basis. It's possible, however, to experience a free trial with the software, to explore all the capabilities (Sisense 2019).

Technical details
It's possible to use with in-house product installation using the equipment owned or leased by the company, or a public cloud, private cloud, or a hybrid cloud implementation. With multilingual support, also can be used in most of the systems available, has it supports this type of devices:

- Windows;
- Linux;
- Android;
- iPhone/iPad;
- Mac;

- Web-based.

Microsoft Power BI

The Microsoft offering for BA is the Microsoft Power BI, a tool designed and created to help businesses systematically scrutinise data and share insights. Offers elegant and comprehensible visuals for their dashboards (Figure 4.8), making it easy for the organisation to gather information. Some of the most prominent organisations using Power BI are HP, Adobe, GE Healthcare and Aston Martin (Microsoft 2019c).

Figure 4.8: Power BI dashboard example.
Source: Microsoft 2019c

Overview of Features

Power BI collects and stores the on-premise and cloud information in a single, more centralised location that can be accessed whenever and wherever. The system makes interaction with your data fast, thanks to the use of simple yet effective drag-and-drop gestures to identify trends and natural language queries to get quick answers (Microsoft 2019c).

Some of the most important features in Power BI are:

- Gather data from multiple resources and combining them in drag and drop created dashboards;
- Collaboration and sharing insights allowing for a more dynamic work;
- With a cloud-based server for dashboards, it's possible to access them anywhere at any time.

Customer target

The solution is mostly large and medium business oriented (Microsoft 2019c).

Pricing model

Microsoft Power BI offers a free desktop solution and two enterprise monthly pricing plans to choose from (Microsoft 2019c).

The details about each one of the solutions:

- Power BI – Free
- Power BI Pro – 8,40 € per user/month
- Power BI Enterprise – per quote/node/month

Technical details

Since Microsoft Power BI is a part of Microsoft's suite of business products, it offers users tight integration with the other popular and widely used Microsoft business tools like Microsoft Excel, Azure, and SQL Server. It's possible to use with in-house product installation using the equipment

owned or leased by the company, or a public cloud, private cloud, or a hybrid cloud implementation. Only with English, but used in most of the systems available, has it supports this type of devices (Microsoft 2019c):

- Windows;
- Android;
- iPhone/iPad;
- Windows mobile;
- Web-based.

QlikView

The last software is QlikView from Qlik, divided in three software's, one being the desktop solution that is QlikView, then Qlik Sense Cloud offers the Cloud integration for sharing dashboards (Figure 4.9) insights and the last one Qlik Sense Enterprise for collaborative work in organisations. This way it's possible to adjust the solution to more small clients than the other solutions (Qlik Technologies 2018).

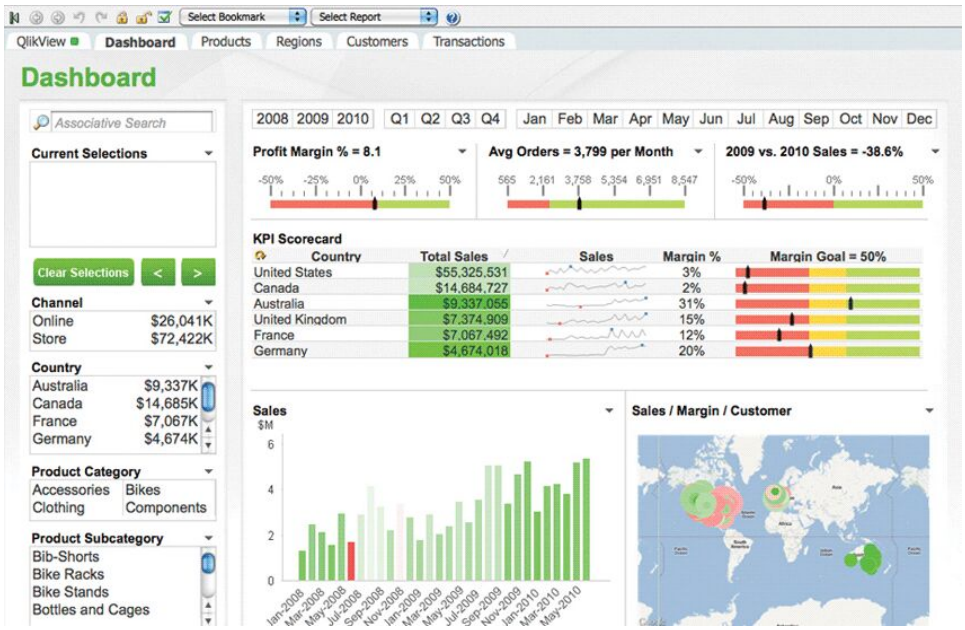


Figure 4.9: QlikView dashboard example.
Source: `www.g2crowd.com`

Overview of Features

QlikView is unique in many aspects, but still flexible enough to meet the needs of businesses from various scales and industries (Qlik Technologies 2018).

QlikView allows custom connectors that it's possible to install upon need, including such that import data from Salesforce, Hive, Teradata, and other popular systems. Therefore, it suggests that QlikView is utterly applicable in all analytic scenarios, both for small and local business, and when performing enterprise-grade big data analytics (Qlik Technologies 2018).

Here are some of the main benefits of this solution:

- Real-time shareable data visualisations;

- Data-driven discoveries with guided paths and analysis;
- Security roles to the user for control of sensitive corporate data;
- Natural search;
- Consistent reporting through dashboards templates.

Customer target
This solution has options for every type of organisation, small, large and medium (Qlik Technologies 2018).

Pricing model
The QlikView solution as the form flexible pricing model of the three, it offers four options for the client to choose from, depending on the customer needs (Qlik Technologies 2018).

- Free Solution;
- Monthly payment - from 15 $ per user/month;
- per quote/monthly payment;
- per quote/One-time payment.

Technical details
It's possible to use with in-house product installation using the equipment owned or leased by the company, or a public cloud, private cloud, or a hybrid cloud implementation. Only supports English language and a limited kind of systems available (Qlik Technologies 2018):

- Windows;
- iPhone/iPad;
- Mac;
- Web-based.

BI Table Comparison

As a summary and comparison of BI front-end software, Table 4.2 is presented, with the main characteristics of each of the applications.

Table 4.2: BI front-end software comparison.
Source: https://financesonline.com/ 2019

	Sisense	**Power BI**	**QlikView**
Company	Sisense	Microsoft	Qlik
Website	www.sisense.com	powerbi.microsoft.com	www.qlik.com
Customer types	Large Enterprises, Medium Business.	Large Enterprises, Medium Business.	Small Business, Large Enterprises, Medium Business.
Pricing model	Annual Subscription, Quote-based.	Free, Monthly payment.	Free, Monthly payment, One-time payment, Quote-based.
Language support	English, Chinese, German, Japanese, Spanish, French, Russian, Italian, Dutch, Portuguese.	English	English
Devices supported	Windows, Linux, Android, iPhone/iPad, Mac, Web-based.	Windows, Android, iPhone/iPad, Web-based, Windows Mobile.	Windows, iPhone/iPad, Mac, Web-based.
Deployment	Cloud Hosted, Organisation hardware	Cloud Hosted, Organisation hardware	Cloud Hosted, Organisation hardware, Open API.
Reporting tools	Ad-hoc analysis, Visualisations, Embeddable widgets & dashboards.	Interactive Dashboards, Interactive Reports, Ad Hoc Analysis, Ad Hoc Reports, Trend Indicators.	Data visualisations, Interaction with dynamic apps, Dashboards and analytics, Custom reports
Integrations	Applications - Salesforce, Zendesk, QuickBase, Google Adwords, Google Analytics, Google Spreadsheets, Amazon Redshift, Heroku, Postgres. Database Servers - MS SQL Server, Oracle Database, MySQL Database, PostgreSQL, DB2, Generic ODBC Driver, Generic OleDB Driver, ERP, Mongo DB.Machine Data - Splunk Big Data Sources - Hadoop Hive, Teradata. Custom - Custom SQL expression, Social networks via RSSBus, Common CRMs via RSSBus.	Microsoft Dynamics, Salesforce, Google Analytics, Microsoft Excel, MailChimp, GitHub, comScore, Adobe Analytics, Acumatica, Circuit ID, Azure Mobile Management.	Customisable APIs, Salesforce

As described above, Sisense's tool is a complete solution, because not only is it the only multi-language tool, it is the one with the highest level of integration with other tools. For the other two solutions, both are presented as similar alternatives in terms of BI functionalities and ease of use and integration. Regarding the dashboards is a matter of personal preference, since all have similar solutions being possible to extend the basic features with the use of plug-ins. As one of the leaders and most robust solutions in the market and to maintain the choice of Microsoft solutions for the development of DW,

for the BI reporting tool it's used the Microsoft's Power BI solution.

4.2.2 Inventory Management Models

As described by Petropoulos et al. 2018, in the categorisation of SKU and forecasting of inventory there are two possible types of evaluation, one using the qualitative knowledge and other using statistical knowledge, as presented in Table 4.3 from Kampen, Akkerman, and Pieter van Donk 2012.

It's not possible to separate the classification of the forecasting because to forecast correctly, and it's necessary to obtain a prior classification of the inventory. Moreover, one of the main reasons for classifying inventory is to get better forecast predictions.

The use of qualitative resources, usually collect knowledge from experts or executives, can be used in the selection and definition of models in different phases of the process, namely:

- Definition of the set of candidate models;
- Selecting the model;
- Model parameterisation;
- Forecast development;
- Review and adjustment of the forecast.

On the other hand, there are the forecasting tools that typically use models based on statistical or quantitative criteria, where performance is assessed based on sample data and the formation of criteria. However, there are situations where the choice of statistical models based on a training set show unsatisfactory results when applied to real data Petropoulos et al. 2018. This type of situation is common in predicting demand, where the task of model selection turns out to be non-trivial.

As concluded by Fildes and Petropoulos 2015, a correct model determination can mean improvement between 25 % to 30 % in the forecast.

Table 4.3: Stock classification techniques.
Source: Kampen, Akkerman, and Pieter van Donk 2012

Knowledge source	Technique	Study
Judgemental	*VED*	Cavalieri et al. (2008), Mukhopadhyay et al. (2003).
	AHP	Flores et al. (1992), Gajpal et al. (1994), Partovi and Burton (1993), Partovi and Hopton (1994), Goyal and Kaushal 2018.
	TOPSIS	Bhattacharya et al. (2007).
	Distance modelling	Chen et al. (2008).
Statistical	*Traditional ABC/ Pareto analysis*	Canen and Galvao (1980), Chrisman (1985), Gardner (1990), Gelders and Van Looy (1978), Mukhopadhyay et al. (2003), Onwubolu and Dube (2006), Portougal (2002), Reid (1987), Sani and Kingsman (1997), Ishizaka et al. 2018.
	FSN/FNS	Cavalieri et al. (2008), Gelders and Van Looy (1978), Mukhopadhyay et al. (2003).
	Bi-criteria ABC	Cavalieri et al. (2008), Flores and Whybark (1986), Flores and Whybark (1987), Harhalakis et al. (1989).
	Graphical/2x2 matrix	D'Alessandro and Baveja (2000), Ghobbar and Friend (2002), Syntetos et al. (2005), Williams (1984).
	Decision tree	Boylan et al. (2008), Eaves and Kingsman (2004), Hautaniemi and Pirttilä (1999), Huiskonen (2001), Kobbacy and Liang (1999), Porras and Dekker (2008).
	Typical profiles	Aitken et al. (2003), Fisher (1997), Ritchie and Kingsman (1985).
	Cluster analysis	Canetta et al. (2005), Duchessi et al. (1988), Ernst and Cohen (1990), Wu et al. (2006).
	Optimisation techniques	Chakravarty (1981), Ng (2007), Ramanathan (2006), Stanford and Martin (2007), Zhou and Fan (2007).
	Neural networks	Huiskonen et al. (2005), Partovi and Anandarajan (2002).
	Genetic Algorithm	Güvenir and Erel (1998), Pareek et al. 2017.

The type of quantitative knowledge presented by Kampen, Akkerman, and Pieter van Donk 2012 is a kind of value judging the knowledge of experts who, with intuition and experience, add value to the techniques used, while in the knowledge statistic, only statistical data is taken into account for the inference of knowledge.

For Kampen, Akkerman, and Pieter van Donk 2012, there's an advantage in analysing groups of products based on common characteristics rather than a single product analysis because it makes the decision faster and more assertive. It is usual for managers to create their product criteria techniques, either by a combination of already used techniques or even unique approaches, but always in line with the specificity of the business.

For classification, it's vital to define the number of classes and the boundaries between them. The most commonly used techniques, according to Kampen, Akkerman, and Pieter van Donk 2012, are the ABC analyses that typically classify product groups based on the value and volume of the demand. The is also another widely used analysis that is the Fast, Normal and Slow (FNS), which characterises products based on the search ratio.

In the study of Kampen, Akkerman, and Pieter van Donk 2012, the most common characteristics for the classification of products are:

- volume;
- product;
- client;
- moment.

Regarding volume, Kampen, Akkerman, and Pieter van Donk 2012 concludes that this attribute refers to the size of demand for a given product, and calculates by combining the unit value with a value relative to demand.

Regarding the product, it's the unit value, average delivery time and value relative to demand.

In the client category, although being the least usually used, it reflects the importance of a product for the customer and the criticality of not being delivered to the customer within the expected time. Typically this criticality characteristic of the product is defined by experts and is typically used in algorithms such as Vital, Essential or Desirable (VED).

Finally, the moment that tries to somehow perceive the frequency and moments of demand for a particular product.

The comparative study by Kampen, Akkerman, and Pieter van Donk 2012, can be verified in the 4.3 table using the methodology of Figure 4.10.

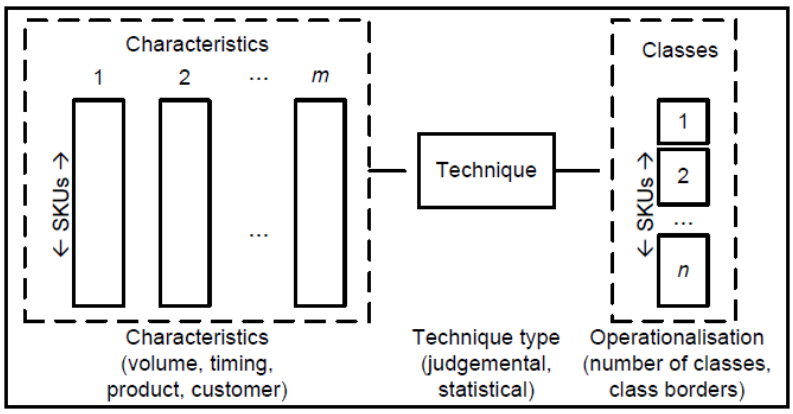


Figure 4.10: Stock classification architecture.
Source: Kampen, Akkerman, and Pieter van Donk 2012

Some other criteria should be considered for the validity of the model to be created, such as Seasonality, Security Inventory and Inventory Days or Days of Stock as shown by Wang and Xiao Xia 2015.

Wu, Yan, and Fan 2012 defends that seasonality is one of the main criteria to be taken into account in forecasting needs, as the need for an article or family of articles varies depending on the time of the year and other cultural constraints.

One primary classification relates to days of stock. This method uses the actual stock and the monthly sales rotation, using the formula 4.1.

$$\textbf{Days of stock} = \frac{\text{Actual Stock} * 30}{\text{Rotation}} \tag{4.1}$$

Safety inventory or Safety Stock, calculated with the formula 4.2, corresponds to the minimum or safety quantities if each SKU to ensure no breakage.

$$\textbf{Safety Stock} = (\text{MDS} * \text{MDD}) - (\text{ADS} * \text{ADD}) \tag{4.2}$$

were,

Table 4.4: Safety stock calculation variables.
Source: Kitti-Udomporn, Sukchareonpong, and Witchakul 2018

Ref	Descrição
MDS	Max daily sales
MDD	Max delivery days
ADS	Average daily sales
ADD	Average delivery days

According to Kitti-Udomporn, Sukchareonpong, and Witchakul 2018, calculation of this value is according to the equation 4.2, taking into account variables such as supplier delivery time and product daily sales.

Classification models

Due to the high number of different SKU that usually exist in inventory makes it necessary to divide them into categories or classes according to the importance and impact on the organisation resources, as cited by Chen, Li, and Liu 2008; Teunter, Babai, and Syntetos 2010. The main objective of this classification is to simplify inventory management by assigning different management policies and service levels for each class, Teunter, Babai, and Syntetos 2010 believes that this categorisation allows the most important products to receive more attention.

ABC classification is one of the most widely used classification methods, and it's based on the Pareto Principle as described by Chen, Li, and Liu 2008. The Pareto Principle, also known as 80/20 rule, indicates that 80 per cent of the effect is provided by 20 per cent of the cause, as shown in Figure 4.11.

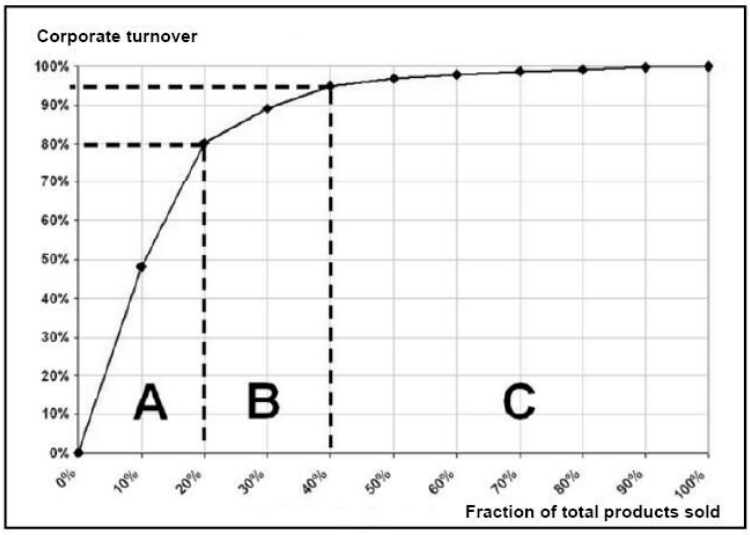


Figure 4.11: ABC classification based on the Pareto Principle.
Source: Swoe 2016

SKU classifies into several groups according to the level of importance. Initially, as its name indicates, it was idealised for three classes. The most critical SKU that requires more attention is placed in group A, the SKU with some importance in group B and the least essential SKU, requiring less attention in group C.

As Chu, Liang, and Liao 2008 defend, the three classes division most common is:

- **Group A**: 20% of the SKU produce up to 80% of the corporate turnover;
- **Group B**: 20% of the SKU produce up to 15% of the corporate turnover;
- **Group C**: 60% of the SKU produce up to 5% of the corporate turnover.

However, this method can easily be applied to more classes, dividing the SKU into more groups, but not being too common to use more than six classes, as stated by Teunter, Babai, and Syntetos 2010. The traditional approach bases on a single criterion, usually, the quarterly sales value since this is an aspect that is valued by managers. One of the significant advantages of using only one criterion is the simplicity of the model, as shown by Iqbal, Malzahn, and Whitman 2017.

Despite its popularity and frequent application, Ramanathan 2006 states that the ABC classification presents some limitations when the classified inventory is not homogeneous or achieves the importance of a SKU by criteria other than just the annual usage value or sales. Thus, Teunter, Babai, and Syntetos 2010 refers that it is common to use different criteria to categorise SKU and, in recent years, several studies have suggested the use of several techniques to improve the quality of classification methodologies based on more than one criterion.

Several authors as Ladhari, Babai, and Lajili 2016; Teunter, Babai, and Syntetos 2010 have suggested the use of several different criteria for the ABC analysis depending on the relevance to the organisation, such as Lead time, substitutability, criticality, obsolescent rate, repair costs, procurement costs, demand rate or inventory value.

XYZ classification, as indicated by Devarajan and Jayamohan 2016, aims to classify the entire inventory according to the current SKU total value, so no historical data needed for this analysis. As a rule, the analysis concludes that 70% of the articles correspond to class X, 20% to class Y and the last 10% to class Z.

FSN classification also described in the study of Devarajan and Jayamohan 2016, divides the inventory into three classes as Fast, Slow and Non-moving. According to the turnover ratio, the classification is

based on individual consumption patterns of the SKU, categorising the items as high turnover, low turnover and no turnover. This type of analysis is especially indicated to absorb the SKU without rotation since it allows the identification of these assertively.

VED classification is based on the cost of SKU shortage. Cavalieri et al. 2008 divide this analysis into three classes based on the criticality of the SKU, referring to them as Vital, Essential or Desirable. In this way, the Vital category represents the indispensable SKU for the operation of the organisation, and the Essential category contains the articles that can affect the normal functioning of the organisation and the category Desirable represents the articles that, in case of nonexistence, do not affect the organisation. This analysis is inherently subjective because it requires qualitative inputs from the managers.

Multi-Criteria Inventory Classification

One of the first proposals of MCIC was introduced by Flores and Clay Whybark 1986, through the use of the ABC methodology to categorise SKU according to two different criteria. Both classifications obtained are then compared through a bi-criteria matrix to obtain the final classification of SKU. Chen, Li, and Liu 2008 presents some limitations to this approach because it assumes that the weight of the evaluated criteria is the same and it becomes difficult to apply when considering more than two criteria, the reason why there are several optimisation algorithms of MCIC.

However, standard criteria matrices are often used, for example, ABC-XYZ analyses from Bulinski, Waszkiewicz, and Buraczwewski 2013, ABC-VED from Pund et al. 2016. In particular, the ABC-XYZ analysis is instrumental because it proves to be an efficient mechanism for the management of inventory because the introduction of XYZ analysis attenuates the limitations of ABC classification as shown by Stojanović and Regodić 2017.

Other techniques for MCIC, since the work of Flores and Clay Whybark 1986, have been developed and refined using various techniques and approaches, to obtain decision-making tools considering multiple criteria.

As can be seen in table 4.3, these techniques can be divided into two groups, quantitative and qualitative, where the experience takes into account, opinions and tacit knowledge of the experts for classification. In the qualitative classifications, the AHP has been applied to several MCIC studies, since it allows to incorporate several criteria. However, the disadvantage of comparisons between pairs of criteria is subject to considerable subjectivity as described by Chu, Liang, and Liao 2008. More recently, hybrid approaches have emerged, combining the AHP method with the TOPSIS decision method, with excellent results as shown by Cherif and Ladhari 2017; Kaabi and Jabeur 2016.

Also, to emphasise, in quantitative methods, models that use Optimisation Techniques. The models that have received more acceptance according to Iqbal, Malzahn, and Whitman 2017 are the R-Model, based on Linear Programming; the Ng-Model, which generalises the previous model; the ZF-Model, which uses weights to limit classification as more critical when it bases on less significant criteria; and the H-model, which unlike previous ones, uses nonlinear optimisation.

Chapter 5

Design

> "*Design is not just what it looks like and feels like. Design is how it works.*"
>
> *- Steve Jobs*

After studying the most modern and usual techniques, it's required to think and design the solution. The DM as a part of Business Dimensional Life cycle methodology developed by Doctor Ralph Kimball covers a set of processes, techniques and concepts for use in data warehouse design. This Chapter expresses the ideas behind the implementation objectively. Later, some engineering and non-functional requirements are defined.

5.1 Assessing Approaches to Problem Solving

In this Section of assessing approaches to problem-solving, the goal is to define methodologies and tools for solution development. Also, there should be analysed the operational database, allowing for a correct selection of attributes for the dimensional model. Defining a correct and appropriate model is an essential step in this phase of the development process.

5.2 Business Intelligence Back-End and Front-End

In the follow up of Chapter 4, of the methodology to develop the DW and which tools should be used for its execution, the following conclusions were made.

Kimball's methodology that describes the DW as a set of bottom-up Data Marts is an adequate solution for this project. This approach allows for a more evolutionary solution, and in the future, more efficiently, it is possible to add other Data Marts to the developed DW.

This way, Kimball's methodology is used for both the planning and execution phases. For DW's support and development tools, the choice lies in Microsoft's previously debated solutions for both the back-end and front-end BI phases.

The software applications used during the development and final solution are:

- Microsoft SQL Server 2016 and Microsoft SQL Server Management Studio

  Application that allow the development of the DW with the creation of the required Database (DB)'s, in this case the SQL server will run locally.

- Microsoft SQL Server Data Tools and Microsoft Visual Studio Analysis Services

  Software for accessing features like SQL Server Analysis Services and SQL Server Integration Services supports the design and implementation of the ETL process.

- Microsoft Power BI

  Sometimes recognised as the BI solution itself, it's the front-end solution that allows the end-user to interact with the data saved into the DW. This BI system is the first communication channel between users and information.

This selection relies on the fact that besides being market-leading tools that respond to the project requirements, also, there are several sources of information to solve most of the possible difficulties during the development stage. On the other hand, the author's professional experience with Microsoft tools is also superior, which reduces the initial learning time required for the use of a new tool.

Next Steps in the Project
A somewhat informed analysis of the operational database, with the help of a data profiling tool. This procedure allowed the author to perceive useful attributes and also the limitations and barriers created by data. After this analysis, it's required to plan a dimensional model, according to Kimball's Dimensional Modeling some steps require identification like the business process, level of detail (grain), dimensions and facts (Ross and Kimball 2013).

The following step is to extract information from the source ERP database and load it into the DW. In the middle of this process, it's needed to adapt the information to the DW required structure, by creating fact tables with the desired fields. There is some relationship that the tables must ensure in one-to-many relations between dimensions: all the possible values of join fields are present in the table; the fields that join with the rest of tables have no null values; lookup tables contain all possible values of the facts and relationship tables values.

The final step it's related to the constructions and evaluation of performance indicators and dashboards. This step indicates that whether a robust and reliable DW because it depends on it to obtain the data needed to support decision-making.

Inventory Management Models
Regarding the inventory management models and at this stage of the project it's not possible to identify the algorithms to use since it depends on the results of the tests to be carried out in the course of developing the solution or the outcomes required.

However, the solution must use a multi-criteria approach, that allows combining several of the models studied such as ABC analysis and XYZ categorisation. The experience of the author holds substance for the evaluation of the best implementation, because according to the previously mentioned in Section 4.2.2, a combination of statistical and judgemental criteria offers better results.

5.3 Dimensional Architecture

Using a bottom-up solution, such as Dr Ralph Kimball's method in Kimball and Ross 2016, is ideal for the project in question. As proof of concept, this project starts to focusing only on an individual department allowing growth to other departments within the company. The bottom-up methodology encourages this flexibility and ease of use as it bases on the information needs of the individual business departments.

This project could be considered as an initial phase even within the target department, as new analysis needs may appear in the future. Once again, the infrastructure in a bottom-up methodology is lighter, providing a shorter response time; that is, the quick integration of new data in this model.

Enabling incremental development by building DM's per department, this way, allows the rapid use and economic development of the data warehouse. The connection of all data marts makes queries through all available data to the user, thus avoiding some redundancy.

As described in Section 4.1.1 of Chapter 4, the process begins with four steps that are critical for the development of an adequate solution. So, the following Sections includes the definition of the

business process, grain, dimension, and fact tables. Then, it concludes with the studying of the business requirements, along with certainties of underlying source data.

5.3.1 Business Process

As detailed in Section 1.3, the main objective is to develop a solution to assist the inventory manager in the process of optimising the inventory and predicting the demand. Consequently, information about purchases and sales must be considered in order the evaluate the stock and correctly predict the demand as seen in Section 4.2.2.

Sales oriented performance indicators help to understand the correctness of the actions taking care by the inventory manager.

Level of Detail

Identifying the correct grain, it's a vital step in the design process.

A fact table row actually verifies precisely the level of detail that can be achieved. So, the grain declaration becomes a binding contract in design. It needs to be stated before choosing dimensions or facts because every candidate dimension or fact must be consistent with the defined grain. This consistency requires uniformity across all dimensional designs that are critical to the BI application performance and ease of use.

Since there is a substantial amount of the company's billing happens at the headquarters and when there is availability of the people that do this process, only daily sales should be considered in the DM. This way is misleading to analyse time based schedules of sales because it would blur data with the billing capacity from the billing department.

Therefore, the granularity used in the Fact Sales table and the Fact Purchase table is per document sales, warehouse, client, product and date. Changing only the client with supplier in the purchases. At last, the granularity on the Fact Inventory table is by product and warehouse.

5.3.2 Exploring and Identifying the Operational Database

The operational DB has eighteen tables that can be distributed by five categories as clients, suppliers, sales, purchases and stock. The DB, as it's possible to see in the figure A.1 it not a simple one, with tables with more than two hundred attributes and some redundant connections.

Therefore, to understand the structural attributes of the operational DB it's is used a set of tools, like the Visual Paradigm Solution and SQL Server Management Studio for visual analysis and Talend Open Studio for data analysis [1] a software tool for data profiling and data quality. This type of tool allows the data manager to obtain a better perception of the data and hence to evaluate the quality and utility of the various attributes in the operational DB.

The process of choosing the right attributes, as Kimball and Ross 2016 states, begins by responding to the requirements with the help of an Enterprise Data Warehouse Bus Matrix. This matrix helps in identifying the needed dimensions and attributes for each specific data mart (Kimball and Caserta 2013).

As referred on Section 2.2 the initial requirements are:

1. Top ten brands by stock by Store;
2. Days of inventory divided by business model

[1] `https://talend.com/`

3. Inventory categorisation with 5 classes from the high rotation to not moving stock
4. Inventory value by warehouse/store
5. Inventory quantity by warehouse/store
6. Inventory value by business model
7. Distribution of "non-moving" inventory by Store
8. Demand forecast by brand/product.
9. Top brands/products by supplier

Each analysis enumerated a selection of several attributes that are obligatory to include in the Dimension tables of the DM.

Table 5.1: Enterprise Data Warehouse Bus Matrix

Requirements	**Dimensions/Attributes**									
	Brand	Product	Stock	Cost	Sales	Purchases	Warehouses	Localisation	Business type	Supplier
1	x		x	x						
2			x		x		x			
3		x	x		x	x				
4				x			x	x		
5			x				x	x		
6				x			x	x	x	
7	x	x	x	x			x	x		
8	x	x	x	x	x					
9	x	x		x						x

Table 5.1 justify the attribute selection phase of the operational DB, matching the requirements with the needed attributes. Some other selected attributes were added to achieve greater significance and analysis of the final solution. This choice limits the flexibility of the analysis.

Data Analysis Requirements

Each table in the DB is associated with a category mentioned before, to assist future creation of dimensional and fact tables.

- **Clients ref. A.1**
  - Table *Clientes*
- **Suppliers ref. A.2**
  - Table *Fornecedores*
  - Table *ArtigoFornecedor*
- **Sales ref. A.3**
  - Table *CabecDoc*
  - Table *CabecDocStatus*
  - Table *DocumentosVenda*
  - Table *LinhasDoc*
- **Purchases ref. A.4**
  - Table *CabecCompras*
  - Table *CabecComprasStatus*

  - Table *DocumentosCompra*
  - Table *LinhasCompras*
- **Stock ref. A.5**
  - Table *Artigo*
  - Table *ArmazensLocalizacoes*
  - Table *Armazens*
  - Table *ArtigoArmazem*
  - Table *ArtigoArmazemStocks*
  - Table *ArtigoMoeda*
  - Table *LinhasSTK*

Now, it's required to select the important attributes in each table, that are related to the project objective. Also, describing the meaning and gathering information about the data type and storage needed per attribute. This step not only allows a correct optimisation of the extraction phase, but also the proper design of the dimensions and facts tables.

For the *Clientes* table in reference A.1, it has 157 columns, which indicate that a time-consuming analysis was made to understand which columns were relevant. The chosen attributes are shown in the table 5.2.

Table 5.2: Table *Clientes*

Table Clientes			
Attribute	**Description**	**Type**	**Max chars**
Cliente	Client index.	nvarchar	12
Nome	Name of the client.	nvarchar	50
Fac_Mor	Street of client address.	nvarchar	50
Fac_Local	Local of client address	nvarchar	50
Fac_Cp	Postal code for client address.	nvarchar	15
DataCriacao	Date of record creation.	date	10
ActividadeEmpresarial	Company or Individual.	boolean	1

For the first table related to suppliers A.2, there is *Fornecedores* with 120 attributes. This table aggregates information about the suppliers. Table 5.3 presents the chosen attributes.

Table 5.3: Table *Fornecedores*

Table Fornecedores			
Attribute	**Description**	**Type**	**Max chars**
Fornecedor	Supplier identifier.	nvarchar	12
Nome	Name of the supplier.	nvarchar	50
NomeFiscal	Fiscal name.	nvarchar	50
Local	Supplier localisation.	nvarchar	35
CpLoc	Postal code for supplier address.	nvarchar	35
Pais	Country.	nvarchar	2
DataCriacao	Record creation date.	date	10

The other table in the suppliers category A.2 is *ArtigoFornecedor*, it has 25 attributes and relates the products with the respective suppliers. Table 5.4 presents the chosen attributes.

Table 5.4: Table *ArtigoFornecedor*

Table ArtigoFornecedor			
Attribute	**Description**	**Type**	**Max chars**
Artigo	Product identifier.	nvarchar	30
Fornecedor	Supplier identifier.	nvarchar	12
PrCustoUltimo	Latest product cost.	decimal	
DatUltEntrada	Latest purchase date.	date	10

For the sales category A.3 the first table is *CabecDoc*, were all the header sales document are recorded. Table 5.5 presents the chosen attributes.

Table 5.5: Table *CabecDoc*

Table CabecDoc			
Attribute	**Description**	**Type**	**Max chars**
Id	Document identifier.	nvarchar	36
Data	Document date.	date	10
HoraCarga	Document time.	time	5
Entidade	Client.	nvarchar	12
TipoDoc	Type of document.	nvarchar	3
NumDoc	Number of document.	integer	10
TotalMerc	Total amount.	decimal	
TotalIva	Taxes amount.	decimal	
NumContribuinte	Tax id client.	nvarchar	20
Nome	Client name.	nvarchar	50
TotalDocumento	Document total.	decimal	

Another table in the same category A.3 is *CabecDocStatus*, that contains the status of the sales documents. This table is mostly to identify the cancelled documents. Table 5.6 presents the chosen attributes.

Table 5.6: Table *CabecDocStatus*

Table CabecDocStatus			
Attribute	**Description**	**Type**	**Max chars**
IdCabecDoc	Document identifier	nvarchar	36
MovContab	Accounting document	integer	1
Anulado	Cancelled documents	boolean	1

The table *DocumentosVenda* in the sales category A.3, is a table containing all the types of sales documents. The type of document can identify client types like individuals or companies. Table 5.7 presents the chosen attributes.

Table 5.7: Table *DocumentosVenda*

Table DocumentosVenda			
Attribute	**Description**	**Type**	**Max chars**
Documento	Document type.	nvarchar	4
Descricao	Document type description.	nvarchar	35
LigaStocks	Stock movement document.	boolean	1
LigaCC	Checking account document.	boolean	1
PagarReceber	Inbound or Outbound Value document.	nvarchar	1
TipoDocSTK	Inbound or Outbound Stock document.	nvarchar	1
TipoDocumento	Document type code.	interger	1

The last table in the sales category A.3, with 147 attributes the table *LinhasDoc* has every document row from every sale document. Table 5.8 presents the chosen attributes.

Table 5.8: Table *LinhasDoc*

Table LinhasDoc			
Attribute	**Description**	**Type**	**Max chars**
Id	Identifier.	nvarchar	36
IdCabecDoc	Foreign key from document.	nvarchar	36
Artigo	Product reference.	nvarchar	30
Quantidade	Units.	integer	
PCM	Average cost.	decimal	
PrecUnit	Unit Sales amount with taxes.	decimal	
TaxaIva	VAT rate	integer.	
Data	Date.	date	10
PrecoLiquido	Total amount without taxes.	decimal	
TotalIliquido	Total amount with taxes.	decimal	
TotalIva	Total taxes amount.	decimal	
DataEntrega	Delivery date.	date	10
DataSaida	Shipping date.	date	10

For the purchase categories, A.4, the tables are similar to the sales. Table *CabecCompras* gathers the information about the headers of the purchase document. Table 5.9 presents the chosen attributes.

Table 5.9: Table *CabecCompras*

Table CabecCompras			
Attribute	**Description**	**Type**	**Max chars**
TipoDoc	Document type	nvarchar	4
NumDoc	Document Number	integer	10
Entidade	Supplier code	nvarchar	12
DataDoc	Document date	date	10
DataVencimento	Due date	date	10
TotalMerc	Total amount with taxes	decimal	
TotalIva	Total taxes amount	decimal	
TotalDesc	Total discount	decimal	
TotalOutros	Services total amount	decimal	
TotalDespesasAdicionais	Shipping total	decimal	
NumContribuinte	VAT ID Suppliers	integer	15
Nome	Supplier Name	nvarchar	50
Id	Document ID	nvarchar	36
IdCabecMovCbl	Id Document	nvarchar	36
TotalDocumento	Document total	decimal	

The table *CabecComprasStatus* related to the purchase categories A.4, stores the information about the purchase document status. Table 5.10 presents the chosen attributes.

Table 5.10: Table *CabecComprasStatus*

Table CabecComprasStatus			
Attribute	**Description**	**Type**	**Max chars**
idCabecCompras	Id Document header	nvarchar	36
MovContab	Accounting document	integer	1
Anulado	Cancelled documents	boolean	1

Also in the purchase categories A.4, the table *DocumentosCompra* that contains all the types of documents related to purchases. Table 5.11 presents the chosen attributes.

Table 5.11: Table *DocumentosCompra*

Table DocumentosCompra			
Attribute	**Description**	**Type**	**Max chars**
Documento	Document code	nvarchar	5
Descricao	Document description	nvarchar	35
LigaStocks	Stock movement document	boolean	1
LigaCC	Checking account document	boolean	1
PagarReceber	Inbound or Outbound Value document	nvarchar	1
TipoDocSTK	Inbound or Outbound Stock document	nvarchar	1
TipoDocumento	Document type code	interger	1

And the table *LinhasCompras* where is stored every row from every purchase document. Table 5.12 presents the chosen attributes.

Table 5.12: Table *LinhasCompras*

Table LinhasCompras			
Attribute	**Description**	**Type**	**Max chars**
Artigo	Product reference	nvarchar	30
TaxaIva	Vat ID	integer	
Quantidade	Units	integer	
PrecUnit	Unit purchase amount with taxes	decimal	
DataDoc	Document date	date	10
MovSTK	Does affect stock	nvarchar	1
PrecoLiquido	Total amout without taxes	decimal	
Descricao	Product description	nvarchar	50
Id	Identifier	nvarchar	36
IdCabecCompras	Foreign key from Document	nvarchar	36
TotalIliquido	Total amout with taxes	decimal	
TotalIva	Total taxes amount	decimal	

The last category A.5, considered is related to the inventory or stock of products, this category contains tables that have information about the products and the warehouses. The first table is *Artigo* with 147 attributes, contains only information about the products, like brand, family, last price, last purchase and other important data. Table 5.13 presents the chosen attributes.

Table 5.13: Table *Artigo*

Table Artigo			
Attribute	**Description**	**Type**	**Max chars**
Artigo	Product code	nvarchar	48
Descricao	Product description	nvarchar	50
STKMinimo	Minimun stock	integer	
STKMaximo	Maximum stock	integer	
STKReposição	Purchase stock	integer	
STKAtual	Actual stock	integer	
PCMedio	Average unit cost	decimal	
PCUltimo	Lost unit cost	decimal	
MovStock	Stock product	nvarchar	1
DataUltEntada	Date of last purchase	date	10
DataUltSaida	Date of last sale	date	10
Familia	Product family	nvarchar	10
TipoArtigo	Product type	nvarchar	2
Ultimo fornecedor	Last supplier	nvarchar	12
SubFamilia	Product sub-family	nvarchar	10
Marca	Brand	nvarchar	10
ArtigoAnulado	cancelled	boolean	1
CDU_CampoVar1	Product subtype	nvarchar	15
CDU_CampoVar2	Product subtype 2	nvarchar	15

Table *ArmazensLocalizacoes* has fewer attributes, and it's easier to select meaningful attributes. Each warehouse can have multiple location's; this table describe them all. Table 5.14 presents the chosen attributes.

Table 5.14: Table *ArmazensLocalizacoes*

Table ArmazensLocalizacoes			
Attribute	**Description**	**Type**	**Max chars**
Localizacao	Localisation within the warehouse.	nvarchar	5
Armazem	Warehouse related to localisation.	nvarchar	5
Descricao	Description of localisation.	nvarchar	28

Related to the table *ArmazensLocalizacoes* and also simpler to analyse is the table *Armazens*, it describes all the available warehouses for inventory. Table 5.15 presents the chosen attributes.

Table 5.15: Table *Armazens*

Table Armazens			
Attribute	**Description**	**Type**	**Max chars**
Armazem	Warehouse.	nvarchar	5
Descricao	Description.	nvarchar	20
CPLocalidade	Localisation geographically.	nvarchar	20

Connecting the product with the respective warehouse in the category A.5 is the table *ArtigoArmazem*, that contains the information about the stock of each product in each warehouse. Table 5.16 presents the chosen attributes.

Table 5.16: Table *ArtigoArmazem*

Table ArtigoArmazem			
Attribute	**Description**	**Type**	**Max chars**
Artigo	Product	nvarchar	30
Armazem	Warehouse	nvarchar	4
Localizacao	Localisation	nvarchar	4
StkAtual	Actual stock	integer	
QtReservada	Reserved stock	integer	
PCMedio	Average unit cost	decimal	
PCUltimo	Last unit cost	decimal	

In the stock category A.5, there are two tables the aren't going to be considered, one being *ArtigoArmazemStocks* that gather information about the minimum, maximum and replenishment stock, but as this table is mostly empty it won't give many useful data. The other table is *ArtigoMoeda* that contains the type of currency in each product, but the company only purchases and sells in euros.

The last table of the stock category A.5 and all the tables is *LinhasSTK*, that contains data for each product regarding the last purchase date and amount, the quantity in stock, warehouse and localisation. Table 5.17 presents the chosen attributes.

Table 5.17: Table *LinhasSTK*

Table LinhasSTK			
Attribute	**Description**	**Type**	**Max chars**
Artigo	Product	nvarchar	48
Quantidade	Quantity	float	53
PCM	Average unit cost	float	53
PrecUnit	Recommended Sale price	float	53
Data	Stock entrance date	date	10
Armazem	Warehouse	nvarchar	30
EntradaSaida	In and Out	nvarchar	1
Descricao	Product description	nvarchar	512
Id	Identifier	nvarchar	36
Localizacao	Product localisation	nvarchar	30
TipoDocumento	Document type code	integer	1

Identifying the Dimension and its Attributes

In this, the process of the design process to define the dimensions of the model. The dimensions define within the grain from the second step of the 4-step of the Dimensional Model process. Dimensions are the foundation of the fact table and are where the data for the fact table is collected (Kimball and Ross 2016).

Dimensions

The first dimension that can be defined is the *DimDate* and contains information about date, allowing for custom searches and analysis. Across most of all dimensions was used, a combination of SCD type 1 and SCD type 2, that allows the update of historic information, as described in Section 4.1.1.

The following attributes are considered for the *DimDate* dimension:

DimDate (Key, Date, FullDate, Year, Month, MonthName, WeekDay, WeekNumber, Day, YearDay, Semester, SemesterName, Quarter, QuarterName, Week, Weekend, BusinessDay, Season, SeasonName.)

The date dimension is presented with static data and aims to respond to the longevity of the data from the operational databaseDBs.

The following attributes are considered for the *DimSupplier* dimension:

DimSupplier (SupplierKey, SystemKey, Name, FiscalName, Local, Country, CreationDate, BeginDate, EndDate, Active.)

The supplier dimension represents the attributes of the suppliers for the purchasing transactions. For the SCD type 2 there must be used the attributes *BeginDate*, *EndDate* and *Active* in order to identify the records chronologically.

The following attributes are considered for the *DimPurchaseDocuments* dimension:

DimPurchaseDocuments (PurchaseDocument, SystemKey, DocumentType, DocumentCode, Business.)

Purchase documents, as the name implies, keeps all records related to the type of purchase documents.

The following attributes are considered for the *DimProduct* dimension:

DimProduct (ProductKey, Code, ProductDescription, Family, SubFamily, Type,, Brand, Supplier, LatestPurchaseDate, LatestSaleDate, LatestCost, AverageCost, VatRate, MinStock, MaxStock, PurchaseUnits, Stock, BeginDate, EndDate, Active.)

DimProduct dimension has all the information needed about the products for the analysis. Also, there is the need to use SCD type 2 in this dimension, as the product is subject to change during its lifecycle, and it's vital to maintain some historical information.

The following attributes are considered for the *DimWarehouse* dimension:

DimWarehouse (WarehouseKey, Warehouse, WarehouseDescription, Localisation, Local, Store.)

This dimension it's required to identify the different locations of the products on sales or even on purchases.

The following attributes are considered for the *DimClient* dimension:

DimClient (ClientKey, NIF, Name, Address, Local, CreationDate, Type, BeginDate, EndDate, Active.)

This client dimension keeps all the details about the client, directly connected to sales movements.

The last dimension is the *DimSalesDocuments* and the selected attributes are:

DimSalesDocuments (SalesDocuments, SystemKey, DocumentType, DocumentCode, Business)

This dimension is similar to the PurchaseDocuments but related to the type of documents from sales.

Identifying the Facts

After all the dimensions selected, it's needed to create fact tables, that are going to aggregate all the meaningfully data for the analysis.

For creating fact tables, is required to understand that these tables combine data that are in the dimensions related to a business area. In this project, there are three distinct business areas: purchasing; sales; stock.

For the sales analysis it's required to create the *FactSales* table, this table relates the dimensions *DimWarehouse*, *DimClient*, *DimSalesDocuments*, *DimProduct* and *DimDate*. Additionally, it calculates some attributes like quantities, unit value without taxes, total value without taxes, taxes total, total value with taxes and profit with and without taxes.

On the other hand, the purchasing analysis requires some similar fact table, but this designates as *FactPurchases*. With similar dimensions like *DimWarehouse*, *DimProduct* and *DimDate* it needs some specific ones as *DimPurchaseDocuments* and *DimSupplier*. It also calculates specific attributes as quantities, unit values without taxes, a total of taxes and total with and without taxes.

The last fact table is the *FactInventory*, to aid the inventory classification and demand prediction. This fact table relates the dimensions tables of *DimProduct* and *DimWarehouse*. For the calculated attributes, there is the stock, booked stock, stock in transit, average cost amount, unit cost amount and total amount.

5.4 Engineering Requirements

In this Section, it's detailed a set of requirements that can serve as a basis for all subsequent development activities.

5.4.1 Dimensional Data Modeling

The dimensional model to respond to all the analysis with the dimensions and fact tables can be visualised in Figure 5.1. This diagram indicates not only the connections between dimension tables and fact tables but also their primary keys, unique attributes, which can be null and their data types.

Figure 5.1: Dimensional Model

Also, in Figure 5.2, it is possible to understand better the system architecture that will respond to the implementation requirements. The operational database is cloned to a new database "ODCopy", that then will suffer the Extract and transform processes. This process will lead the managed data to the staging area database, that will also be complemented with external excel sources, for additional information that isn't in the database.

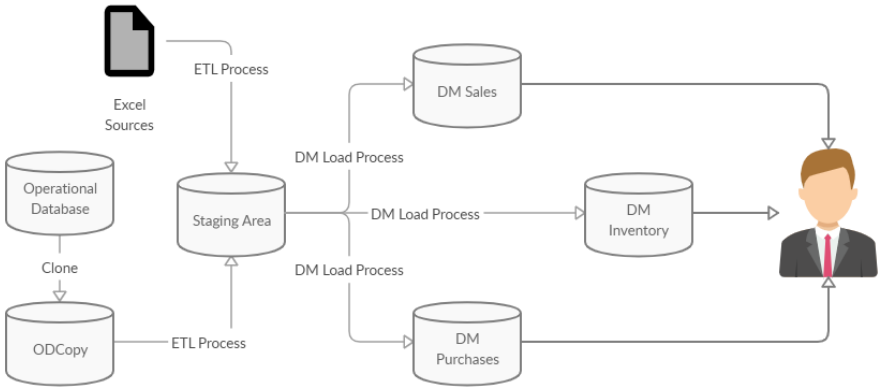


Figure 5.2: Logical System Architecture

After all the information is stored into the staging area database, the data marts are ready to be loaded with valued information. This information will later give an informed analysis to the manager through the use of business intelligence tools.

5.4.2 Local Databases

Since this project runs on a local instance of SQL Server, there are some important considerations to take into account at the beginning of development.

The ETL process should occupy the shortest possible operational DB. To minimise the use time, a local DB named "*ODCOPY*" was created with the only purpose of replicate the operational DB tables. This way, the whole process can act on a local DB. The DB creating scripts can be consulted in the Appendix A.

For the next two DB's are the required for the data preparation Staging Area (SA) named "*SA*" and for the construction of the star schema referred in the Section 5.4.1 also know as Data Mart (DM) named "*DM*" in the Integration Services (IS) process. The creation scripts can be consulted in the Appendix A.

The final DB is a Analysis Services (AS) type, required for the development of the Data Cube in the AS project. This last DB it's created automatically in the AS process.

Also, there is some information related to the business model, that it's not represented in the DB. So for that, external information in excel files complement and bring more context to the information, like business types, stores names and geographically locations. These files are also available in Appendix C

Chapter 6

Implementation

> "*No matter what people tell you, words and ideas can change the world.*"
>
> *- Robin Williams*

In this Chapter, the implementation of the solution is carried out according to the whole study and design made in the previous chapters. As follows, it describes the entire phase of construction and problem solving and as well as the evaluation of results obtained of the solution.

6.1 Integration Services

This first step was to use the Microsoft SQL Server Integration Services from Microsoft Visual Studio and connect it to the Operational Database (OD), extracting all the crucial data, transform it and apply some corrections to achieve a Star-Schema DM. This process allowed building a high-performance data integration solution.

6.1.1 ETL Process

The ETL process consists in a series of workflows that extracts the data from the source DB, modulate the data according to the needs and finally load them into a new DB called Data Mart, that could later be part of a DW.

For this process is required to create three DBs where the data from the OD is going to be loaded and others to create the Data Mart. So, to complete this task it was used the Microsoft SQL Server Management Studio to run the required queries to create all the DB and their respective tables.

The first procedure was to create a clone "ODCOPY" from the Operational DB to reduce the amount of time that it is using operational DB resources. This way, all the following steps are going to use the clone to read the data. The staging area is a DB in which the data from the OD is loaded and then modulated to fit the project needs and some information quality parameters. In a step to create the table dimensions into the new ETL DB, it uses scripts generated in Visual Paradigm, to accelerate the DB process.

As mentioned before the scripts that generated the three DB can be consulted in the Appendix A, Section A.3, A.4, A.5, A.6, A.7 and A.8.

In Microsoft SQL Server Management Studio, after running all the scripts, it is possible to verify the correct creation of the DB's, as shown in Figure 6.1.

A Business Intelligence Integration Services project has been created to initiate the ETL process, as seen in Figure 6.2.

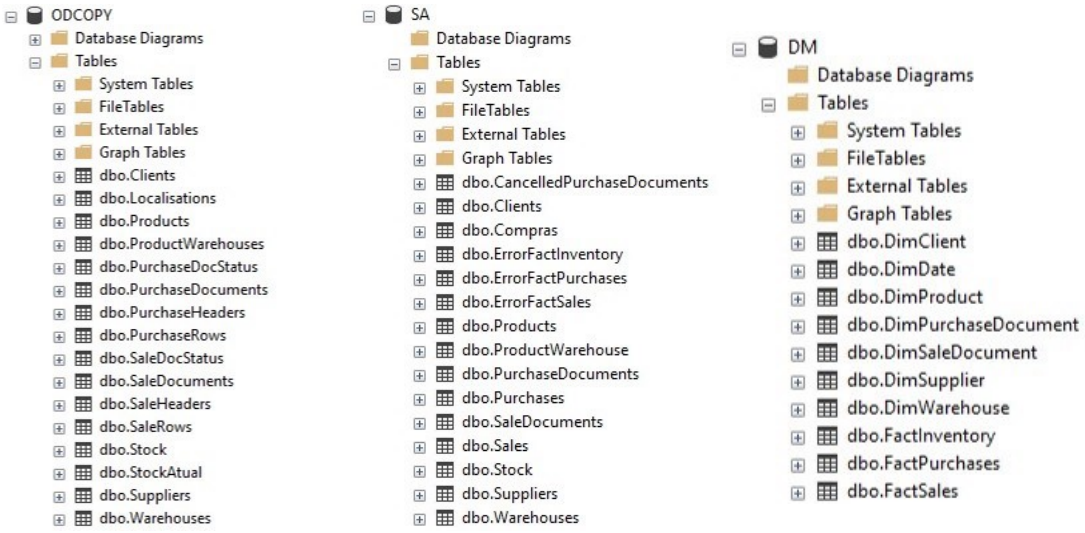


Figure 6.1: SSMS Databases.
Source: System print-screen.

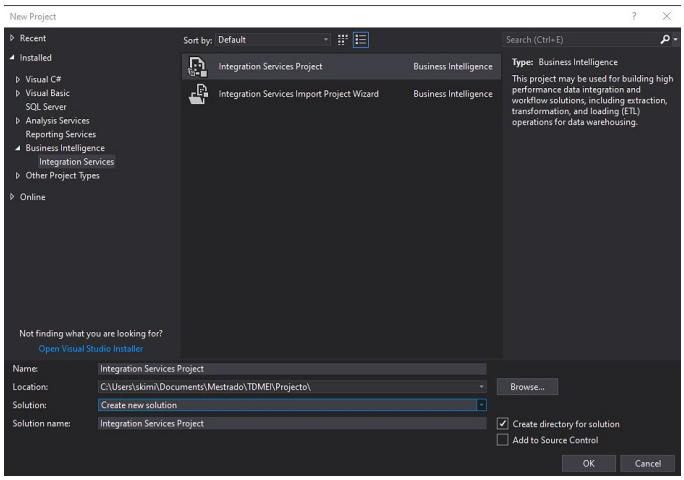


Figure 6.2: Integration Services Project.
Source: System print-screen.

Ensure ETL correct operation

The first sequence container was created to assure the correct operation at the ETL process and to verify that all the needed tables and DB exist and if not creates them. Also, it was always chosen to create a clean copy of the "ODCOPY" and "SA" DB, this way guarantees that they are always ready and updated. For the "DM" DB's it is not needed to drop and create the DB as it uses mechanisms that ensure the correct update of the data, such as the SCD.

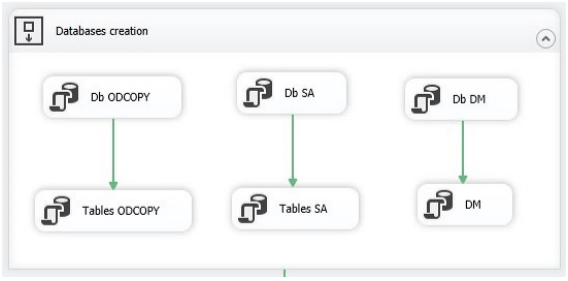


Figure 6.3: Database creation sequence container.
Source: System print-screen.

This container in Figure 6.3, shows six modules named execute SQL task that as the name implies execute a query from SQL. Connected two by two, each pair corresponds to a specific DB. To program this module in the Figure 6.4, it is straightforward, we need to define a connection type to the source of data, create a logical connection and the SQL statement that it is required to execute.

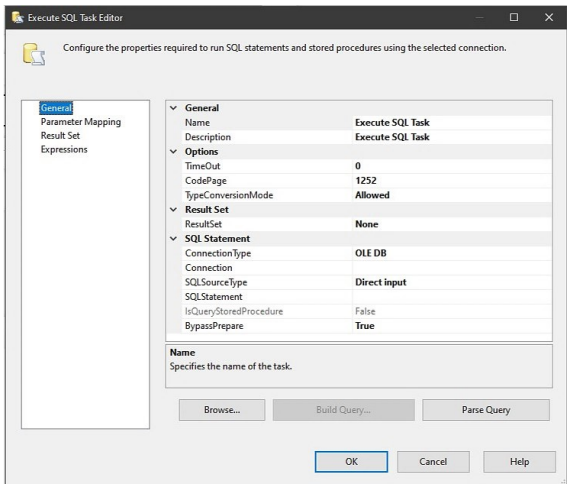


Figure 6.4: Execute SQL task.
Source: System print-screen.

For the connection type, an OLE DB was required to connect to the SQL Server instance. To create the connection, we have to create a new OLE DB connection to the master DB that it is only present in the base instance of the SQL Server.

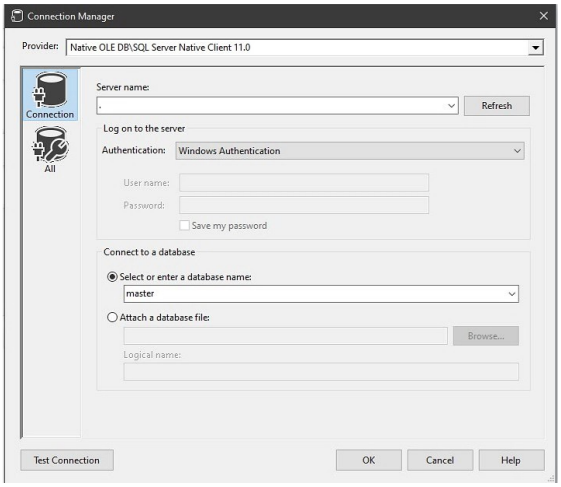


Figure 6.5: OLE DB connection.
Source: System print-screen.

In the panel shown in Figure 6.5, it is required to fill the following information:

- **Server Name:** here it could be a "." or "localhost", as the SQL Server installation is local.
- **Authentication:** Windows Authentication works perfectly.
- **Select or enter a DB name:** here we must choose a DB that it is present in all the systems with SQL Server, so it must be the master DB.

The last step is to create the SQL query that it is required to execute and set it in the SQL statement field.

```
IF EXISTS ( SELECT [name] FROM sys.databases WHERE [name] = 'ODCOPY' )
BEGIN
ALTER DATABASE ODCOPY SET  SINGLE_USER WITH ROLLBACK IMMEDIATE
DROP DATABASE ODCOPY
END
```

This first query is to check if the DB exists and drop it so that in the following step, it is possible to create it again clean. Even if the DB doesn't exist the task executes successfully and the next "Execute SQL Task" it is going to create the DB and each table correctly.

The second "Execute SQL Task" it is similar to the creation of the first with one difference, instead of writing the query directly into the task module, saves it in a script file, and the task runs the complete script from the file. The script can be consulted in A.8

The other two tables have similar process with different scripts that can be consulted, as mentioned before, in A.7, A.3, A.4, A.5 and A.6.

Operational Database Clone

The second "Sequence Container" in Figure 6.6 it is related to extract the data to clone of the OD, simple copies the tables from the source to the local "ODCOPY" DB without any transformation.

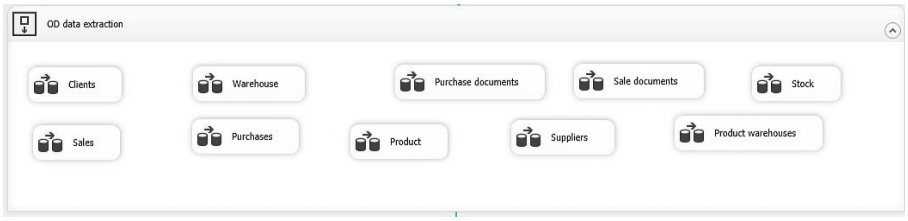


Figure 6.6: Operational Database Clone.
Source: System print-screen.

Categories group the processes of extracting data from the source table and loading into the local DB. Each Data Flow Task component aggregates the tasks related to each category.

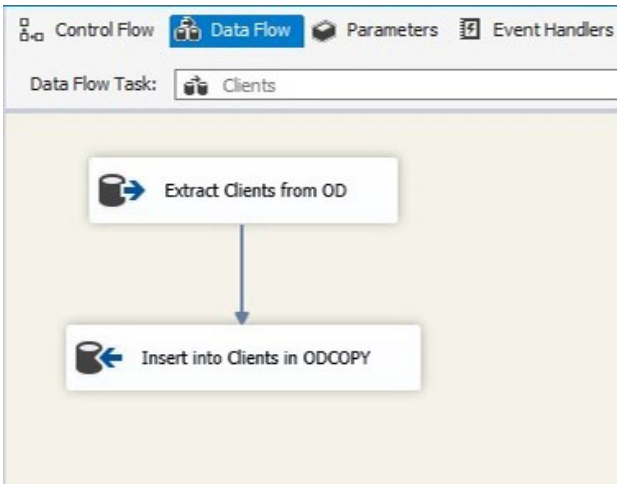


Figure 6.7: Data Flow task for clients.
Source: System print-screen.

The component used to extract data from a SQL source is the "OLE DB Source" that requires an OLE DB connection manager and a table in the source to extract. The connection manager is similar to the one created before but this time connected to the OD DB.

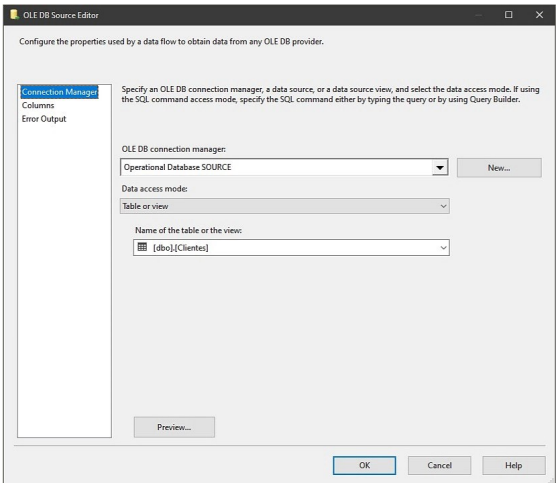


Figure 6.8: OLE DB Source.
Source: System print-screen.

The other component in Figure 6.7 is the one that sends the data to another SQL destination, namely the OLE DB Destination that as the name implies it is used similarly as the OLE DB Source with the difference in the table selected that acts as the destination and not the source.

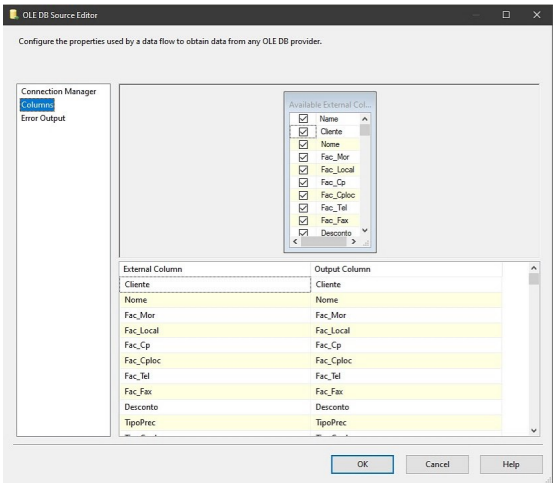


Figure 6.9: OLE DB Source Columns.
Source: System print-screen.

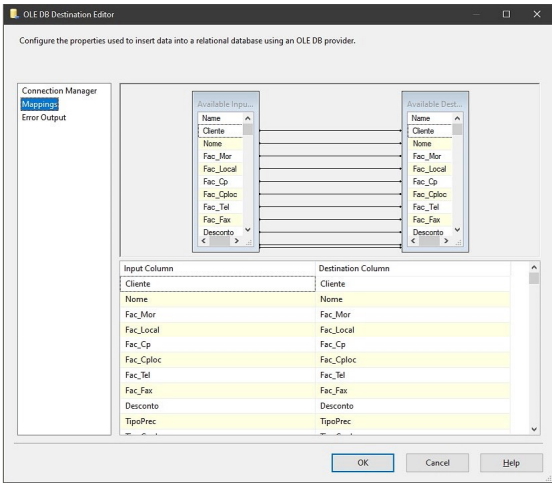


Figure 6.10: OLE DB Source Columns.
Source: System print-screen.

Both components also have a tabbed option called columns that in the OLE DB Source is to select the attributes to import as shown in the Figure 6.9 and in the OLE DB Destination to connect the source data with the available columns in the destination table, as shown in Figure 6.10.

As mentioned before each data flow component is related to a category such as Clients, Warehouses, Purchase or Sale Documents, Products and other, in this way the data flow component has the extraction and loading of each table related with the category.

In essence, this sequence container is as simple as it gets, fulfilling the unique purpose of extraction the necessary data from the OD without getting to much processing time of it.

Staging Area Load

Meanwhile, in the third sequence container, we get to one of the most critical steps in the ETL process. This container aggregates all the transformations and corrections needed to consolidate the data as information. Once again, this container groups the processes by category, as seen in Figure 6.11, so this way, it is easily understandable and managed.

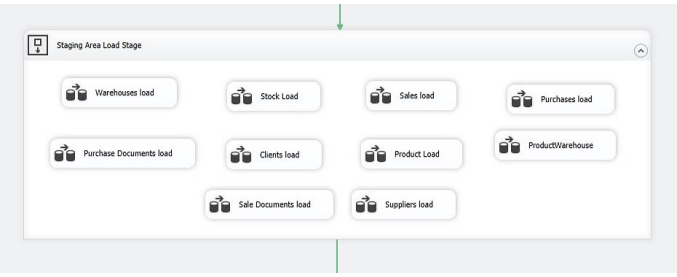


Figure 6.11: Staging Area.
Source: System print-screen.

There are many types of transformation and corrections made into the data, but "Data Quality" it is also complementing the data with additional information that it is not available directly in the OD DB.

In an example, for the data flow of loading the warehouses from the "ODCOPY" to the "Staging Area", we have some transformations, but also it is added complementary information.

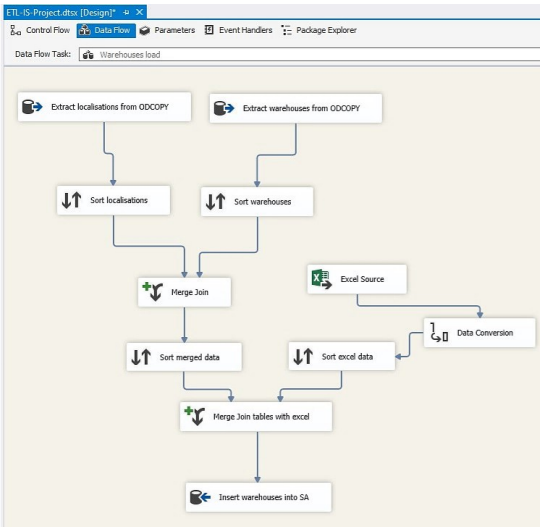


Figure 6.12: SA warehouses process.
Source: System print-screen.

In Figure 6.12, it is possible to see the extraction of two tables from the "ODCOPY", using the OLE DB Source component, one with the warehouses and the other that relates the warehouses with localisations. In the business model of the subject company, each warehouse can have multiple localisations, and each type of business or store have multiple warehouses. So, the first step is to merge the warehouse for each localisation using the sort component to order the data by the common attribute because it is a requirement for the merge component. Then, in the merge component, it is used the method of "full outer join" to guarantee the inclusion of every localisation and warehouse. For the end-user to see added value in the BI system, it is added some external information from an excel file C.2 merged with the data joined from the tables before. This way, it is not required that the end-user must know the store from which warehouse and localisation. In the end, the "Staging Area" receives the data in the form of information.

The "Excel Data Source" is a component comparable with the "OLE DB Source", but the source data is on excel file instead of the SQL Server. In Figure 6.13, it is possible to check the similarities, even needing the connection manager to reach the specific excel file.

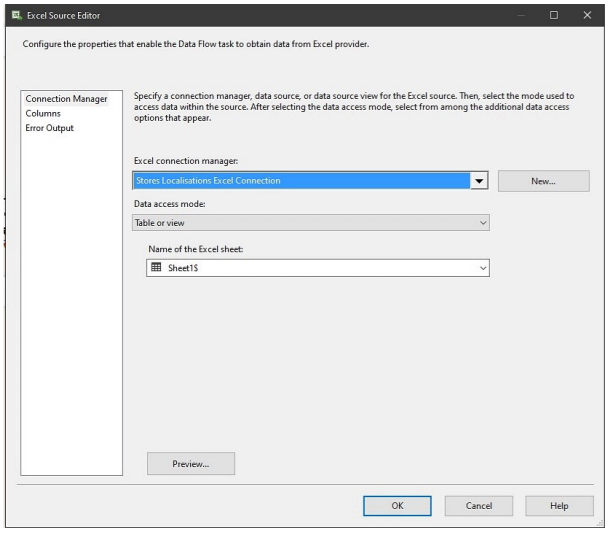


Figure 6.13: Excel Data Source.
Source: System print-screen.

It also uses a data conversion component, that converts the type of the data, in Figure 6.14 to the data coming from the excel file so that it matches the data format from the source tables. Cause, we not only adding information such as the store but correcting information such as local and description.

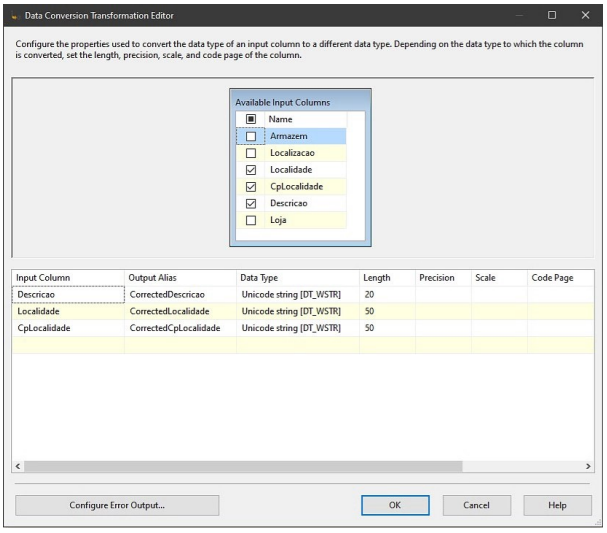


Figure 6.14: Data Conversion.
Source: System print-screen.

The “Purchase Document Load” and “Sale Document Load” data flows are similar to the warehouses’ processes as shown in Figure 6.15, but instead of splitting the information into two tables in “ODCOPY” it is only one table with all the information.

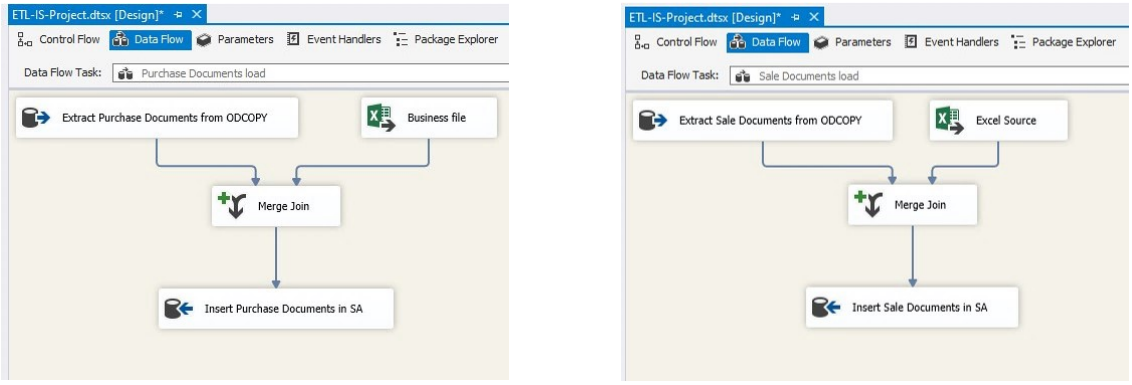


Figure 6.15: Purchase and Sale Document Load.
Source: System print-screen.

This time, the excel file is regarding the documents codes and associate them with a specific business. The excel file can be consulted in C.1.

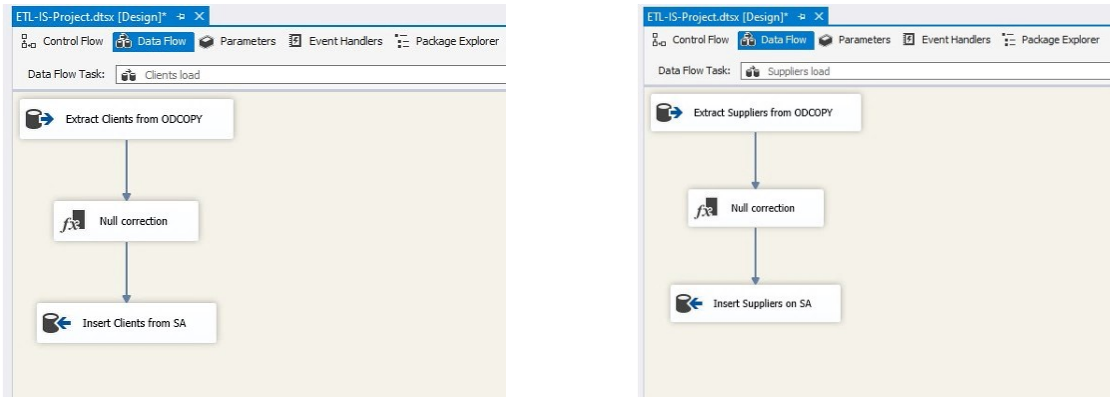


Figure 6.16: Clients and Suppliers Load.
Source: System print-screen.

Other two similar data flows are the ones related to clients and suppliers. As shown in Figure 6.16 it has an OLE DB source and an OLE DB destination with a Derived Column component to replace all the "null" with some information.

The "null" was a critical problem when processing the Clients and Suppliers tables, as there was much critical information that was missing in the records tables. With the use of Microsoft SQL Server Management Studio, it was possible to understand the length of the problem and correct the lack of information in the DM. More details about this process in Section 6.1.4 related to data quality.

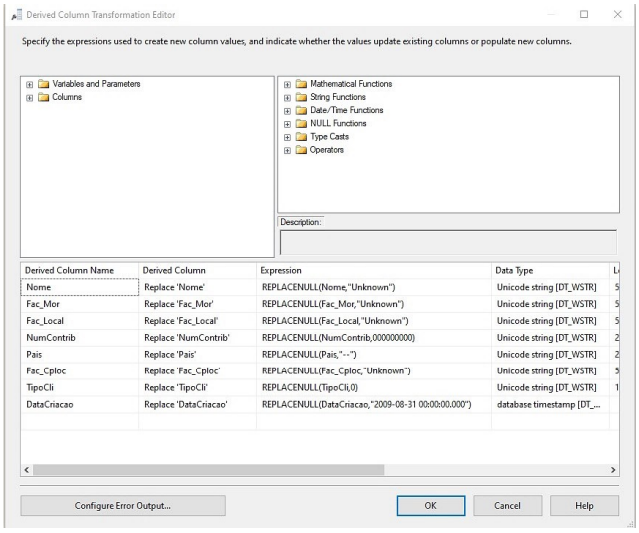


Figure 6.17: Derived Column in Clients.
Source: System print-screen.

The Derived Column component can apply transformations to data, according to expression and conditions. In the case of Figure 6.17, it is configured to avoid "null" data in the DM.

Until now, the processes were somewhat simple, but they can get very complicated and time-consuming, not only in the development stage but also each time that the data flow executes.

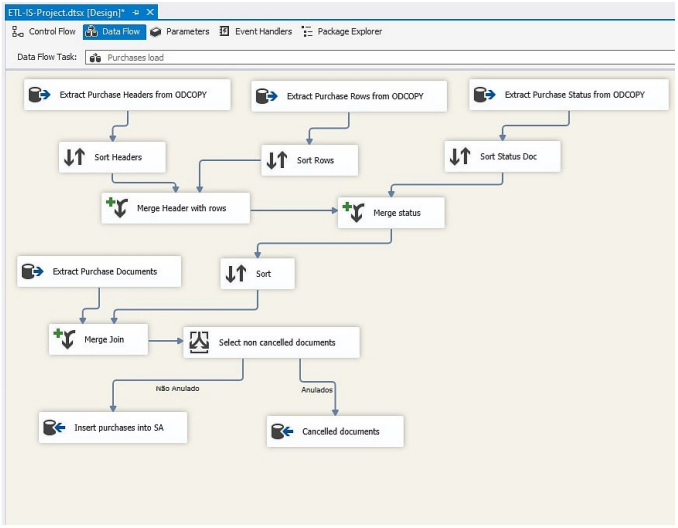


Figure 6.18: Purchases Load.
Source: System print-screen.

As shown in Figure 6.18, the data source is coming from four tables that must be sorted and merged to join them. Each sort module is very time consuming, which make this process to take longer to process than the average. Also, there is the need for using a conditional split component, as shown in Figure 6.19, to exclude cancelled rows, with zero in quantities or not essential to include in the DM.

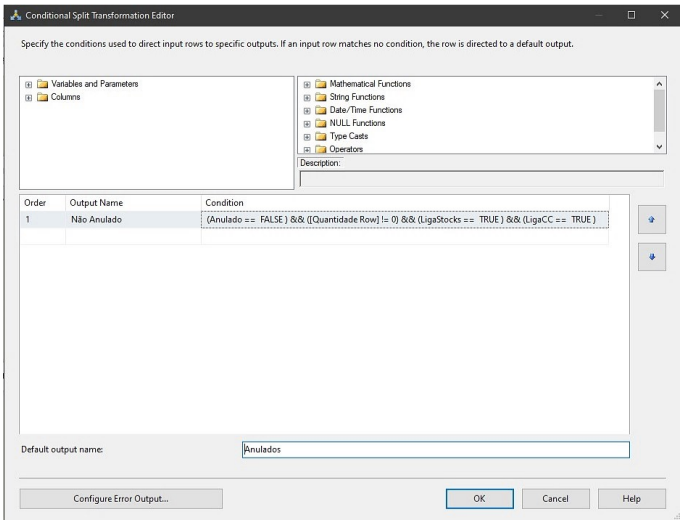


Figure 6.19: Conditional Split.
Source: System print-screen.

As an optional step, the use of an OLE DB destination to keep the cancelled documents in a table named "CancelledPurchasedDocuments", not only to allow later consult but also to validate the cancelled documents filter. This approach of keeping records of rows that weren't accepted is used in other data flow processes, in the load of the fact tables, to understand the excluded records. The creation of the tables happens in the SA and Microsoft SQL Server Management Studio can access them later.

The sales load as a similar schema of components but the problem was that while the purchased load have to deal with 650 000 rows, the sales load have more than 3 760 000 rows. Measuring the processing time of the data flow of purchasing load takes on average 8 minutes, with all the sorts and transformations, while the sales load takes on average 45 minutes. The sales data flow is always the last one to complete in the sequence container related to the SA. This way, there was a need to find a more efficient way to load this data and the most reliable way is to put the process of joining the tables and excluding the not needed documents to SQL Server with a direct query.

```
SELECT SR.NumLinha, SR.Artigo, SR.Taxalva, SR.Quantidade, SR.PCM, SR.PrecUnit,
    SR.TipoLinha, SR.Armazem, SR.PrecoLiquido, SR.Id, SR.Descricao, SR.
    PercentagemMargem, SR.Margem, SR.Totallliquido, SR.Totallva, SH.[Data], SH.
    Entidade, SH.TipoDoc, SH.NumDoc, SH.Serie, SH.Nome, SH.Localidade, SH.
    CodPostalLocalidade, SH.TipoEntidade
        FROM SaleRows SR LEFT JOIN SaleHeaders SH ON SR.IdCabecDoc = SH.Id
        LEFT JOIN SaleDocStatus SS ON SR.IdCabecDoc = SS.IdCabecDoc
        LEFT JOIN SaleDocuments SD ON SH.TipoDoc = SD.Documento
        WHERE SS.Anulado = 'False' AND SR.MovSTK = 'S' AND SR.Quantidade <> 0
    AND SD.LigaCC = 1 AND SD.LigaStocks = 1
        ORDER BY SR.Id
```

The result SQL query does a similar process as the one seen in the purchase load, but this time it takes less than 30 minutes.

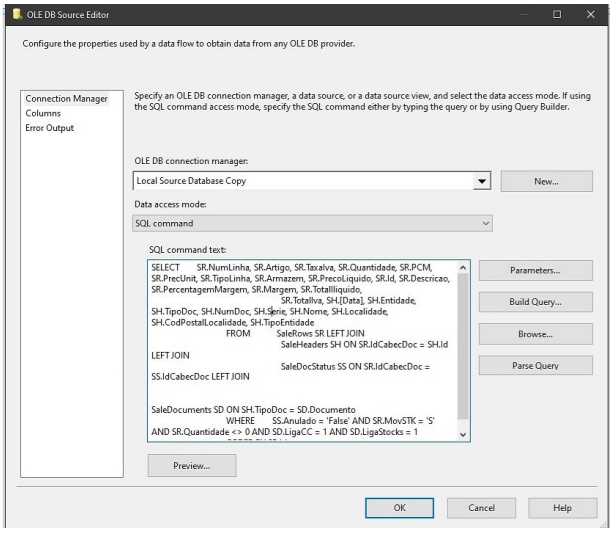


Figure 6.20: Sales Load.
Source: System print-screen.

As shown in Figure 6.20, the component is the same, but instead of using a data access mode to a table is a SQL command.

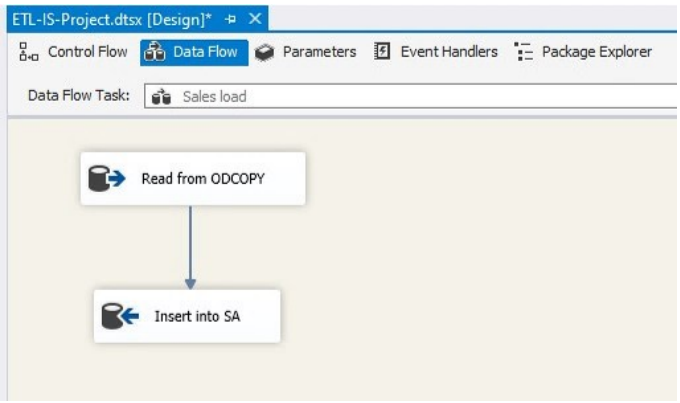


Figure 6.21: Sales Load data flow.
Source: System print-screen.

Resulting in a more simple data flow but less flexible as shown in Figure 6.21, without the possibility of recording in a table the cancelled documents, being a significant benefit the lesser time spent processing this data flow.

In Figure 6.22, there is another complex data flow, first because it is needed to split the movements related to sales and purchases and then as they were some products rows with “null” descriptions. With the help of the conditional split component and derived column component, there were created two columns one for sale quantity and another to purchase quantity. For the missing descriptions, a merge with the table Products solved the problem. Even in there are two OLE DB Destination components, both sent to the same table in the SA DB.

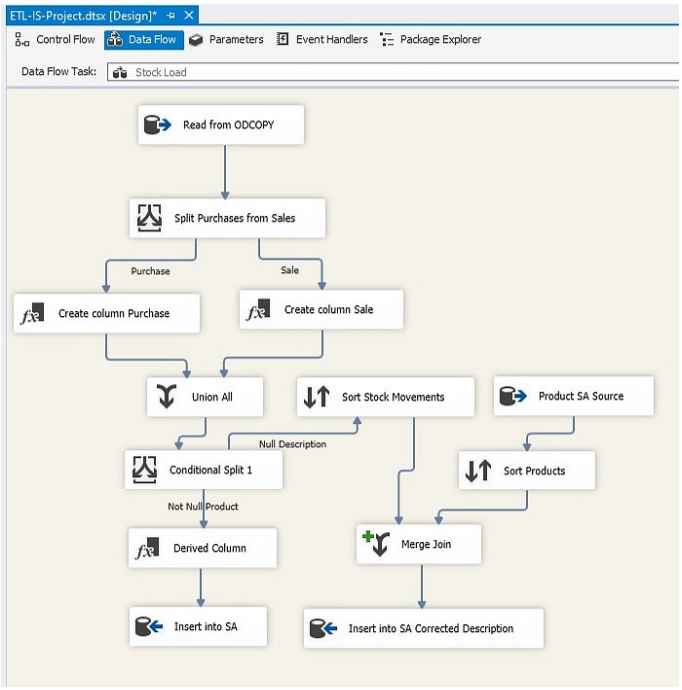


Figure 6.22: Stock Movement Load.
Source: System print-screen.

The products load is a simple data task with some simple transformations and corrections that increment the value of the information.

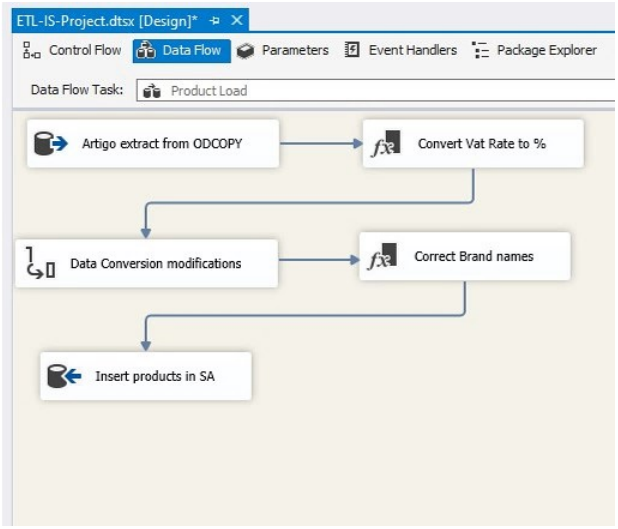


Figure 6.23: Products Load.
Source: System print-screen.

In Figure 6.23 there are derived column components and a data conversion component. In the derived

components, it is converted the VAT amount to a percentage and some corrections about “nulls”, and misleading text is applied. The data conversion occurs in the data types so it can match the destination table.

The sequence container related to the SA terminated is execution, and now the load of the dimension tables are going to take place.

Dimensions Load

The creation of the star schema that allows the construction of the cube is the last segment of the integration services process. In this step initially are loaded all the dimensions and on a next sequence container the fact tables because of key constraints on the tables.

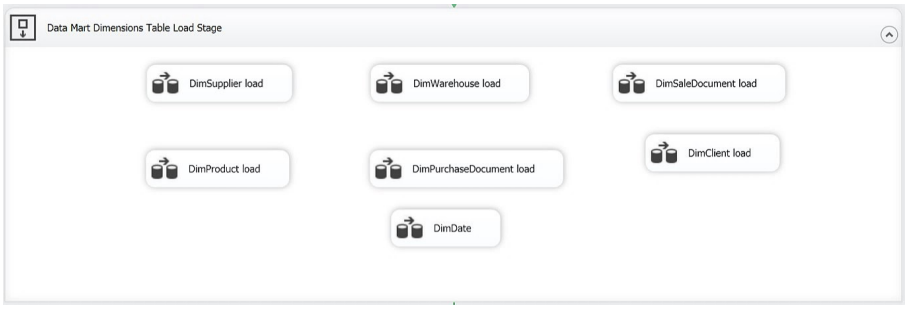


Figure 6.24: Dimensions Load.
Source: System print-screen.

In the dimensions load process the most simple table is DimDate table, it is a table based on a static flat CSV[1] file without the need of any transformations. The required operation is only to load the CSV to a table.

The CSV file was created in Excel with the help of the existent functions that help to extract more information of a simple data. The file can be consulted in the Appendix C.4.

Inside the DimDate control flow, there is one Flat File Source to connect to the excel file and extract the data and an OLE DB Destination to insert it to the DB.

Also, there is required to create global connections in the Connection Manager to allow the correct link from the modules to the DBs or source files as shown before in Figure 6.5 or 6.13.

The other dimension tables make use of the SCD strategy to maintain the data updated and providing some historical records, as explained in Section 4.1.1.

[1] A comma-separated values (CSV) file that stores tabular data (numbers and text) in plain text, delimited by a comma to separate values.

Two types of SCD are used, SCD type 1 for the tables that don't have attributes that need to keep historical and SCD type 2 for the attributes in tables that it could be useful to have a historical record of changes.

For the SCD type 1 the tables are DimWarehouse, DimSaleDocument and DimPurchaseDocument. Using the SCD type 2 there are the tables DimSupplier, DimProduct and DimClient.

The process of creation is similar in both cases, as it has a simple wizard that helps configure the process that takes care of changes over time. It starts with the configuration of an OLE DB Source that's connected to a component called Slowly Changing Dimension as shown in Figure 6.25.

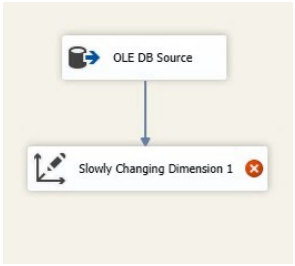


Figure 6.25: Slowly Changing Dimensions component.
Source: System print-screen.

The SCD configuration is straightforward, the first panel in Figure 6.26 is related to the destination table, working such as an OLE DB Destination component were a connection must be selected or created to the indicate the destination DB and table.

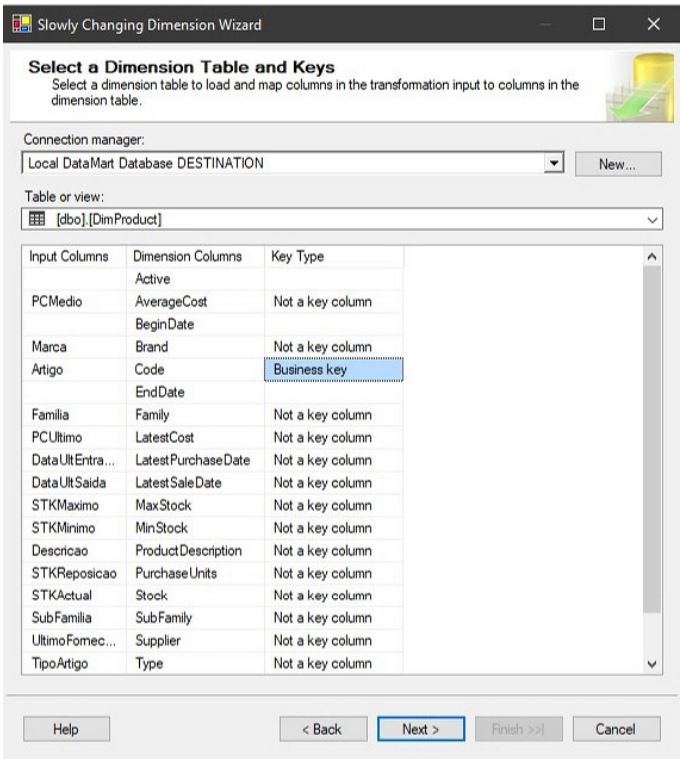


Figure 6.26: Slowly Changing Dimensions relations.
Source: System print-screen.

Posteriorly, the selection of the connections between the source and the destination indicating the business key of the table.

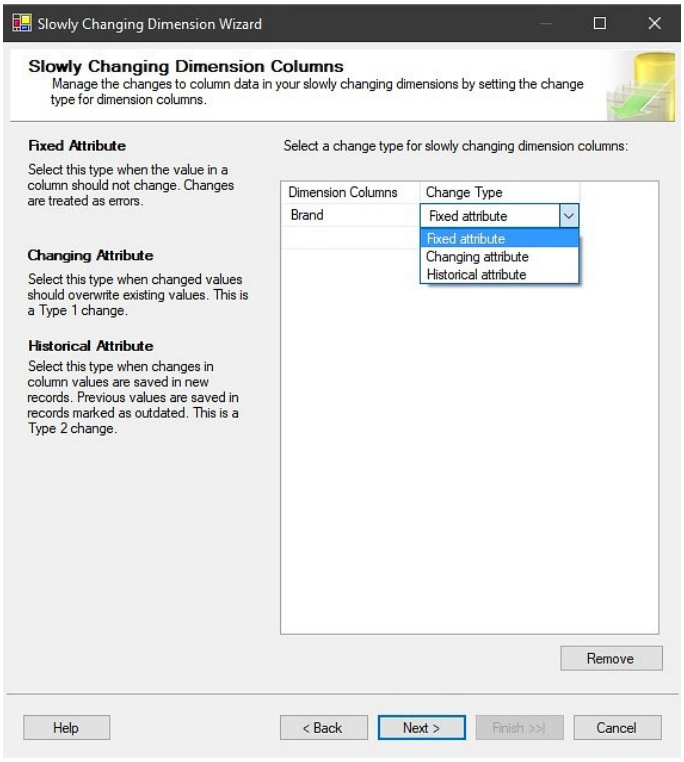


Figure 6.27: Slowly Changing Dimensions strategy.
Source: System print-screen.

In the next panel as shown in Figure 6.27, it is possible to choose for each attribute the strategy to deal with the changes, "fixed attribute" that don't change, "changing attribute" that the change replaces the old value and the "historical attribute" that keep both records registering the date between that the record is valid, also has been added an "active" boolean that indicates the valid record, making easier to know the last record when multiple exists in the table. In the next panel, there are two checkboxes, one indicating that it should fail the process if a fixed attribute changes and other that requests if when a changing attribute should update all the older records also or only the valid one. The subsequent panel about "Inferred Dimension Members" it is not required to activate as it deals with problems of records arrive earlier to fact tables than the dimensions, but as the loading of the fact tables happens in a separate sequence container that only executes after the successfully loading of all the dimensions, there is no problem.

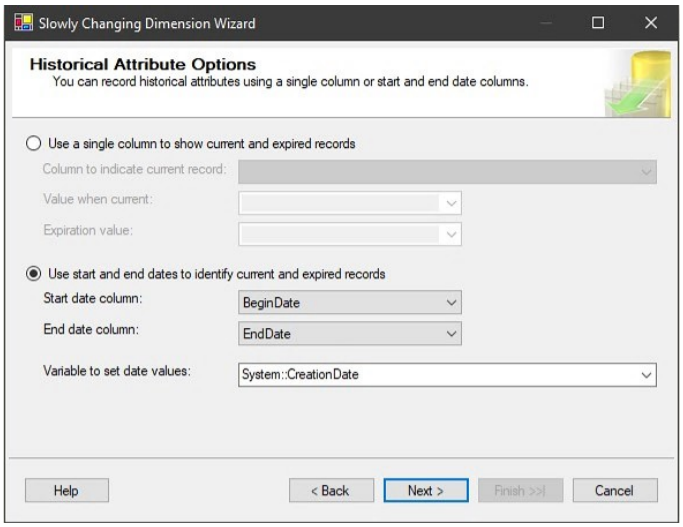
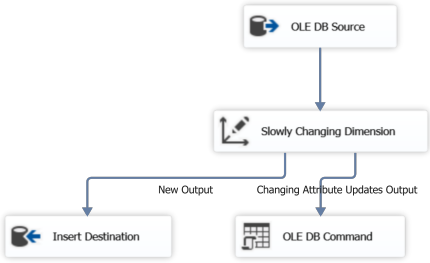
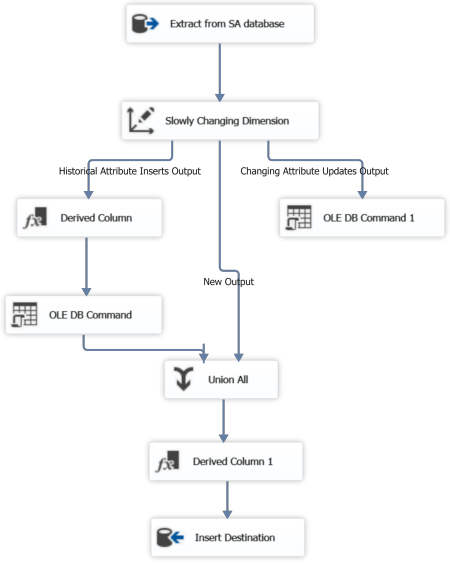


Figure 6.28: Slowly Changing Dimensions historical attributes.
Source: System print-screen.

For the last panel, it shows a summary of the options selected waiting for finishing the process. In the historical attribute configuration, there are some additional steps, the first shown in Figure 6.28 that requires to select the destination attributes that keep the begin and end date of the record, then outside the wizard is also configured the active boolean as explained before, adding in the derived column of the historical attribute path the column Active with the value 0 as "false", and in the derived column of the path for new output setting the column Active to 1 as "true". For the changing attribute or SCD type 1 table the final schema is shown in the Figure 6.29a and for the historical attribute or SCD type 2 the schema is as shown in the right side of the Figure 6.29b.



(a) Type 1



(b) Type 2

Figure 6.29: Slowly Changing Dimensions examples.

As soon as the load of the dimension tables is complete, the process moves on to the next and final

sequence container, the load the fact tables and the creation of the star schema tables accordingly with Kimball's architecture and studied in Section 4.1.1.

Fact's Load

In the last sequence container related to the integration services is the load of the fact tables. There are three areas of analysis, so for that, there is three fact tables, Fact Purchases for procurement analysis, Fact Sales for business analysis and Fact Inventory to stock related analysis.

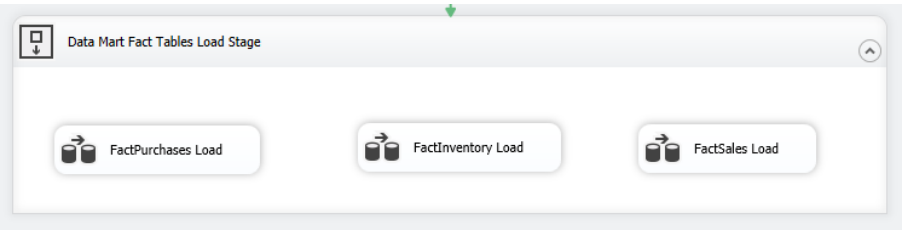


Figure 6.30: Fact Tables.
Source: System print-screen.

To send dimension data to fact tables, you need to replace the information in each key attribute with the key in the corresponding dimension.

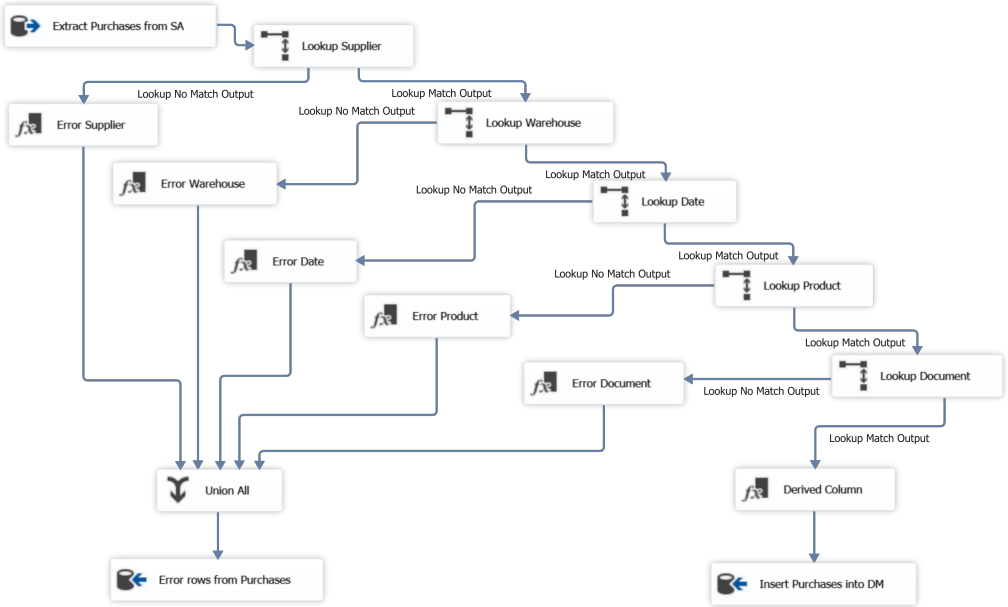


Figure 6.31: Fact Purchases.
Source: System print-screen.

The process is done using a Lookup component that allows you to search for an attribute common to two tables and return the required attribute.

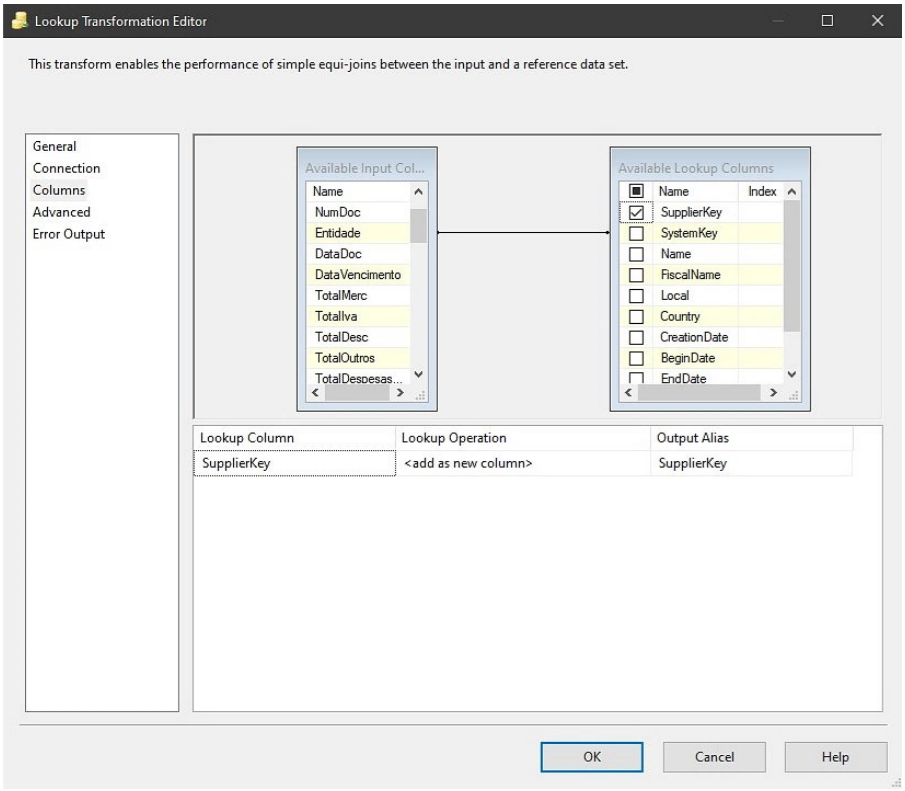


Figure 6.32: Lookup component.
Source: System print-screen.

After choosing the table to look at, it is necessary to link the record present in both tables and put the check in the return key attribute. In this case, Figure 6.32 shows an example for the table fact purchases load in the supplier lookup, and it returns in a new column.

This process must repeat for each key attribute using the lookup component and dimension table.

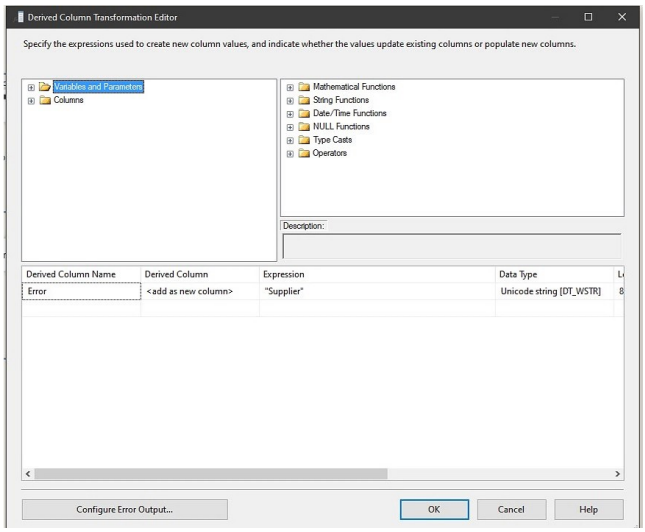


Figure 6.33: Derived Column error Lookup.
Source: System print-screen.

As explained before the values that have no match are stored in an error table for further analysis, so for every no match lookup with the derived column component, a column error with the name of the table is recorded. Later, it's possible to know were that record didn't match. The derived column component configuration can be seen in example for the table fact purchases load in the supplier lookup, in Figure 6.33.

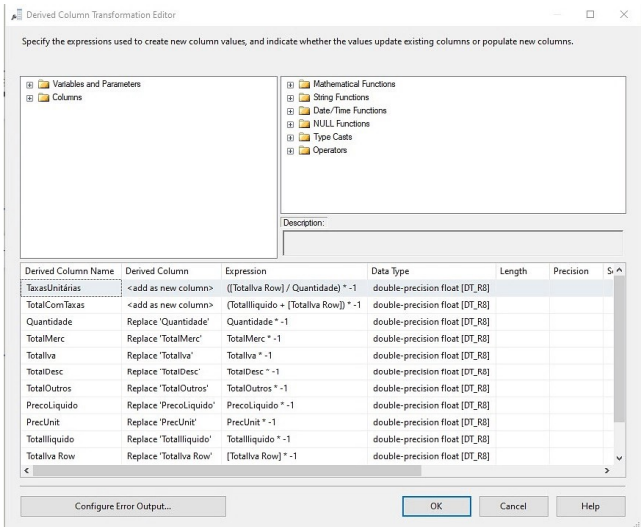


Figure 6.34: Derived Column corrections and content creation.
Source: System print-screen.

After finishing the lockups, there's another derived column as seen in Figure 6.34 to create some new columns that didn't exist. These columns are the unit amount of taxes and total with taxes, but also to convert values to positive, cause in the OD the values about purchases are negative.

For the fact sales, the process is similar to the one observed for the fact purchases, differing only on the lookup tables and attributes generated.

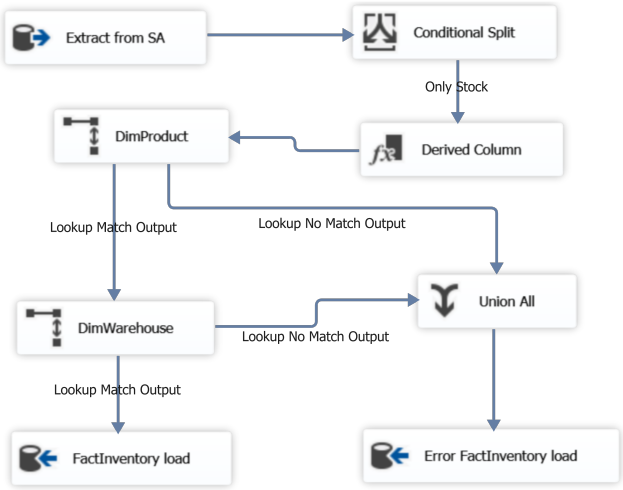


Figure 6.35: Fact inventory load.
Source: System print-screen.

On the other hand, the fact inventory load has some differences as seen in Figure 6.35, such as a conditional split component to exclude some rows that don't have stock and aren't relevant for the analysis, as the inventory analysis is only made to actual stock products.

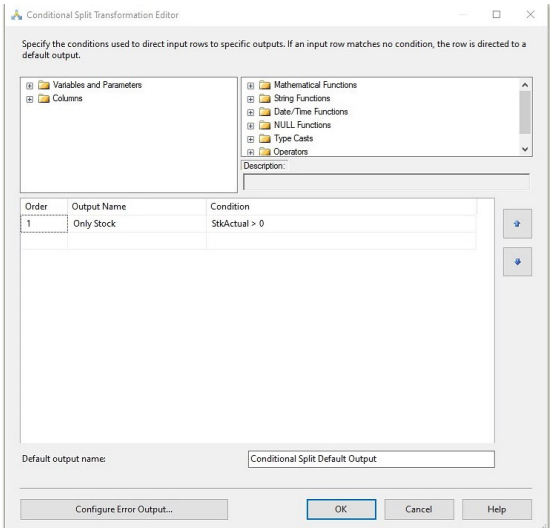


Figure 6.36: Conditional Split.
Source: System print-screen.

In Figure 6.36, it is possible to check a simple condition to have cleaner data in the fact table.

With the last sequence container completed, the ETL process has ended. At this point, the ETL process loaded the dimensions and fact tables in the DW allowing the generation of the MOLAP Cube described in Section 6.1.2.

6.1.2 Analysis Services

Microsoft SQL Server Analysis Services (SSAS), is an OLAP in Microsoft SQL Server. SSAS is a tool to analyse and understand information.

Some of the advantages of building a Cube is to deal with a higher amount of data and tables more efficiently, as the MOLAP is designed for optimal performance search queries. It is possible with the glsROLAP solution already achieved in IS to connect it to Power BI and work some dashboards from it, but the idea was to find an adequate solution for the specific situation. This way, both methods are going to be tested and described.

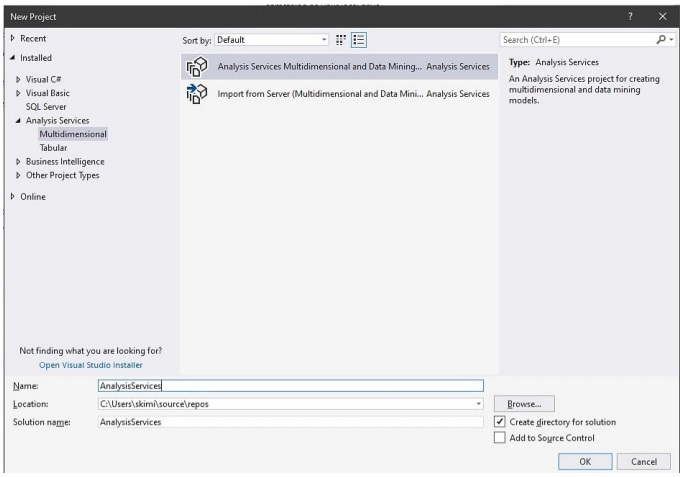


Figure 6.37: Analysis Services new project.
Source: System print-screen.

For this method, it has been used the Microsoft Visual Studio once again, this time creating an Analysis Services Multidimensional and Data Mining project as in Figure 6.37.

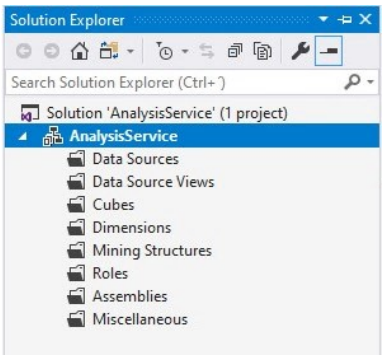


Figure 6.38: Analysis Services project tree.
Source: System print-screen.

After the creation, the solution explorer presented the project tree as in Figure 6.38, and in here, some elements needed creation, such as the Data Source; Data Source Views, the Dimensions and lastly the Cube.

In a multidimensional AS model, a data source object represents a connection to the data source from which is processed and imported data. A multidimensional model must contain at least one data source object, but it is possible to add more to combine data from multiple data warehouses.

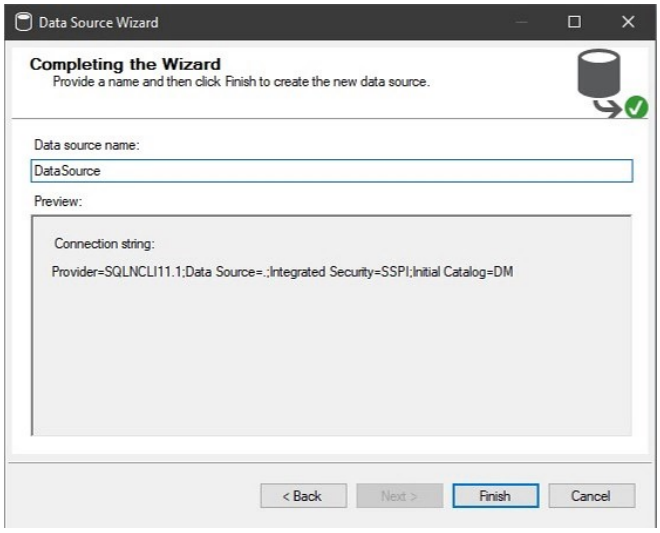


Figure 6.39: Analysis Services Data Source.
Source: System print-screen.

Using the wizard to create the Data Source, initially, there must be set a data source connection to the DM DB, that was created in the IS, then about the impersonation information use the service account (more information in Section 6.1.3) and to finish selecting a name to the Data Source as shown in Figure 6.39.

The data source view contains the logical schema model used by AS multidimensional DB objects, that is, cubes, dimensions, and mining structures. A data source view is the metadata definition, stored in XML format, of these schema elements used by the Unified Dimensional Model.

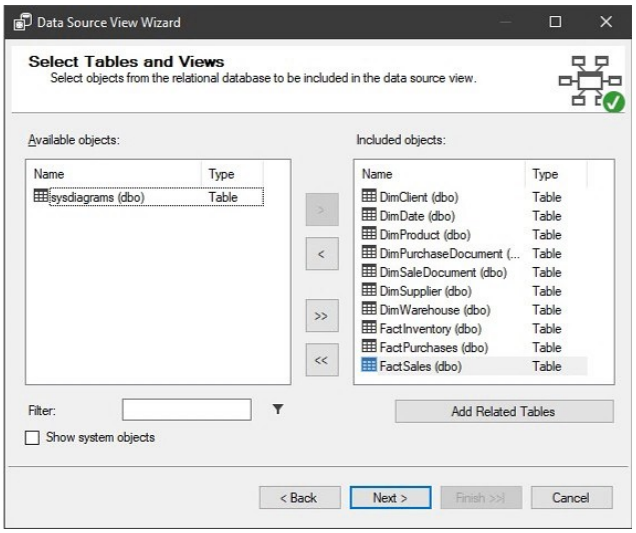


Figure 6.40: Analysis Services Data Source View.
Source: System print-screen.

Once again, to create a Data Source View there is a wizard that guides all the process, and the first step is to select the Data Source created before, then there must be selected all the dimensions and fact tables important to the Cube as in Figure 6.40. For the last step is required to introduce a name to the Data Source View.

After defining a data source view in the Microsoft AS project, it is time to define an initial Analysis Services cube.

The last wizard supervises the process of creation of the Cube, using existing tables from the Data Source View created. Then it is required to select the fact tables, and their measures, the dimensions related to the fact tables appear after automatically selected, as there are relationships in the DB between them it is easy to link them. The Cube creation wizards end with a request for the name and a preview of all the selections made regarding dimensions and fact tables.

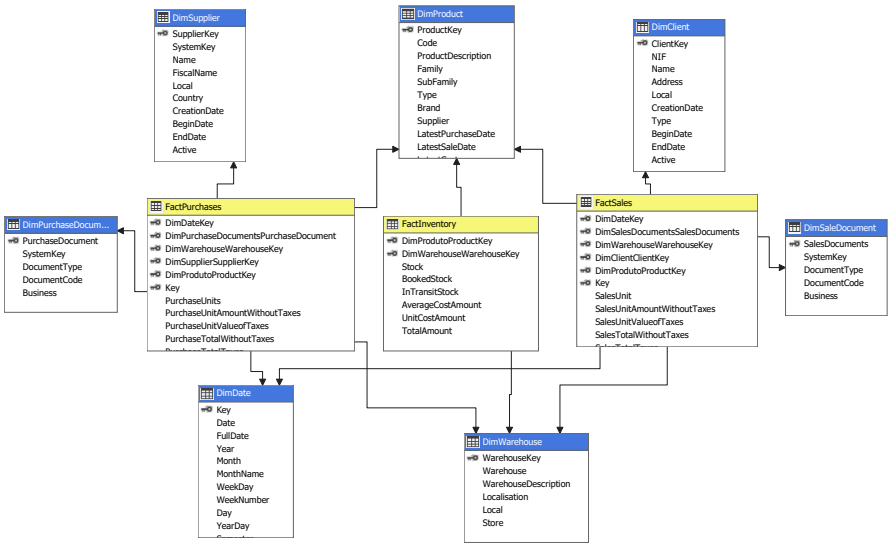
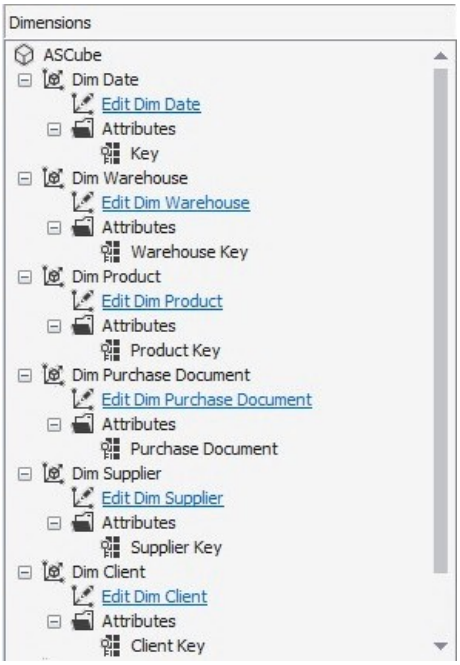
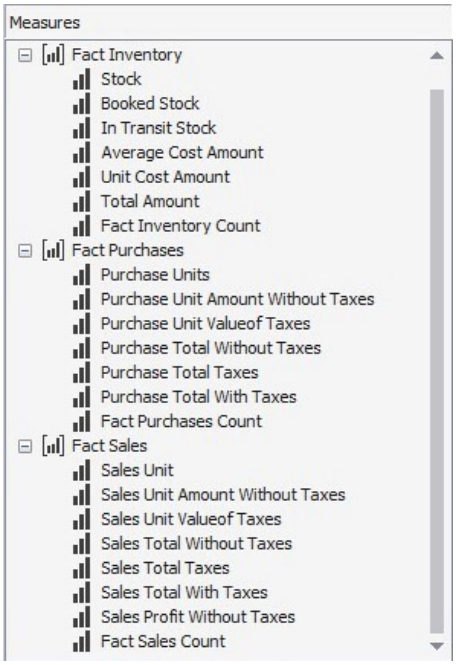


Figure 6.41: Cube Model - Data Source View.
Source: System print-screen.

At this stage, the Cube is created and ready to be connected to a BI such as Power BI. However, some parameters need to be defined, attributes chosen and hierarchies specified to refine the data in the cube. As in Figure 6.41, the Cube already presents the fact tables correctly connected to the fact tables and the measures defined in the IS are already selected as shown in Figure 6.42b, but for the dimensions, there aren't any selectable attributes as it is possible to perceive in Figure 6.42a.



(a) Dimension Tables



(b) Fact Tables

Figure 6.42: Tables on Data Source View.

In each dimension, it is required to choose attributes manually, to allow the use of dimension attributes as filters in the Cube. Selecting them in the Data Source View and drag them to the attributes panel. Another valuable procedure is the use of hierarchies in the attributes; it isn't required to do will all the tables, but some are almost mandatory, such as the DimDate, the were two hierarchies created.

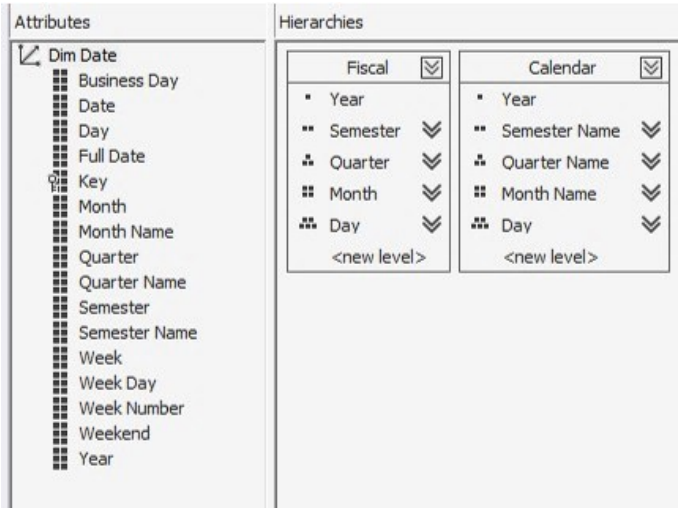


Figure 6.43: DimDate Hierarchies.
Source: System print-screen.

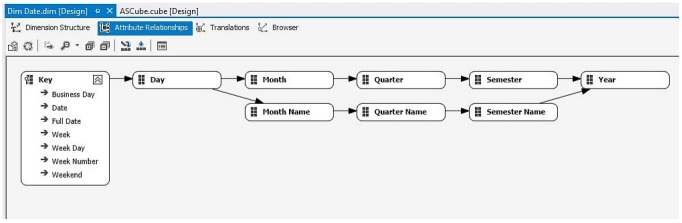


Figure 6.44: DimDate Hierarchies relationships.
Source: System print-screen.

- **Fiscal**
  Hierarchies with numeric values for
  $Year \rightarrow Semester \rightarrow Quarter \rightarrow Month \rightarrow Day$
- **Calendar**
  Hierarchies with text values for
  $Year \rightarrow SemesterName \rightarrow QuarterName \rightarrow MonthName \rightarrow Day$

After selecting all the attributes and drag them to the Hierarchies panel as shown in Figure 6.43 and connection accordingly the attributes in the attribute relationships panel such as Figure 6.44 in the properties for each attribute it is required to define the key columns and name column.

Source	
CustomRollupColumn	(none)
CustomRollupPropertiesColumr	(none)
KeyColumns	(Collection)
DimDate.Year (Double)	DimDate.Year (Double)
DimDate.Semester (Double)	DimDate.Semester (Double)
DimDate.SemesterName (WC	DimDate.SemesterName (WChar)
DimDate.Quarter (Double)	DimDate.Quarter (Double)
DimDate.QuarterName (WCh	DimDate.QuarterName (WChar)
DimDate.Month (Double)	DimDate.Month (Double)
DimDate.MonthName (WCha	DimDate.MonthName (WChar)
DimDate.Day (Double)	DimDate.Day (Double)
NameColumn	**DimDate.Day (WChar)**
ValueColumn	(none)

Figure 6.45: DimDate Hierarchies KeyColumns.
Source: System print-screen.

In the example of Figure 6.45 for attribute Day, all the above attributes in the hierarchy structure must be selected in the order defined previously. This way, it is possible to drill up or down in the hierarchy correctly, allowing the user in the dashboards a more intuitive way to explore the data.

Hierarchies can provide a simple, intuitive view of an otherwise more elaborate data structure, with the ultimate purpose of providing a better user experience.

Other dimensions with hierarchy structures are:

- DimProduct dimension
  $Brand \rightarrow Family \rightarrow SubFamily$
- DimPurchaseDocuments and DimSaleDocuments dimensions
  $Business \rightarrow DocumentCode \rightarrow DocumentType$

- DimSupplier dimension
  $Country \rightarrow Local$
- DimClient dimension
  $Local \rightarrow Address$ relating Local with Address.
- DimWarehouse dimension
  $Local \rightarrow Warehouse \rightarrow Localisation$

The last step to finalising the AS process is to deploy the cube to the database.

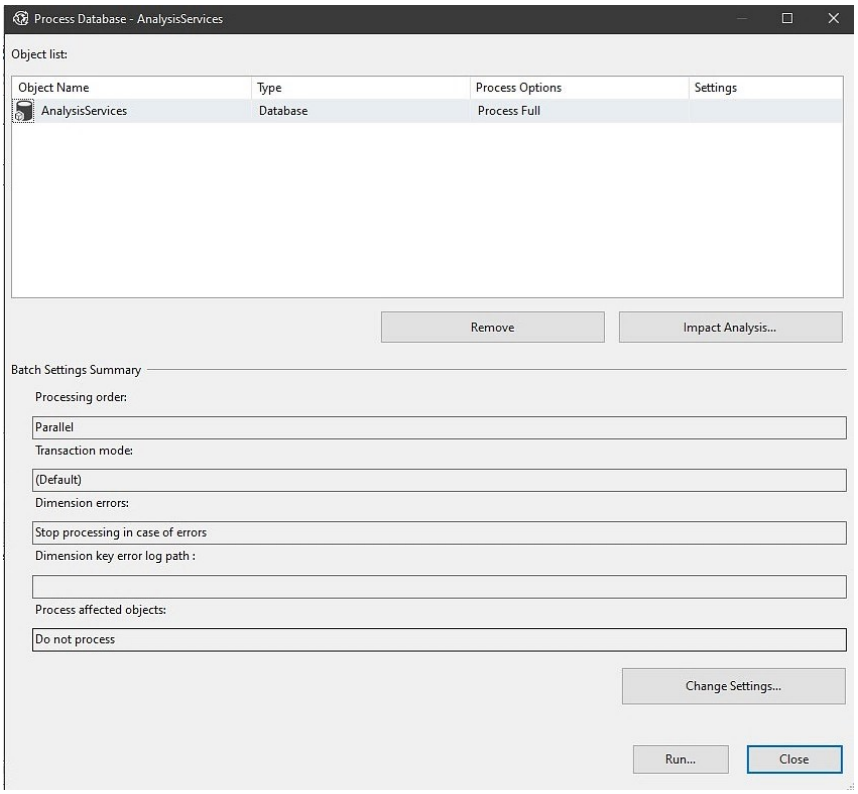


Figure 6.46: Deploy Process.
Source: System print-screen.

All the previous configurations are necessary to achieve the processing of the cube, which allows access to the cube through AS, as shown in Figure 6.46 enabling to process the whole project.

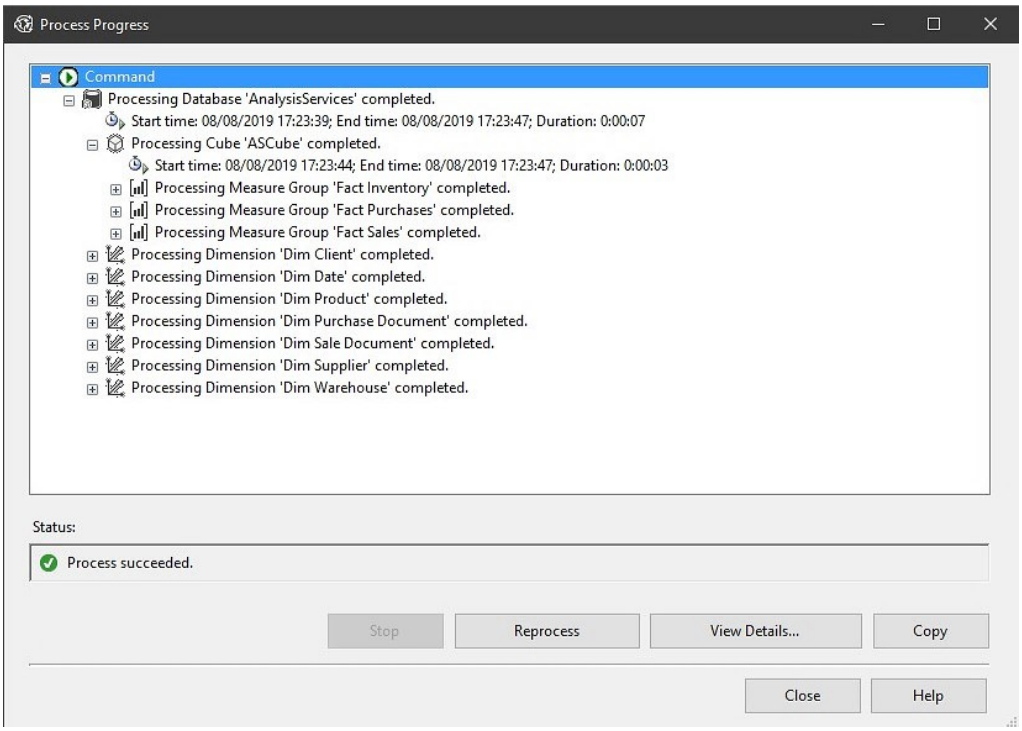


Figure 6.47: Deploy achieved successfully.
Source: System print-screen.

After a moment, the process ends with Figure 6.47 showing the success of the operation, and the cube is now available for access.

Calculations and KPIs

There is also the possibility to create additional measures know as calculations or KPIs.

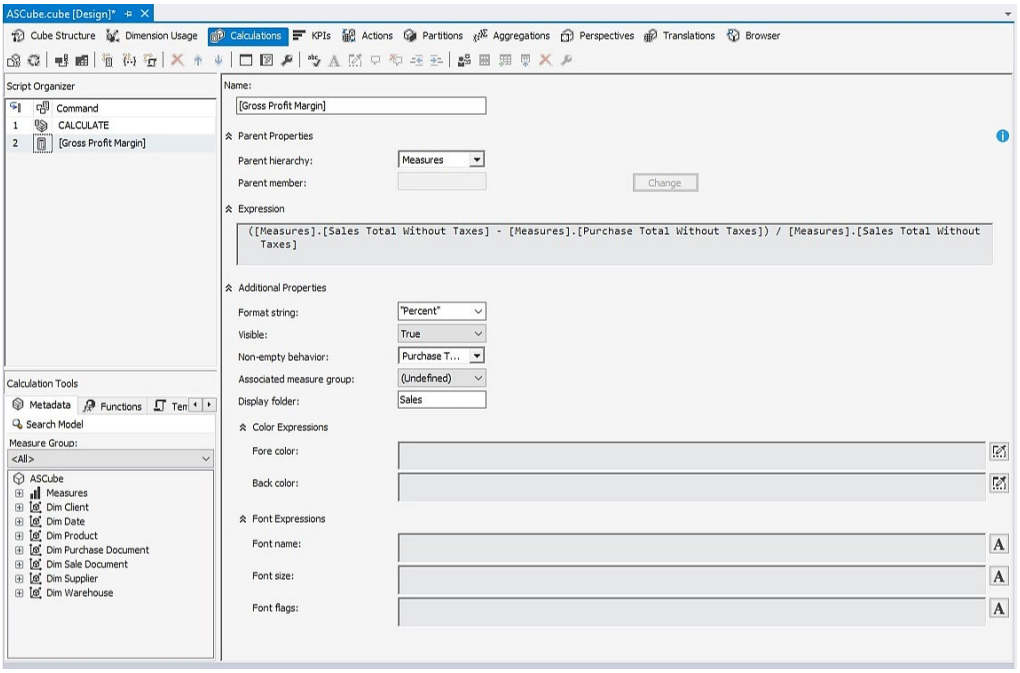


Figure 6.48: Analysis Services Calculations.
Source: System print-screen.

For the calculations, the AS calculate these new attributes with an expression that include actual measures as in Figure 6.48 to calculate the Gross Profit Margin.

The DAX expression used is the following:

```
1 ([Measures].[Sales Total Without Taxes] - [Measures].[Purchase Total Without
    Taxes]) / [Measures].[Sales Total Without Taxes]
```

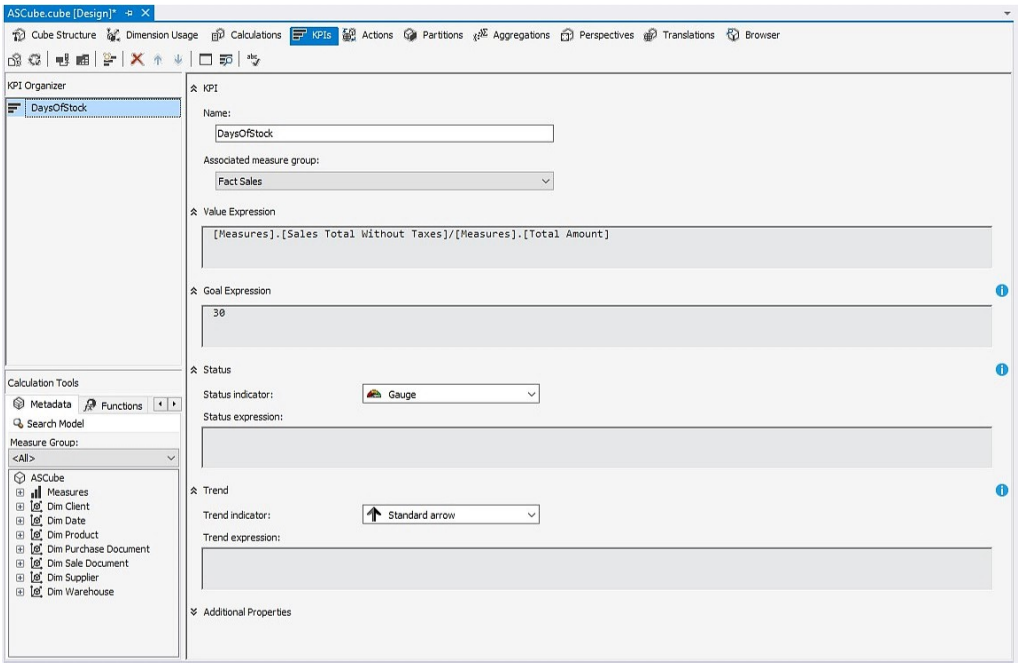


Figure 6.49: Analysis Services KPIs.
Source: System print-screen.

For the KPIs, the process is similar, but now there are two expressions, one for the calculated value and other for the goal expression as in the example for Days of Stock KPI in Figure 6.49.

The DAX expression used is the following:

```
1 [Measures].[Sales Total Without Taxes]/[Measures].[Total Amount]
```

These calculations and KPI's are also available for creation in the Microsoft Power BI tool, allowing a more efficiently and flexibly approach, as the author has more experience in the Power BI and most of the conditions for these calculations and specially KPI can change over time, this way there isn't the need to go back to the AS.

6.1.3 ETL Automated Execution

There are different ways to Execute Microsoft SQL Server Integration Services (SSIS) projects, using Visual Studio, or command line, SQL Server Agent, or even using the Windows Scheduler or any third-party scheduler.

The Visual Studio option in the least interesting as it obligates to open the program and execute it every time that updated data is required, limiting a lot the usability for other users. The command line uses an executable named "Dtexec.exe" that is included by the Microsoft SQL Server. This option is preferable that the previous one but also not ideal as is a manual process. The use of the Windows Scheduler also requires the use of the "Dtexec.exe" by creating a batch file and executing it by the Windows Scheduler. The last studied option is the SQL Server Agent Job and considered better than the others. SQL Server Agent can be used to create a job that can run the SSIS Package on-demand

or schedule. The SQL Server Agent Job can be single Step calling a SSIS Package, or it can consist of multiple steps calling more than one SSIS Packages. SQL Server agent can access the packages that are stored in SQL Server or from folder storage.

A job in the SQL Server Agent created at the Microsoft SQL Server Management Studio in the DB that holds the DM as in Figure 6.50, then a step to run the SSIS is added to this job as Figure 6.50 defining a user with permissions to access the DB.

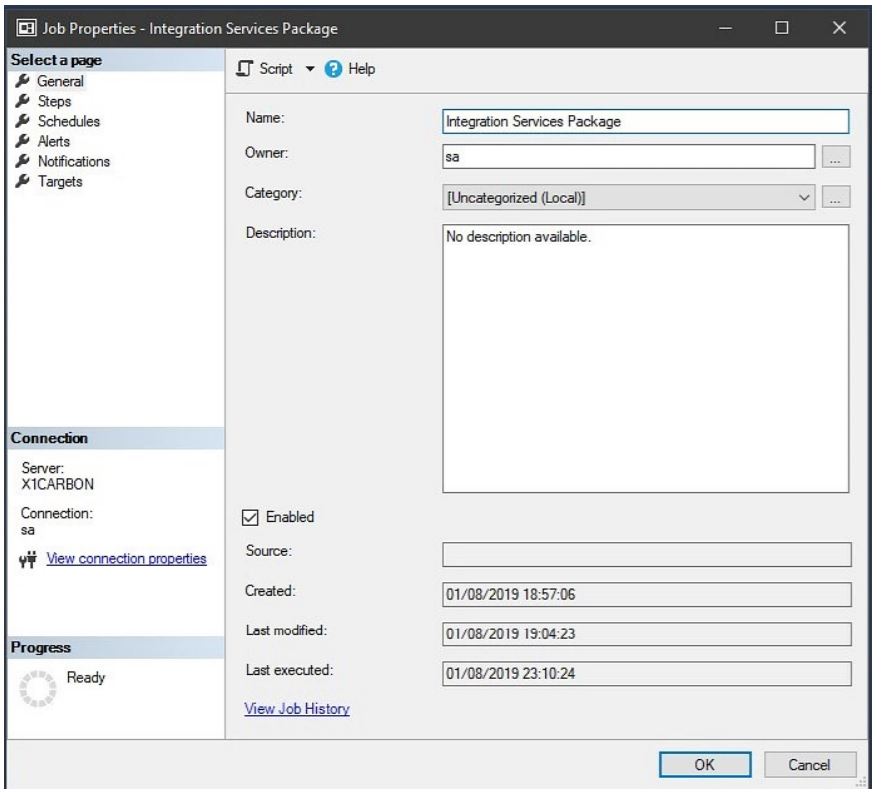


Figure 6.50: SQL Server Agent Job.
Source: System print-screen.

The last stage is to define the scheduler that recurrently executes the SSIS package, like Figure 6.51.

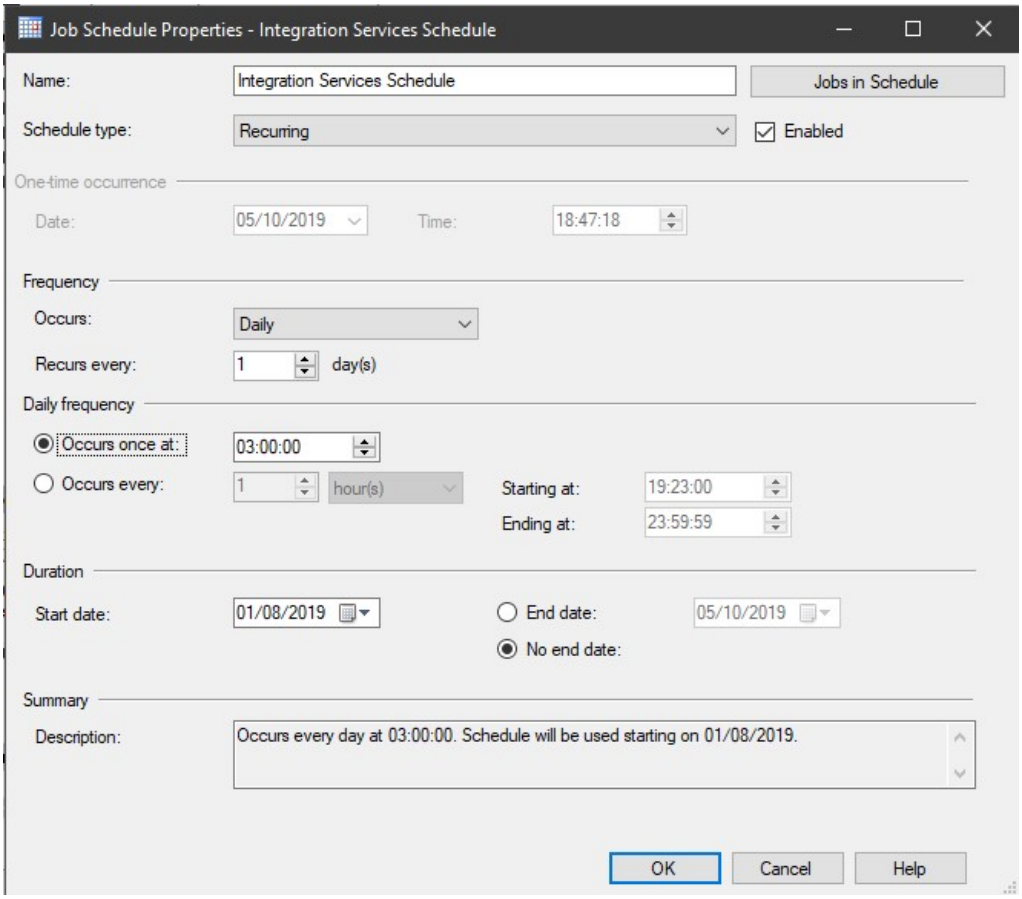


Figure 6.51: SQL Server Agent Job Step Scheduler.
Source: System print-screen.

Also, in Microsoft Power BI is possible to automate the execution of SSIS and SSAS packages, making a fully automated process and always updated. The Microsoft On-premises Data Gateway acts as a bridge to provide a fast and secure data transfer between local data and various Microsoft cloud services like Microsoft Power BI. Microsoft On-premises Data Gateway allows access to databases and other data sources on their local area networks while still securely using this local data in cloud services.

In both methods, it is possible to configure email notifications in case of the update isn't possible, and this way warn the users of not updated information in the dashboards.

Database Permissions to Analysis Services Project

This project uses data source impersonation settings that specify the security context under which data is imported or processed. By default, the impersonation settings specify the AS service account for accessing the data. For this default setting, there is the need to ensure that the service account under which AS runs has data reader permissions on the DM DB.

So to do that it must be determined the service account. In SQL Server Configuration Manager or the Services console application to view account information. As the AS was installed as the default instance, using the default account, the service is running as NT Service\MSSQLServerOLAPService. In Microsoft Management Studio, connect to the DB engine instance and expanding the Security

folder and creating a New Login. On the General page, the Login name is defined to NT Service\MSSQLServerOLAPService and under User Mapping, the Role membership for the new login must include "db_datareader" and "public" in the DM DB.

6.1.4 Data Quality

Data quality is a fundamental process in ETL, because how much complete and correct are the data in the source the better and more in-depth analysis is allowed.

Transformations and Corrections

There were many corrections made in this project related to data quality, and here there some examples:

- Null data;
  An analysis in Microsoft SQL Server Management Studio with a query to the OD that allows not only to perceive the attributes that have considerable "null" data and to what extent.

  Query example to analyse the problem and allowed the generate the Table C.3:

```
        SET NOCOUNT ON
        DECLARE @Schema NVARCHAR(100) = 'dbo'
        DECLARE @Table NVARCHAR(100) = 'Warehouses'
        DECLARE @sql NVARCHAR(MAX) =''
        IF OBJECT_ID ('tempdb..#Nulls') IS NOT NULL DROP TABLE #Nulls

        CREATE TABLE #Nulls (TableName sysname, ColumnName sysname ,
    ColumnPosition int ,NullCount int , NonNullCount int)

         SELECT @sql += 'SELECT  '''+TABLE_NAME+''' AS TableName , '''+
    COLUMN_NAME+''' AS ColumnName,  '''+CONVERT(VARCHAR(5),
    ORDINAL_POSITION)+''' AS ColumnPosition, SUM(CASE WHEN '+COLUMN_NAME+'
     IS NULL THEN 1 ELSE 0 END) CountNulls , COUNT(' +COLUMN_NAME+')
    CountnonNulls FROM '+QUOTENAME(TABLE_SCHEMA)+'.'+QUOTENAME(TABLE_NAME)
    +';'+ CHAR(10)
        FROM INFORMATION_SCHEMA.COLUMNS
        WHERE TABLE_SCHEMA = @Schema
        AND TABLE_NAME = @Table

        INSERT INTO #Nulls
        EXEC sp_executesql @sql

        SELECT *
        FROM #Nulls

        DROP TABLE #Nulls

```

  To remove the "null" attributes, it was used a Derived Column component with the expression similar to the one below:

```
        REPLACENULL([Descricao],"Unknown")

```

- Misspelled words;
  Especially in product brands, there are many errors in product brands, especially with quotes at

the beginning of the brand, which causes duplication of brands in the system. This correction was a useful but straightforward correction for the analysis.

For the correction of the names it was used a Derived Column component with the expression:

```
1        REPLACE([Marca],"\"","")
2
```

- Missing generic information;
  Some tables didn't have complete information even if that information was present in another table, for example, the stock movement table lacks descriptions of products, but the same products in the products table have the description. So, it was used the merge component to complete this information as seen in the "stock movement" data flow process in the SA.
- Missing information about the business.
  The missing information about the business is a complementary action, as this type of information creates added value to the analysis but usually isn't present in OD DB. There were created two excel tables C.1 and C.2 with information about the type of business, store and locations loaded with the warehouses to the purchase and sales documents.

6.1.5 Limitations with Analysis Services

The advantage of using Microsoft Power BI with SSAS is scalability. The Analysis Services model can grow to handle hundreds of gigabytes, reports and users without problems. Analysis Services offers a level of business robustness that goes beyond what Microsoft Power BI can handle in a file — leaving an excellent solution for companies with many gigabytes of DB. Unfortunately, it lacks flexibility compared to when using without SSAS, as it's not possible to customise or create any tables or measures in the Microsoft Power BI free, not even changing a data type on a column is allowed. As it was of the author interest to develop the Inventory Analysis in Microsoft Power BI, the connection through SSAS could not be the solution.

6.1.6 Major Problems Encountered

There was only one major issue through all the process of development, but it was a significant problem that took weeks to solve and many reinstalls of the Microsoft SQL Server.

The problem occurred when I restarted the computer the next time that I tried to access to database engine I received the following error:

```
1 Script level upgrade for database 'master' failed because upgrade step 'msdb
    110_upgrade.sql' encountered error 200, state 7, severity 25. This is a
    serious error condition which might interfere with regular operation and
    the database will be taken offline. If the error happened during upgrade of
     the 'master' database, it will prevent the entire SQL Server instance from
     starting. Examine the previous errorlog entries for errors, take the
    appropriate corrective actions and re-start the database so that the script
     upgrade steps run to completion.
```

moreover, in error log the information was the following:

```
OLE DB error: OLE DB or ODBC error: Login timeout expired; HYT00; A network-
    related or instance-specific error has occurred while establishing a
    connection to SQL Server. Server is not found or not accessible. Check if
    instance name is correct and if SQL Server is configured to allow remote
    connections. For more information see SQL Server Books Online.; 08001; SQL
    Server Network Interfaces: The specified LocalDB instance does not exist. [
    x89C50107]. ; 08001.
```

Even when trying to start the service "SQL SERVER (MSSQLSERVER)" manually it wasn't possible until a reinstall of the Microsoft SQL Server software.

After, many research and reading of similar problems that the solutions never solved my problem, finally I found that the problem was in Windows 10. Because of using the system in English with the locale in Portuguese, Microsoft in a recent update decides to automatically check a beta option with the following description "Beta: Use Unicode UTF-8 for worldwide language support".

6.2 Business Intelligence Dashboard's

Microsoft Power BI is a powerful yet straightforward tool to create insights in the form of dashboards, with the use of the drag-and-drop function it is possible to create exceptional dashboards, but with the help of the Data Analysis Expressions (DAX)[2], it is possible to push forwarder the analysis.

6.2.1 Power BI Integration

The integration of the SSAS with Microsoft Power BI is very straightforward as it supports the import of data from these servers directly. Through the menu of "Get Data" and choosing "Analysis Services", a connection manager appears to allow the configuration of the connection as in Figure 6.52.

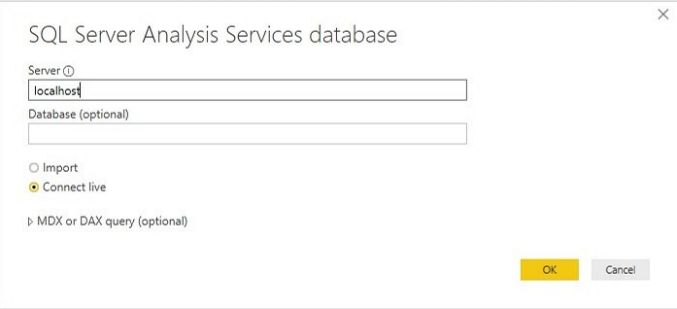


Figure 6.52: Power BI connection manager.
Source: System print-screen.

In this specific case, the server is the localhost and the DB it is not required at this moment. The type of connection recommended is "Connect Live" as the import method loads all the copy of all the data, making the process slower and less efficient.

[2]DAX is a library of functions and operators that can be combined to build formulas and expressions in Power BI Desktop and other services such as Azure Analysis Services, SQL Server Analysis Services, and Power Pivot in Excel.

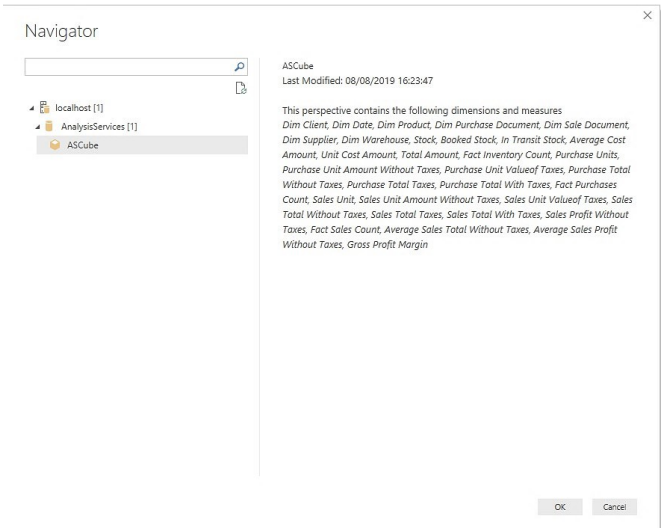


Figure 6.53: Power BI database selection.
Source: System print-screen.

In the next panel, the “Navigator” allows the selection of the DB as shown in Figure 6.53.

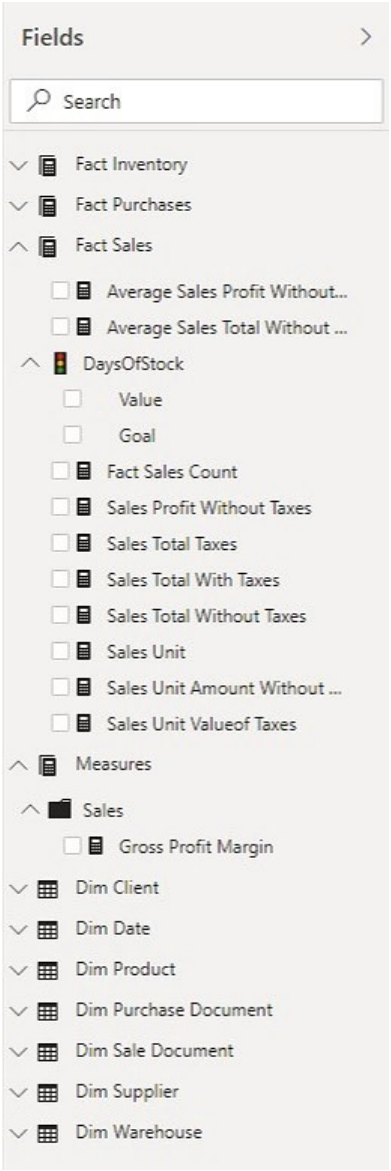


Figure 6.54: Power BI fields.
Source: System print-screen.

In Figure 6.54, it is possible to perceive that at this moment, the attributes, measures and KPIs selected or created in SSAS are available to use in the dashboards.

6.2.2 Dashboards

According to the limitations related in Section 6.1.5 there were implemented two solutions, one with a direct connection to SSAS and other connected directly to the DB.

Connected to SQL Server Analysis Service

The first dashboard in Figure 6.55, it is related to the brands, inventory amount and sales versus margin accumulated per store and brand.

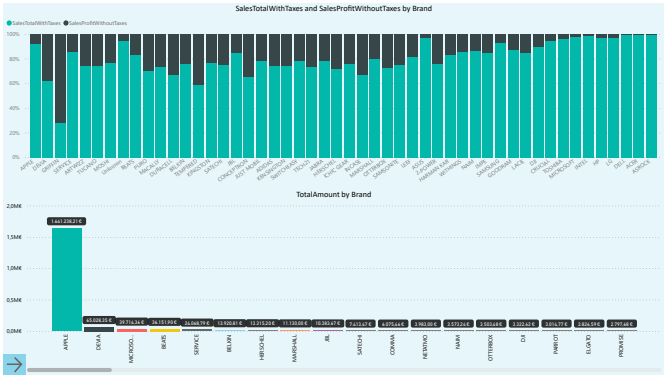


Figure 6.55: Sales versus Margin and Inventory per Store and Brand.
Source: System print-screen.

All the dashboards have dynamic filters as a sidebar or by clicking a component in the graph. When filtering the data in the side filters, all the visual graphs update accordingly, as shown in Figure 6.56.

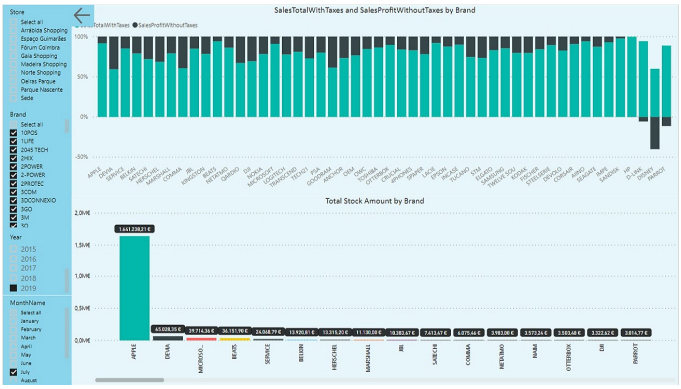


Figure 6.56: Sales versus Margin and Inventory per Store and Brand Filtered.
Source: System print-screen.

In the dashboard presented in Figure 6.55 it's possible to perceive the brands that generate more profit, this way, allowing the manager to focus in the most profitable brands and act in the less ones.

The following dashboard in Figure 6.57 is about stock in amount and units per store, with the filtering available per brand. The Figure 6.58 offers a similar analysis with a different visual indicator.

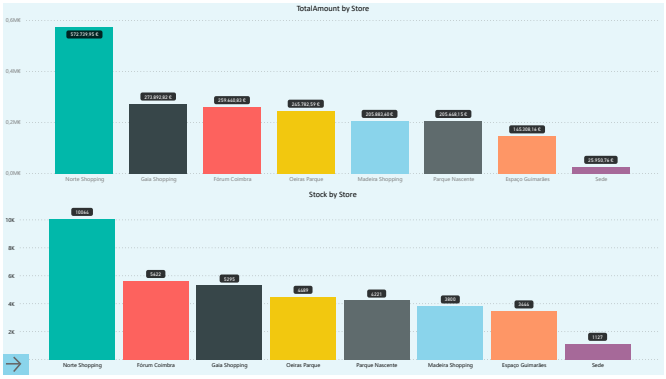


Figure 6.57: Stock in amount and units per store location - Bar chart.
Source: System print-screen.

This dashboard helps the manger to see how the stock distribution is being managed, for example, the store in Matosinhos has almost the double of stock in value and amount than the others stores. This stock is justified by the store size and the sales produced in that store, as it's possible to see in the dashboard of the Figure 6.59.

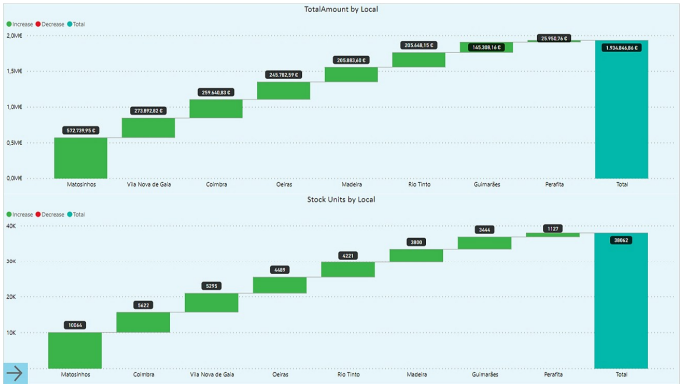


Figure 6.58: Stock in amount and units per store location - Waterfall chart.
Source: System print-screen.

These four dashboards in Figures 6.59, 6.60, 6.61 and 6.62 shows different approaches to the subject of Sales.

Figure 6.59: Sales and profit - Infographic chart.
Source: System print-screen.

The first one is an infographic type of graph that shows the sales and margin per store and separated by year. Shows that the second semester and the last quarter of the year are the most strong in sales and profit, but when the analysis is made to the week day the day with most sales in Friday, but in Thursdays normally sales generate more profit.

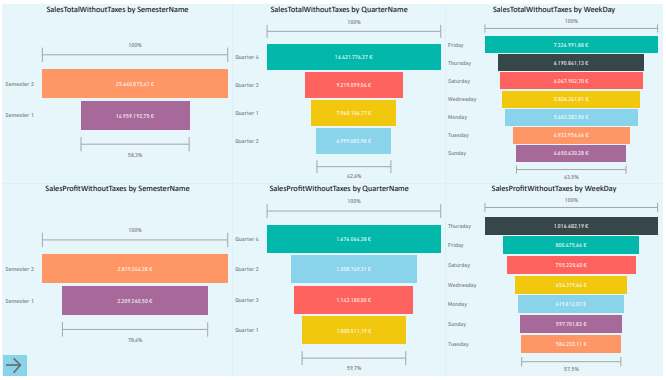


Figure 6.60: Various sales related graphs.
Source: System print-screen.

The second shows a set of graphs that represent the tendencies of purchasing, for example, sales and margin in the days of the week, sales and margin in the week compared to the weekend.

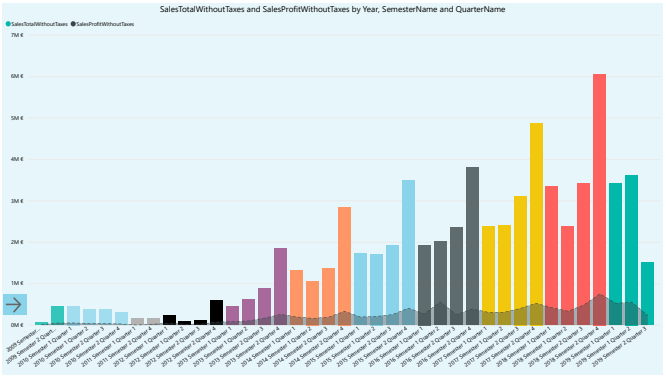


Figure 6.61: Sales and profit by time - Line and Bar chart.
Source: System print-screen.

The fourth is a line and bar chart showing the time trend of sales and profit.

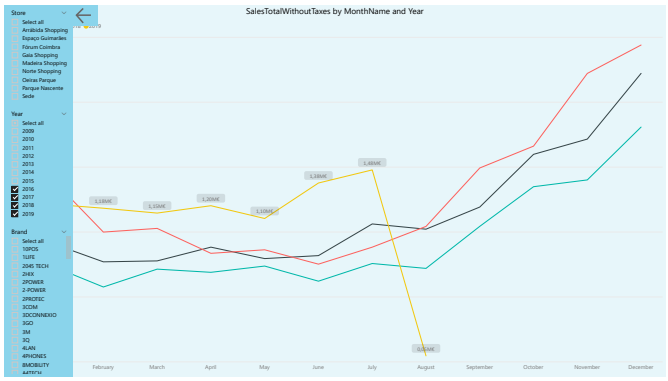


Figure 6.62: Sales by year for each month - Line chart.
Source: System print-screen.

The last chart is a line chart that represents each year by a line and shows the history of total sales over the months.

It this two last dashboards in Figures 6.61 and 6.62 shows sustained sales growth, and that the increase is almost always similar since 2012.

Figure 6.63 and 6.64 are based on the initial requirements to achieve this project, and with Power BI, delivered efficiently.

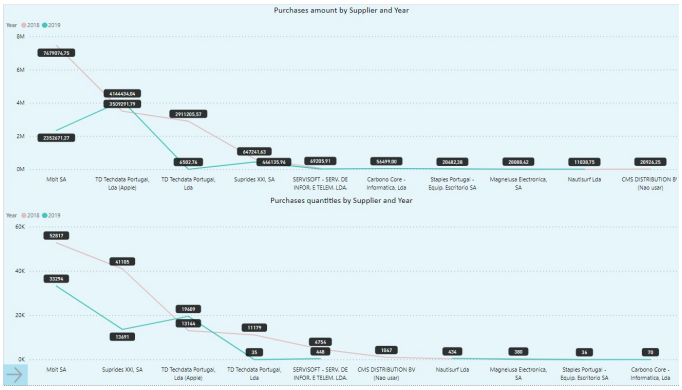


Figure 6.63: Top Suppliers by Year - Line chart.
Source: System print-screen.

The dashboard in Figure 6.63 represent that there wasn't much difference in the suppliers from 2018 to 2019, they maintain their position from the year over year analysis.

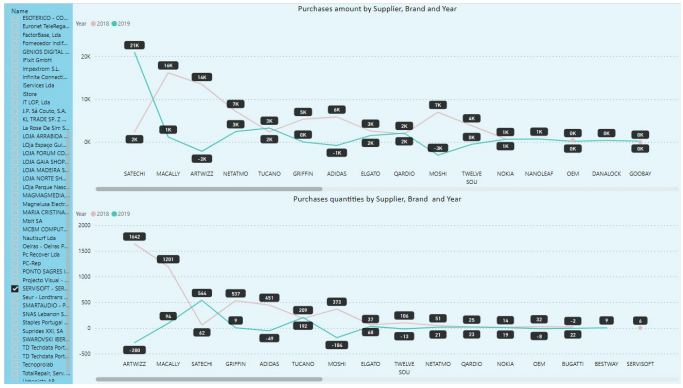


Figure 6.64: Purchased brands by supplier - Line chart.
Source: System print-screen.

Figure 6.64 helps analyse the change in purchases from to 2018 to 2019 from each supplier and brand, in the case exemplified the purchases from the supplier selected maintain the same from 2018 but the brand purchased changed significantly.

According to the limitations mentioned before of Microsoft Power BI free when connected to SSAS through "Connect Live", it wasn't possible to proceed with the analysis with this method, so to achieve the expected results a new instance of Microsoft Power BI has been created this time communicating directly with the DB engine. This way, allowing for the flexibility required for the inventory analysis.

Connected to SQL Server Database Engine

The configuration of Microsoft Power BI with the DB engine is similar to the one described in Section 6.2.1, with the only difference in the menu "Get Data" instead of selecting "Analysis Services", select "SQL Server" and the data connectivity mode instead of "Connect Live", select "DirectQuery".

6.2.3 Inventory Analysis

With the information gathered in Section 4.2.2, it was possible to create a process of inventory classification and forecasting.

The objective was to implement visual indicators that provide a reactive and proactive stance in the resolution of unstructured problems in the immediate, short and medium-term.

One of the attributes required to set in the is the working days of stock. This attribute indicates the correct positioning of quantities in stock. According to formula 4.1, "days of stock" is calculated with the actual direct value of the stock and a calculated value using the last sales quantities, named "rotation" of an SKU. The rotation could be the latest thirty days sales or the latest ninety days sales dividing the value by three. However, in both cases, it could be missing the selling trend. For rotation value optimisation, it's used the method recommended by the organisation inventory manager with the following formula 6.1 for 30 days stock.

$$\textbf{Rotation} = (\text{Latest30DaysSales} + (\text{Latest60DaysSales}/2) + (\text{Latest90DaysSales}/3))/3 \quad (6.1)$$

In an example and assuming product A with the sales in the table 6.1, the product sale was of 20 units in the last month and 35 units in the last three months.

Table 6.1: Product A Sales Example

Months	Product A sales
January	5
February	10
March	20

The rotation measured with only the last thirty days sales it's 20, for the last ninety days sales is 12 units, but using the formula 6.1 is 16 units, this way it's not very affected by possible outlier values.

So, for the days of stock measure of the product A, supposing that there are 12 units in stock, the product has 23 days of stock, as shown in the calculation 6.2.3.

$$\textbf{Actual Stock} = 12$$
$$\textbf{Rotation} = 16$$
$$\textbf{Days of stock Product A} = \frac{12 * 30}{16} = 23$$

In Power BI a table must be created to support all the calculations and classifications, so later can be used in charts through the dashboards.

This table called "InventoryManagement", has the following headers: SKU, Description, Brand, Family, SubFamily, Stock and ProductKey from each product in stock, this defines the rows for the table. Then, the values required for measures and classifications such as UnitCost, TotalCost, Last30DaysSale, Last60DaysSale, Last90DaysSale, LastPurchaseDate, Days in stock and Rotation.

In the DAX language to get all the ProductKey in stock the following code line must be used:

```
InventoryManagement = DISTINCT(FactInventory[DimProdutoProductKey])
```

Then all the other attributes are filled with the "ProductKey", as the SKU example in the following code line:

```
SKU = (LOOKUPVALUE(DimProduct[Code];DimProduct[ProductKey];InventoryManagement[
    DimProdutoProductKey]))
```

The TotalCost is calculated directly in the table with the code line:

```
Total Cost = InventoryManagement[UnitCost]*InventoryManagement[Stock]
```

For calculations such as "Last30DaysSales" and the other similar calculations, the DAX code block is the following:

```
Last30DaysSale = IF(
    ISBLANK(CALCULATE(SUM(FactSales[SalesUnit]);
    FILTER(FactSales;FactSales[DimProdutoProductKey]=InventoryManagement[
    DimProdutoProductKey]);
FILTER(FactSales;FactSales[DimDateKey]>(MAX(FactSales[DimDateKey])-30))));0;
CALCULATE(SUM(FactSales[SalesUnit]);
    FILTER(FactSales;FactSales[DimProdutoProductKey]=InventoryManagement[
    DimProdutoProductKey]);
FILTER(FactSales;FactSales[DimDateKey]>(MAX(FactSales[DimDateKey])-30))))
```

The "Days in Stock" indicator is calculated using the LastPurchaseDate and the actual date, using the following DAX code block:

```
DaysInStock = IF((TODAY()-InventoryManagement[LastPurchaseDate].[Date])
    >365;365;
(TODAY()-InventoryManagement[LastPurchaseDate].[Date]))
```

"Days in Stock" is limited to 365 days, as there is an advantage in the classification above one year in stock in the IT market.

The "Rotation" is calculated with the following DAX code, respecting the formula 6.1:

```
Rotation = ROUND((((InventoryManagement[Last30DaysSale])+(InventoryManagement[
    Last60DaysSale]/2)+(InventoryManagement[Last90DaysSale]/3))/3);0)
```

One of the latest attributes is the forecast or demand, that predicts the necessity for purchasing units according to the actual stock and the rotation. It is calculated using the DAX code block:

```
Forecast = IF(
    InventoryManagement[Stock]>InventoryManagement[Rotation];0;
    InventoryManagement[Rotation]-InventoryManagement[Stock])
```

For the classification models, Multi-Criteria Inventory Classification is used and with specific rules stipulated by the administration in the current analysis. The selected methods go through "ABC classification", "FSN classification" both method considered to sales and a custom "XYZ classification" that relates to stock. This way, getting a final classification for each product individually and allowing a macro analysis.

The ABC classification respects the studied formula in Section 4.2.2 with the most common division in three classes:

- **Group A**: 20% of the SKU produce up to 80% of the corporate turnover;
- **Group B**: 20% of the SKU produce up to 15% of the corporate turnover;
- **Group C**: 60% of the SKU produce up to 5% of the corporate turnover.

The ABC classification requires the calculation of three attributes to classification correctly: Last30DaysSaleAmount; 30DaysCumulatedSales and 30DaysColumatedPercentage.

For the Last30DaysSaleAmount the calculation is similar to the Last30DaysSale, but this time with amount instead of quantities. The DAX code block is the following:

```
Last30DaysSaleAmount = IF(
    ISBLANK(CALCULATE(SUM(FactSales[SalesTotalWithoutTaxes]);
FILTER(FactSales;FactSales[DimProdutoProductKey]=InventoryManagement[
    DimProdutoProductKey]);
FILTER(FactSales;FactSales[DimDateKey]>(MAX(FactSales[DimDateKey])-30))));0;
CALCULATE(SUM(FactSales[SalesTotalWithoutTaxes]);
FILTER(FactSales;FactSales[DimProdutoProductKey]=InventoryManagement[
    DimProdutoProductKey]);
FILTER(FactSales;FactSales[DimDateKey]>(MAX(FactSales[DimDateKey])-30))))
```

In the 30DaysCumulatedSales, as the name implies it's the cumulated sales in the latest 30 days and the DAX code block is the following:

```
30DaysCumulatedSales =
CALCULATE (
    SUM ( InventoryManagement[Last30DaysSaleAmount] );
    ALL ( InventoryManagement );
    InventoryManagement[Last30DaysSaleAmount] >= EARLIER ( InventoryManagement[
    Last30DaysSaleAmount] ))
```

The latest calculation 30DaysColumatedPercentage, is the same as the cumulated sales but in percentage, achieved with the following DAX code line:

```
30DaysCumulatedPercentage =
InventoryManagement[30DaysCumulatedSales] / SUM ( InventoryManagement[
    Last30DaysSaleAmount] )
```

The column that gives the ABC classification is calculated based on the percentages of the cumulated sales calculated before, and the DAX code block is the following:

```
ABC Class (30 Days) =
SWITCH (
    TRUE ();
    InventoryManagement[30DaysCumulatedPercentage] <= 0,2; "A";
     InventoryManagement[30DaysCumulatedPercentage] <= 0,4; "B";
    "C"
)
```

The next classification is the FSN classification, that as mentioned before, relates to sales quantities. According to an auxiliary table, the SKU are classified into three categories, as shown in Table 6.2. The categorisation of a SKU that sell less than 4 unit per month as non-moving; however, a product that sells more than twenty units per month is considered fast-moving, between those numbers is the slow-moving SKU.

Table 6.2: FSN Classification auxiliary table

SalesFrom	SalesTo	FSN Classification
0	4	N
4	20	S
20	∞	F

Another classification related to stock is the XYZ classification, this categorisation has five groups, and it's related to the number of days in stock since the last purchase. This categorisation has the first range from 0 to 15 days, and it classifies as A, then as seen in Table 6.3, goes up to more than 181 days to classify as E.

Table 6.3: Custom XYZ Classification auxiliary table

DaysInStockFrom	DaysInStockTo	XYZ classification
0	15	A
16	30	B
31	60	C
61	180	D
181	∞	E

At this point, it is possible to use those classifications individually in Power BI to classify the stock, as seen in Figure 6.65.

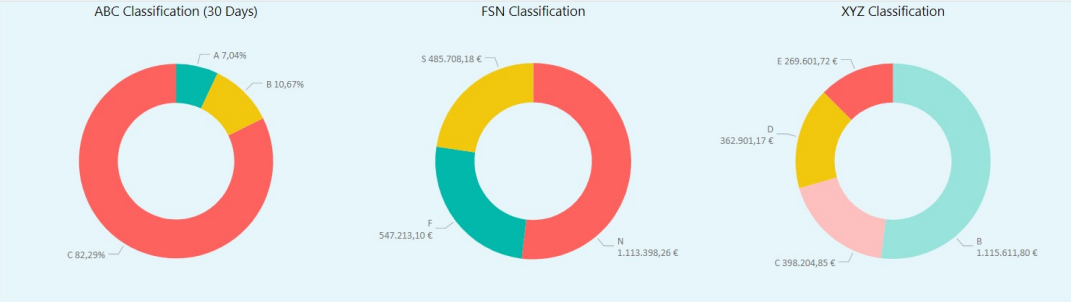


Figure 6.65: Individually classifications - Donut chart.
Source: System print-screen.

As getting insights from three different classifications to act in the inventory it's a more time-consuming task. The organisation inventory manager created a fourth classification that combines all the three classifications before represented in Table 6.4, this way, only have to look at one insight but also creates a meaningful visual indicator.

Table 6.4: Final classification auxiliary table

DaysInStockClassification	FSN	ABC	FinalClassification
A	F	A	High Rotation
A	F	B	High Rotation
A	F	C	High Rotation
A	S	A	Normal Rotation
A	S	B	Normal Rotation
A	S	C	Normal Rotation
A	N	A	Bet
A	N	B	Bet
A	N	C	Normal Rotation
B	F	A	High Rotation
B	F	B	High Rotation
B	F	C	High Rotation
B	S	A	Normal Rotation
B	S	B	Normal Rotation
B	S	C	Normal Rotation
B	N	A	Bet
B	N	B	Bet
B	N	C	Bet
C	F	A	High Rotation
C	F	B	High Rotation
C	F	C	Bet
C	S	A	Normal Rotation
C	S	B	Bet
C	S	C	Bet
C	N	A	Bet
C	N	B	Bet
C	N	C	Not Moving
D	F	A	High Rotation
D	F	B	High Rotation
D	F	C	Normal Rotation

Table 6.4: Final classification auxiliary table

DaysInStockClassification	FSN	ABC	FinalClassification
D	S	A	Normal Rotation
D	S	B	Bet
D	S	C	Bet
D	N	A	Bet
D	N	B	Not Moving
D	N	C	Not Moving
E	F	A	High Rotation
E	F	B	High Rotation
E	F	C	Normal Rotation
E	S	A	Bet
E	S	B	Bet
E	S	C	Bet
E	N	A	Bet
E	N	B	Not Moving
E	N	C	Critical Stock Problem

This final classification has five categories, such as high rotation, normal rotation, bet, not moving and critical stock problem. The objective is to have the most SKU in the high and normal rotation and less in not moving or critical stock problem. One of the visual indicators a macro insight over the inventory is to use a funnel chart as in Figure 6.66. In this specific example, it's possible to perceive that there is significant amount being identified has *Not Moving* and that it's needed to act as soon as possible.

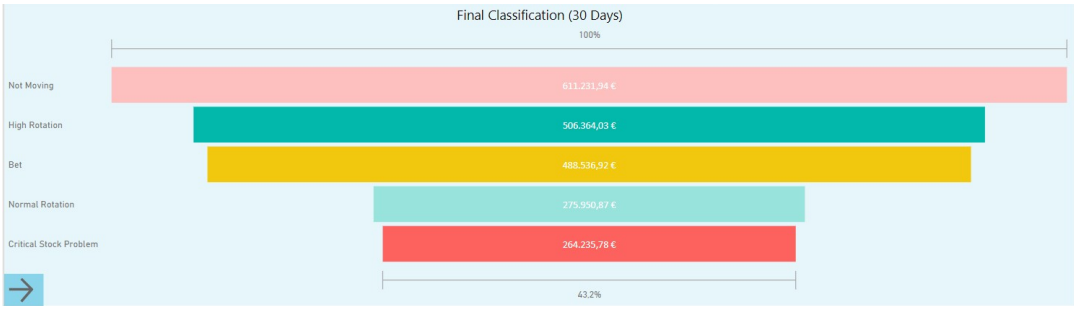
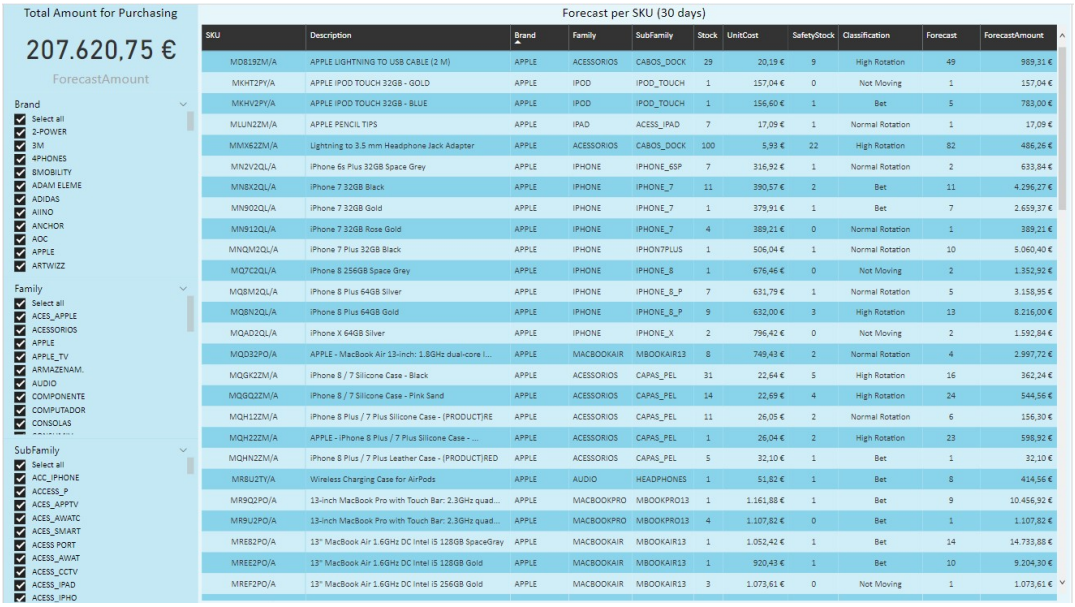


Figure 6.66: Final classification - Funnel chart.
Source: System print-screen.

There are already tools to achieve insights of the inventory in macro perspective, but to forecast demand the inventory manager must do it in SKU level, for that it's required to have not only a table with all the references suggested to purchase, but also filters by Brand, Family and Subfamily so that the manager can act as required. In Figure 6.67, it's possible to get the total purchasing amount in the top left corner of the dashboard, below some filter to facilitate the experience and the flexibility and on the right an interactive table that not only shows all the recommended SKU to purchase but also explains why, because includes the classification individually, rotation and stock quantities, leaving the last decision to the inventory manager.



SKU	Description	Brand	Family	SubFamily	Stock	UnitCost	SafetyStock	Classification	Forecast	ForecastAmount
MD819ZM/A	APPLE LIGHTNING TO USB CABLE (2 M)	APPLE	ACESSORIOS	CABOS_DOCK	29	20,19 €	9	High Rotation	49	989,31 €
MKHT2PY/A	APPLE IPOD TOUCH 32GB - GOLD	APPLE	IPOD	IPOD_TOUCH	1	157,04 €	0	Not Moving	1	157,04 €
MKHV2PY/A	APPLE IPOD TOUCH 32GB - BLUE	APPLE	IPOD	IPOD_TOUCH	1	156,60 €	1	Bet	5	783,00 €
MLUN2ZM/A	APPLE PENCIL TIPS	APPLE	IPAD	ACESS_IPAD	7	17,09 €	1	Normal Rotation	1	17,09 €
MMX62ZM/A	Lightning to 3.5 mm Headphone Jack Adapter	APPLE	ACESSORIOS	CABOS_DOCK	100	5,93 €	22	High Rotation	82	486,26 €
MN2V2QL/A	iPhone 6s Plus 32GB Space Grey	APPLE	IPHONE	IPHONE_6SP	7	316,92 €	1	Normal Rotation	2	633,84 €
MN8X2QL/A	iPhone 7 32GB Black	APPLE	IPHONE	IPHONE_7	11	390,57 €	2	Bet	11	4.296,27 €
MN902QL/A	iPhone 7 32GB Gold	APPLE	IPHONE	IPHONE_7	1	379,91 €	1	Bet	7	2.659,37 €
MN912QL/A	iPhone 7 32GB Rose Gold	APPLE	IPHONE	IPHONE_7	4	389,21 €	0	Normal Rotation	1	389,21 €
MNQM2QL/A	iPhone 7 Plus 32GB Black	APPLE	IPHONE	IPHON7PLUS	1	506,04 €	1	Normal Rotation	10	5.060,40 €
MQ7C2QL/A	iPhone 8 256GB Space Grey	APPLE	IPHONE	IPHONE_8	1	676,46 €	0	Not Moving	2	1.352,92 €
MQ8M2QL/A	iPhone 8 Plus 64GB Silver	APPLE	IPHONE	IPHONE_8_P	7	631,79 €	1	Normal Rotation	5	3.158,95 €
MQ8N2QL/A	iPhone 8 Plus 64GB Gold	APPLE	IPHONE	IPHONE_8_P	9	632,00 €	3	High Rotation	13	8.216,00 €
MQAD2QL/A	iPhone X 64GB Silver	APPLE	IPHONE	IPHONE_X	2	796,42 €	0	Not Moving	2	1.592,84 €
MQD32PO/A	APPLE - MacBook Air 13-inch: 1.8GHz dual-core i...	APPLE	MACBOOKAIR	MBOOKAIR13	8	749,43 €	2	Normal Rotation	4	2.997,72 €
MQGK2ZM/A	iPhone 8 / 7 Silicone Case - Black	APPLE	ACESSORIOS	CAPAS_PEL	31	22,64 €	5	High Rotation	16	362,24 €
MQGQ2ZM/A	iPhone 8 / 7 Silicone Case - Pink Sand	APPLE	ACESSORIOS	CAPAS_PEL	14	22,69 €	4	High Rotation	24	544,56 €
MQH12ZM/A	iPhone 8 Plus / 7 Plus Silicone Case - (PRODUCT)RE	APPLE	ACESSORIOS	CAPAS_PEL	11	26,05 €	2	Normal Rotation	6	156,30 €
MQH22ZM/A	APPLE - iPhone 8 Plus / 7 Plus Silicone Case - ...	APPLE	ACESSORIOS	CAPAS_PEL	1	26,04 €	2	High Rotation	23	598,92 €
MQHN2ZM/A	iPhone 8 Plus / 7 Plus Leather Case - (PRODUCT)RED	APPLE	ACESSORIOS	CAPAS_PEL	5	32,10 €	1	Bet	1	32,10 €
MR8U2TY/A	Wireless Charging Case for AirPods	APPLE	AUDIO	HEADPHONES	1	51,82 €	1	Bet	8	414,56 €
MR9Q2PO/A	13-inch MacBook Pro with Touch Bar: 2.3GHz quad...	APPLE	MACBOOKPRO	MBOOKPRO13	1	1.161,88 €	1	Bet	9	10.456,92 €
MR9U2PO/A	13-inch MacBook Pro with Touch Bar: 2.3GHz quad...	APPLE	MACBOOKPRO	MBOOKPRO13	4	1.107,82 €	0	Bet	1	1.107,82 €
MRE82PO/A	13" MacBook Air 1.6GHz DC Intel I5 128GB SpaceGray	APPLE	MACBOOKAIR	MBOOKAIR13	1	1.052,42 €	1	Bet	14	14.733,88 €
MREE2PO/A	13" MacBook Air 1.6GHz DC Intel I5 128GB Gold	APPLE	MACBOOKAIR	MBOOKAIR13	1	920,43 €	1	Bet	10	9.204,30 €
MREF2PO/A	13" MacBook Air 1.6GHz DC Intel I5 256GB Gold	APPLE	MACBOOKAIR	MBOOKAIR13	3	1.073,61 €	0	Not Moving	1	1.073,61 €

Figure 6.67: Forecasting.
Source: System print-screen.

The purchase team has, in this specific example, around 207 000,00 € to purchase, showing which product to purchase.

The last dashboard as shown in Figure 6.68, shows the global "Days of Stock", that as explained before is an essential measure of the work of the inventory manager, also shows the "Days of Stock" KPI per store or business allowing a better understanding in the different locations, Additionally shows a table that shows this reference value individually, so it's possible to act directly per SKU.

Days of stock is one of the most important indicators for a purchasing manager, in the example below the value is 42 days, that it's above the normally 30 days of objective. This value is somewhat justified by the approach of the last quarter of the year, and it's normal to increase stock to meet the usual demand.

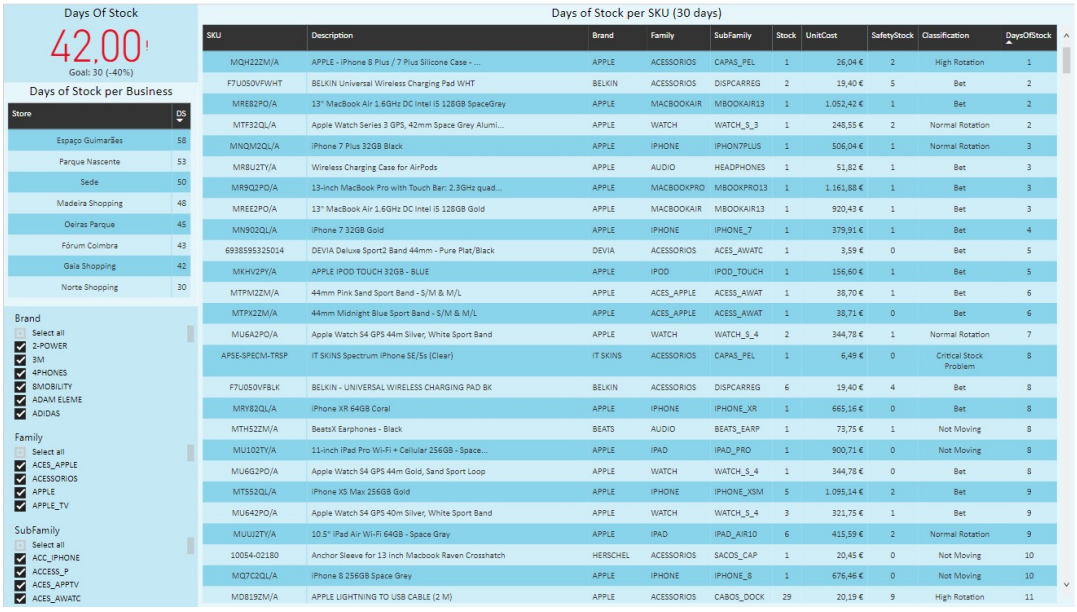


Figure 6.68: Days of stock.
Source: System print-screen.

All the dashboard are created dynamically so that the created filters, it's possible to achieve a more customised search and therefore, more relevant information for the manager. Adding a new dashboard with the data model well structured it's intuitive and straightforward.

6.3 Data Analysis Conclusion's

In the process of creating a DM, the initial configuration can be tedious and time-consuming because of all of the analysis required to the operational databases, but in the end, the solution obtained is way more structured and useful to the manager. Even when there is required to make some adjustments or adding new attributes, the process gets more accessible.

This type of process set in a real organisation environment is at a server that's is always available, with the automatic and incremental updates configured so that the information refreshes effortlessly. In this case of this PoC, the installation is locally, but even then it's notorious the advantages and the step-up in the analysis gained in the process. For example, in Figure 6.60, it's possible to obtain valuable information about some costumers tendencies, such as best sell days, quarters and semesters. In the analysis used nowadays, it isn't even possible to get this class of information, but on Power BI it takes a couple of minutes to achieve this type of information.

Chapter 7

Conclusion

"*Without big data analytics, companies are blind and deaf, wandering out onto the web like deer on a freeway.*"

- Geoffrey Moore

The first five chapters allowed an adequate framework with DSS related topics and inventory management, such as who are the reference authors in these areas and what their approaches are. Subsequently, the current tools and methodologies that allow the implementation of a decision support system, in a reliable and useful way for the inventory manager, are acknowledged.

In Chapter sixth, following an extensive study of the operational database and how to achieve the proposed objectives, delivered the design and thought of the solution.

The seventh Chapter dedicated to project development strived to report the entire development process from extracting data to creating Power BI dashboard and inventory analysis models.

7.1 Author Comments

Undoubtedly, this functional solution was an exciting project from the inventory manager's point of view, bringing great motivation for the development. Due to the author's experience in the area, it was easier to understand which indicators would be more appealing and how to achieve some of these same indicators, thus bringing higher value to the project. Also, for the continuity of the project, it will be easier to achieve, as the author will work with it daily and will be able to improve on it on demand.

The techniques used to develop the solution are following the examples described in the studied papers, but they were adjusted to the specific problem and according with the knowledge of the authors that works in the area for more than eight years, allowing to achieve a professional and fully operational Decision Support System. Isn't possible to make a direct comparison to the studied examples, as they differ from our solution in some approaches, but it is assumed of the achievement of the main objective of a complete solution that responds to the needs of an inventory manager.

As a comment to the study related to inventory management algorithms, it is verified that the classification of *SKU's* and choice of characteristics must respect the specificities and context of each business and a smaller number of classes is recommended for a less automated system as it tends to be more difficult to manage a large number of classes. In addition, these specificities almost always require a detailed expert view to aid quantitative and qualitative analysis as described in the 4.2.2 section. It's understandable that with the evolution of algorithms and analysis techniques, the need for human intervention will tend to decrease, but at this moment the process is not very autonomous due to different constraints, requiring the knowledge and expedite intervention of one or more experts.

A key point to the solution is the availability and interactivity of the analysis, all this through a flexible and user friendly platform.

The author believes that the solution answer in completeness to what he had proposed to do in this project.

7.1.1 Achieved Objectives

As a goal achieved, this project completes having fulfilled all proposed requirements and objectives with success. Therefore, it was able to demonstrate all the proposed requirements in Section 2.2:

- Updated information daily;
- All the dashboards allows filtering the information on demand;
- Sales and stock analysis by store;
- Margin amount values by store, brand and business;
- Visual ratio and KPI to evaluate the stores;
- Demonstrate powerful stock analysis to SKU level;
- Device to obtain an informed action on the forecast demand.

The project accomplished all the visual indicators that are nowadays available in the organisation, adding more insight and possibilities of analysis.

7.2 Future Work

The objective is to present this tool to the managers in the organisation, expecting that this project could pass from an academic solution to a real-world tool, supporting the inventory manager for more informed decisions and up to date awareness.

It was my initial hope that this presentation and result would be part of the project, as it would not only validate its usefulness but also give more significant support to the work done, but inflicted by time constraints and unavailability by the managers, the presentation is on stand-by until the meeting gets arranged.

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Appendix A

Database information

This Appendix aggregates information related to the databases used in the project, no only descriving tables and attirbutes, but also, queries and creation scripts.

A.1 Entity Relationship Diagram

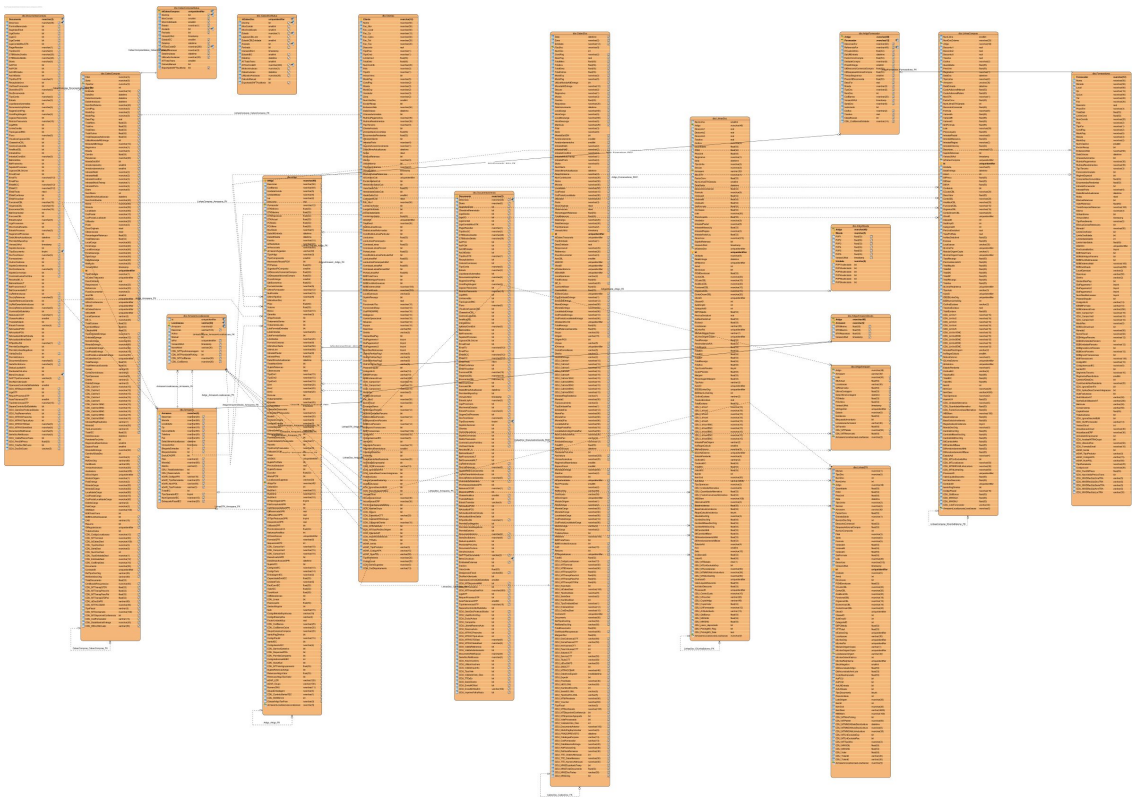

Figure A.1: Entity Relationship Diagram from Operatinal Database

A.2 Table Analysis from Production Database

Table A.1: Clients related tables

Clients		
Table	**Description**	**Attributes**
Clientes	Cliente details	157

Table A.2: Suppliers related tables

Supplies		
Table	**Description**	**Attributes**
ArmazensLocalizacoes	Localizations in the diferent warehouses	13
Armazens	Warehouses	26
Fornecedores	Suppliers details	120

Table A.3: Sales related tables

Sales		
Table	**Description**	**Attributes**
CabecDoc	Sales documents	213
CabecDocStatus	Legally and status information	19
DocumentosVenda	Types of sales documents	141
LinhasDoc	Each line of the sales document	147

Table A.4: Purchase related tables

Purchases		
Table	**Description**	**Attributes**
CabecCompras	Purchases documents	159
CabecComprasStatus	Legally and status information	17
DocumentosCompra	Types of purchasing documents	123
LinhasCompras	Each line of the purchasing documents	138

Table A.5: Stock related tables

Stock		
Table	**Description**	**Attributes**
Artigo	Product information	147
ArtigoArmazem	Legally and status information	19
ArtigoArmazemStocks	Types of purchasing documents	6
ArtigoFornecedor	Relating product with supplier	25
ArtigoMoeda	Sales price for each product	16
LinhasSTK	Each line of the purchasing documents	83

A.3 SQL DM Creation Scripts

```
USE [master]
IF NOT EXISTS ( SELECT [name] FROM sys.databases WHERE [name] = 'DM')
BEGIN
  CREATE DATABASE [DM]
   CONTAINMENT = NONE
   ON  PRIMARY
  ( NAME = N'DM', FILENAME = N'C:\Program Files\Microsoft SQL Server\MSSQL14.
    MSSQLSERVER\MSSQL\DATA\DM.mdf' , SIZE = 2367488KB , MAXSIZE = UNLIMITED,
    FILEGROWTH = 65536KB )
   LOG ON
  ( NAME = N'DM_log', FILENAME = N'C:\Program Files\Microsoft SQL Server\
    MSSQL14.MSSQLSERVER\MSSQL\DATA\DM_log.ldf' , SIZE = 794624KB , MAXSIZE =
    2048GB , FILEGROWTH = 65536KB )

  ALTER DATABASE [DM] SET COMPATIBILITY_LEVEL = 100

  IF (1 = FULLTEXTSERVICEPROPERTY('IsFullTextInstalled'))
  begin
  EXEC [DM].[dbo].[sp_fulltext_database] @action = 'enable'
  end

  ALTER DATABASE [DM] SET ANSI_NULL_DEFAULT OFF

  ALTER DATABASE [DM] SET ANSI_NULLS OFF

  ALTER DATABASE [DM] SET ANSI_PADDING OFF

  ALTER DATABASE [DM] SET ANSI_WARNINGS OFF

  ALTER DATABASE [DM] SET ARITHABORT OFF

  ALTER DATABASE [DM] SET AUTO_CLOSE OFF

  ALTER DATABASE [DM] SET AUTO_SHRINK OFF

  ALTER DATABASE [DM] SET AUTO_UPDATE_STATISTICS ON

  ALTER DATABASE [DM] SET CURSOR_CLOSE_ON_COMMIT OFF

  ALTER DATABASE [DM] SET CURSOR_DEFAULT  GLOBAL

  ALTER DATABASE [DM] SET CONCAT_NULL_YIELDS_NULL OFF

  ALTER DATABASE [DM] SET NUMERIC_ROUNDABORT OFF

  ALTER DATABASE [DM] SET QUOTED_IDENTIFIER OFF

  ALTER DATABASE [DM] SET RECURSIVE_TRIGGERS OFF

  ALTER DATABASE [DM] SET  DISABLE_BROKER

  ALTER DATABASE [DM] SET AUTO_UPDATE_STATISTICS_ASYNC OFF

  ALTER DATABASE [DM] SET DATE_CORRELATION_OPTIMIZATION OFF

  ALTER DATABASE [DM] SET TRUSTWORTHY OFF

  ALTER DATABASE [DM] SET ALLOW_SNAPSHOT_ISOLATION OFF

  ALTER DATABASE [DM] SET PARAMETERIZATION SIMPLE

  ALTER DATABASE [DM] SET READ_COMMITTED_SNAPSHOT OFF

  ALTER DATABASE [DM] SET HONOR_BROKER_PRIORITY OFF
```

```
61
62    ALTER DATABASE [DM] SET RECOVERY SIMPLE
63
64    ALTER DATABASE [DM] SET  MULTI_USER
65
66    ALTER DATABASE [DM] SET PAGE_VERIFY CHECKSUM
67
68    ALTER DATABASE [DM] SET DB_CHAINING OFF
69
70    ALTER DATABASE [DM] SET FILESTREAM( NON_TRANSACTED_ACCESS = OFF )
71
72    ALTER DATABASE [DM] SET TARGET_RECOVERY_TIME = 60 SECONDS
73
74    ALTER DATABASE [DM] SET DELAYED_DURABILITY = DISABLED
75
76    EXEC sys.sp_db_vardecimal_storage_format N'DM', N'ON'
77
78    ALTER DATABASE [DM] SET QUERY_STORE = OFF
79  END
```

A.4 SQL DM Dimensions Table Scripts

```
1  CREATE TABLE DimDate (
2    [Key]         int IDENTITY NOT NULL,
3    [Date]        datetime NOT NULL,
4    FullDate      varchar(50) NOT NULL,
5    Year          numeric(18, 0) NOT NULL,
6    Month         numeric(18, 0) NOT NULL,
7    MonthName     varchar(50) NOT NULL,
8    WeekDay       varchar(50) NOT NULL,
9    WeekNumber    numeric(18, 0) NOT NULL,
10   Day           numeric(18, 0) NOT NULL,
11   YearDay       numeric(18, 0) NOT NULL,
12   Semester      numeric(18, 0) NOT NULL,
13   SemesterName  varchar(50) NOT NULL,
14   Quarter       numeric(18, 0) NOT NULL,
15   QuarterName   varchar(50) NOT NULL,
16   Week          varchar(50) NOT NULL,
17   Weekend       varchar(50) NOT NULL,
18   BusinessDay   varchar(50) NOT NULL,
19   Season        numeric(18, 0) NOT NULL,
20   SeasonName    varchar(50) NOT NULL,
21   PRIMARY KEY ([Key]));
22
```

```
1  CREATE TABLE DimProduct (
2    ProductKey          int IDENTITY NOT NULL,
3    Code                nvarchar(48) NOT NULL,
4    ProductDescription  nvarchar(50) NULL,
5    Family              nvarchar(10) NULL,
6    SubFamily           nvarchar(10) NULL,
7    Type                nvarchar(3) NOT NULL,
8    Brand               nvarchar(10) NULL,
9    Supplier            nvarchar(12) NULL,
10   LatestPurchaseDate  datetime NULL,
11   LatestSaleDate      datetime NULL,
12   LatestCost          float(30) NULL,
13   AverageCost         float(30) NULL,
14   VatRate             nvarchar(2) NOT NULL,
```

```
    MinStock            decimal(28, 0) NULL,
    MaxStock            decimal(28, 0) NULL,
    PurchaseUnits       decimal(28, 0) NULL,
    Stock               decimal(28, 0) NULL,
    BeginDate           datetime NOT NULL,
    EndDate             datetime NULL,
    Active              bit NOT NULL,
    PRIMARY KEY (ProductKey));

```

```
CREATE TABLE DimPurchaseDocument (
    PurchaseDocument int IDENTITY NOT NULL,
    SystemKey        nvarchar(255) NOT NULL,
    DocumentType     tinyint NOT NULL,
    DocumentCode     nvarchar(255) NOT NULL,
    Business         nvarchar(255) NULL,
    PRIMARY KEY (PurchaseDocument));

```

```
CREATE TABLE DimSaleDocument (
    SalesDocuments int IDENTITY NOT NULL,
    SystemKey      nvarchar(255) NOT NULL,
    DocumentType   tinyint NOT NULL,
    DocumentCode   nvarchar(255) NOT NULL,
    Business       nvarchar(255) NULL,
    PRIMARY KEY (SalesDocuments));

```

```
CREATE TABLE DimSupplier (
    SupplierKey  int IDENTITY NOT NULL,
    SystemKey    nvarchar(255) NOT NULL,
    Name         nvarchar(255) NOT NULL,
    FiscalName   nvarchar(255) NOT NULL,
    Local        nvarchar(255) NULL,
    Country      nvarchar(255) NULL,
    CreationDate datetime NOT NULL,
    BeginDate    datetime NOT NULL,
    EndDate      datetime NULL,
    Active       bit NOT NULL,
    PRIMARY KEY (SupplierKey));

```

```
CREATE TABLE DimWarehouse (
    WarehouseKey          int IDENTITY NOT NULL,
    Warehouse             nvarchar(5) NOT NULL,
    WarehouseDescription  nvarchar(20) NOT NULL,
    Localisation          varchar(30) NOT NULL,
    Local                 nvarchar(50) NULL,
    Store                 nvarchar(255) NULL,
    PRIMARY KEY (WarehouseKey));

```

```
CREATE TABLE DimClient (
    ClientKey    int IDENTITY NOT NULL,
    NIF          nvarchar(255) NOT NULL,
```

```
  Name          nvarchar(255) NULL,
  Address       nvarchar(255) NULL,
  Local         nvarchar(255) NULL,
  CreationDate  datetime NULL,
  Type          nvarchar(1) NULL,
  BeginDate     datetime NOT NULL,
  EndDate       datetime NULL,
  Active        bit NOT NULL,
  PRIMARY KEY (ClientKey));
```

A.5 SQL DM Fact Table Scripts

```
CREATE TABLE FactInventory (
  DimProdutoProductKey      int NOT NULL,
  DimWarehouseWarehouseKey  int NOT NULL,
  Stock                     int NOT NULL,
  BookedStock               int NOT NULL,
  InTransitStock            int NOT NULL,
  AverageCostAmount         decimal(19, 2) NOT NULL,
  UnitCostAmount            decimal(19, 2) NOT NULL,
  TotalAmount           decimal(19, 2) NOT NULL,
  PRIMARY KEY (DimProdutoProductKey,
  DimWarehouseWarehouseKey));

```

```
CREATE TABLE FactPurchases (
  DimDateKey                              int NOT NULL,
  DimPurchaseDocumentsPurchaseDocument    int NOT NULL,
  DimWarehouseWarehouseKey                int NOT NULL,
  DimSupplierSupplierKey                  int NOT NULL,
  DimProdutoProductKey                    int NOT NULL,
  [Key]                                   nvarchar(50) NOT NULL,
  PurchaseUnits                           int NOT NULL,
  PurchaseUnitAmountWithoutTaxes           decimal(19, 2) NOT NULL,
  PurchaseUnitValueofTaxes                        decimal(19, 2) NOT NULL,
  PurchaseTotalWithoutTaxes                       decimal(19, 2) NOT NULL,
  PurchaseTotalTaxes                              decimal(19, 2) NOT NULL,
  PurchaseTotalWithTaxes                          decimal(19, 2) NOT NULL,
  PRIMARY KEY (DimDateKey,
  DimPurchaseDocumentsPurchaseDocument,
  DimWarehouseWarehouseKey,
  DimSupplierSupplierKey,
  DimProdutoProductKey,
  [Key]));

```

```
CREATE TABLE FactSales (
  DimDateKey                        int NOT NULL,
  DimSalesDocumentsSalesDocuments   int NOT NULL,
  DimWarehouseWarehouseKey          int NOT NULL,
  DimClientClientKey                int NOT NULL,
  DimProdutoProductKey              int NOT NULL,
  [Key]                             nvarchar(50) NOT NULL,
  SalesUnit                        bigint NOT NULL,
  SalesUnitAmountWithoutTaxes              decimal(19, 2) NOT NULL,
  SalesUnitValueofTaxes                   decimal(19, 2) NOT NULL,
  SalesTotalWithoutTaxes                  decimal(19, 2) NOT NULL,
```

```
12    SalesTotalTaxes                    decimal(19, 2) NOT NULL,
13    SalesTotalWithTaxes                decimal(19, 2) NOT NULL,
14    SalesProfitWithoutTaxes            decimal(19, 2) NOT NULL,
15    PRIMARY KEY (DimDateKey,
16    DimSalesDocumentsSalesDocuments,
17    DimWarehouseWarehouseKey,
18    DimClientClientKey,
19    DimProdutoProductKey,
20    [Key]));
```

A.6 SQL DM Table Constrains and Index Scripts

```
1  CREATE INDEX FactInventory_DimProdutoProductKey
2    ON FactInventory (DimProdutoProductKey);
3  CREATE INDEX FactInventory_DimWarehouseWarehouseKey
4    ON FactInventory (DimWarehouseWarehouseKey);
5  CREATE INDEX FactPurchases_DimDateKey
6    ON FactPurchases (DimDateKey);
7  CREATE INDEX FactPurchases_DimPurchaseDocumentsPurchaseDocument
8    ON FactPurchases (DimPurchaseDocumentsPurchaseDocument);
9  CREATE INDEX FactPurchases_DimWarehouseWarehouseKey
10   ON FactPurchases (DimWarehouseWarehouseKey);
11 CREATE INDEX FactPurchases_DimSupplierSupplierKey
12   ON FactPurchases (DimSupplierSupplierKey);
13 CREATE INDEX FactPurchases_DimProdutoProductKey
14   ON FactPurchases (DimProdutoProductKey);
15 CREATE INDEX FactPurchases_Key
16   ON FactPurchases ([Key]);
17 CREATE INDEX FactSales_DimDateKey
18   ON FactSales (DimDateKey);
19 CREATE INDEX FactSales_DimSalesDocumentsSalesDocuments
20   ON FactSales (DimSalesDocumentsSalesDocuments);
21 CREATE INDEX FactSales_DimWarehouseWarehouseKey
22   ON FactSales (DimWarehouseWarehouseKey);
23 CREATE INDEX FactSales_DimClientClientKey
24   ON FactSales (DimClientClientKey);
25 CREATE INDEX FactSales_DimProdutoProductKey
26   ON FactSales (DimProdutoProductKey);
27 CREATE INDEX FactSales_Key
28   ON FactSales ([Key]);
29
30 ALTER TABLE FactInventory ADD CONSTRAINT FKFactInvent877680 FOREIGN KEY (
       DimWarehouseWarehouseKey) REFERENCES DimWarehouse (WarehouseKey);
31 ALTER TABLE FactInventory ADD CONSTRAINT FKFactInvent890432 FOREIGN KEY (
       DimProdutoProductKey) REFERENCES DimProduct (ProductKey);
32 ALTER TABLE FactPurchases ADD CONSTRAINT FKFactPurcha854535 FOREIGN KEY (
       DimDateKey) REFERENCES DimDate ([Key]);
33 ALTER TABLE FactPurchases ADD CONSTRAINT FKFactPurcha808549 FOREIGN KEY (
       DimProdutoProductKey) REFERENCES DimProduct (ProductKey);
34 ALTER TABLE FactPurchases ADD CONSTRAINT FKFactPurcha791710 FOREIGN KEY (
       DimSupplierSupplierKey) REFERENCES DimSupplier (SupplierKey);
35 ALTER TABLE FactPurchases ADD CONSTRAINT FKFactPurcha389379 FOREIGN KEY (
       DimPurchaseDocumentsPurchaseDocument) REFERENCES DimPurchaseDocument (
       PurchaseDocument);
36 ALTER TABLE FactPurchases ADD CONSTRAINT FKFactPurcha959563 FOREIGN KEY (
       DimWarehouseWarehouseKey) REFERENCES DimWarehouse (WarehouseKey);
37 ALTER TABLE FactSales ADD CONSTRAINT FKFactSales652690 FOREIGN KEY (
       DimWarehouseWarehouseKey) REFERENCES DimWarehouse (WarehouseKey);
38 ALTER TABLE FactSales ADD CONSTRAINT FKFactSales420804 FOREIGN KEY (
       DimProdutoProductKey) REFERENCES DimProduct (ProductKey);
39 ALTER TABLE FactSales ADD CONSTRAINT FKFactSales41386 FOREIGN KEY (
       DimClientClientKey) REFERENCES DimClient (ClientKey);
```

```
ALTER TABLE FactSales ADD CONSTRAINT FKFactSales51075 FOREIGN KEY (
    DimSalesDocumentsSalesDocuments) REFERENCES DimSaleDocument (SalesDocuments
    );
ALTER TABLE FactSales ADD CONSTRAINT FKFactSales466790 FOREIGN KEY (DimDateKey)
     REFERENCES DimDate ([Key]);


```

A.7 SQL SA Database and Table creation Scripts

```

USE [master]
GO
CREATE DATABASE [SA]
 CONTAINMENT = NONE
 ON  PRIMARY
( NAME = N'SA', FILENAME = N'C:\Program Files\Microsoft SQL Server\MSSQL14.
    MSSQLSERVER\MSSQL\DATA\SA.mdf' , SIZE = 11476992KB , MAXSIZE = UNLIMITED,
    FILEGROWTH = 65536KB )
 LOG ON
( NAME = N'SA_log', FILENAME = N'C:\Program Files\Microsoft SQL Server\MSSQL14.
    MSSQLSERVER\MSSQL\DATA\SA_log.ldf' , SIZE = 270336KB , MAXSIZE = 2048GB ,
    FILEGROWTH = 65536KB )
GO
ALTER DATABASE [SA] SET COMPATIBILITY_LEVEL = 130
GO
IF (1 = FULLTEXTSERVICEPROPERTY('IsFullTextInstalled'))
begin
EXEC [SA].[dbo].[sp_fulltext_database] @action = 'enable'
end
GO
ALTER DATABASE [SA] SET ANSI_NULL_DEFAULT OFF
GO
ALTER DATABASE [SA] SET ANSI_NULLS OFF
GO
ALTER DATABASE [SA] SET ANSI_PADDING OFF
GO
ALTER DATABASE [SA] SET ANSI_WARNINGS OFF
GO
ALTER DATABASE [SA] SET ARITHABORT OFF
GO
ALTER DATABASE [SA] SET AUTO_CLOSE OFF
GO
ALTER DATABASE [SA] SET AUTO_SHRINK OFF
GO
ALTER DATABASE [SA] SET AUTO_UPDATE_STATISTICS ON
GO
ALTER DATABASE [SA] SET CURSOR_CLOSE_ON_COMMIT OFF
GO
ALTER DATABASE [SA] SET CURSOR_DEFAULT  GLOBAL
GO
ALTER DATABASE [SA] SET CONCAT_NULL_YIELDS_NULL OFF
GO
ALTER DATABASE [SA] SET NUMERIC_ROUNDABORT OFF
GO
ALTER DATABASE [SA] SET QUOTED_IDENTIFIER OFF
GO
ALTER DATABASE [SA] SET RECURSIVE_TRIGGERS OFF
GO
ALTER DATABASE [SA] SET  DISABLE_BROKER
GO
ALTER DATABASE [SA] SET AUTO_UPDATE_STATISTICS_ASYNC OFF
```

```
GO
ALTER DATABASE [SA] SET DATE_CORRELATION_OPTIMIZATION OFF
GO
ALTER DATABASE [SA] SET TRUSTWORTHY OFF
GO
ALTER DATABASE [SA] SET ALLOW_SNAPSHOT_ISOLATION OFF
GO
ALTER DATABASE [SA] SET PARAMETERIZATION SIMPLE
GO
ALTER DATABASE [SA] SET READ_COMMITTED_SNAPSHOT OFF
GO
ALTER DATABASE [SA] SET HONOR_BROKER_PRIORITY OFF
GO
ALTER DATABASE [SA] SET RECOVERY SIMPLE
GO
ALTER DATABASE [SA] SET  MULTI_USER
GO
ALTER DATABASE [SA] SET PAGE_VERIFY CHECKSUM
GO
ALTER DATABASE [SA] SET DB_CHAINING OFF
GO
ALTER DATABASE [SA] SET FILESTREAM( NON_TRANSACTED_ACCESS = OFF )
GO
ALTER DATABASE [SA] SET TARGET_RECOVERY_TIME = 60 SECONDS
GO
ALTER DATABASE [SA] SET DELAYED_DURABILITY = DISABLED
GO
EXEC sys.sp_db_vardecimal_storage_format N'SA', N'ON'
GO
ALTER DATABASE [SA] SET QUERY_STORE = OFF
GO
USE [SA]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[CancelledPurchaseDocuments](
  [Serie] [nvarchar](5) NULL,
  [TipoDoc] [nvarchar](5) NULL,
  [NumDoc] [int] NULL,
  [Entidade] [nvarchar](12) NULL,
  [DataDoc] [datetime] NULL,
  [DataVencimento] [datetime] NULL,
  [TotalMerc Doc] [float] NULL,
  [TotalIva Doc] [float] NULL,
  [TotalDesc Doc] [float] NULL,
  [TotalOutros Doc] [float] NULL,
  [TotalDespesasAdicionais Doc] [float] NULL,
  [Id Doc] [uniqueidentifier] NULL,
  [TipoEntidade] [nvarchar](1) NULL,
  [Documento] [nvarchar](50) NULL,
  [TotalDocumento] [float] NULL,
  [RegimeIva Doc] [nvarchar](1) NULL,
  [NumContribuinte] [nvarchar](20) NULL,
  [IdCabecMovCbl] [uniqueidentifier] NULL,
  [LocalCarga] [nvarchar](50) NULL,
  [HoraCarga] [nvarchar](20) NULL,
  [Armazem] [nvarchar](5) NULL,
  [Artigo] [nvarchar](48) NULL,
  [DataEntrada] [datetime] NULL,
  [Desconto1] [real] NULL,
  [Desconto2] [real] NULL,
  [Descricao] [nvarchar](512) NULL,
  [Id Row] [uniqueidentifier] NULL,
  [IdCabecCompras] [uniqueidentifier] NULL,
  [MovSTK] [nvarchar](1) NULL,
```

```
    [NumDocExterno] [nvarchar](20) NULL,
    [NumLinha] [smallint] NULL,
    [PrecoLiquido Row] [float] NULL,
    [PrecUnit Row] [float] NULL,
    [Quantidade Row] [float] NULL,
    [RegimeIva Row] [nvarchar](1) NULL,
    [TaxaIva Row] [real] NULL,
    [TipoLinha] [nvarchar](2) NULL,
    [TotalIliquido Row] [float] NULL,
    [TotalIva Row] [float] NULL,
    [Estado] [nvarchar](1) NULL,
    [Anulado] [bit] NULL,
    [Fechado] [bit] NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Clients](
    [Cliente] [nvarchar](12) NULL,
    [Nome] [nvarchar](50) NULL,
    [Fac_Mor] [nvarchar](50) NULL,
    [Fac_Local] [nvarchar](50) NULL,
    [Fac_Cploc] [nvarchar](50) NULL,
    [NumContrib] [nvarchar](20) NULL,
    [Pais] [nvarchar](2) NULL,
    [DataCriacao] [datetime] NULL,
    [DataUltimaActualizacao] [datetime] NULL,
    [TipoCli] [nvarchar](1) NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Compras](
    [Serie] [nvarchar](5) NULL,
    [TipoDoc] [nvarchar](5) NULL,
    [NumDoc] [int] NULL,
    [Entidade] [nvarchar](12) NULL,
    [DataDoc] [datetime] NULL,
    [DataVencimento] [datetime] NULL,
    [TotalMerc] [float] NULL,
    [TotalIva] [float] NULL,
    [TotalDesc] [float] NULL,
    [TotalOutros] [float] NULL,
    [TotalDespesasAdicionais] [float] NULL,
    [Id] [uniqueidentifier] NULL,
    [TipoEntidade] [nvarchar](1) NULL,
    [Documento] [nvarchar](50) NULL,
    [TotalDocumento] [float] NULL,
    [RegimeIva] [nvarchar](1) NULL,
    [NumContribuinte] [nvarchar](20) NULL,
    [IdCabecMovCbl] [uniqueidentifier] NULL,
    [LocalCarga] [nvarchar](50) NULL,
    [HoraCarga] [nvarchar](20) NULL,
    [Armazem] [nvarchar](5) NULL,
    [Artigo] [nvarchar](48) NULL,
    [DataEntrada] [datetime] NULL,
    [Desconto1] [real] NULL,
    [Desconto2] [real] NULL,
    [Descricao] [nvarchar](512) NULL,
    [Id Roes] [uniqueidentifier] NULL,
    [IdCabecCompras] [uniqueidentifier] NULL,
    [MovSTK] [nvarchar](1) NULL,
    [NumDocExterno] [nvarchar](20) NULL,
```

```
183     [NumLinha] [smallint] NULL,
184     [PrecoLiquido] [float] NULL,
185     [PrecUnit] [float] NULL,
186     [Quantidade] [float] NULL,
187     [RegimeIva Row] [nvarchar](1) NULL,
188     [TaxaIva] [real] NULL,
189     [TipoLinha] [nvarchar](2) NULL,
190     [TotalIliquido] [float] NULL,
191     [TotalIva Row] [float] NULL,
192     [Estado] [nvarchar](1) NULL,
193     [Anulado] [bit] NULL,
194     [Fechado] [bit] NULL
195 ) ON [PRIMARY]
196 GO
197 SET ANSI_NULLS ON
198 GO
199 SET QUOTED_IDENTIFIER ON
200 GO
201 CREATE TABLE [dbo].[ErrorFactInventory](
202     [Modulo] [nvarchar](1) NULL,
203     [TipoDoc] [nvarchar](5) NULL,
204     [NumDoc] [int] NULL,
205     [NumLinha] [int] NULL,
206     [Artigo] [nvarchar](48) NULL,
207     [Quantidade] [float] NULL,
208     [PCM] [float] NULL,
209     [PrecUnit] [float] NULL,
210     [TipoLinha] [nvarchar](2) NULL,
211     [Armazem] [nvarchar](5) NULL,
212     [EntradaSaida] [nvarchar](1) NULL,
213     [NumLinDocOrig] [int] NULL,
214     [DescontoComercial] [float] NULL,
215     [DespesaAdicionalCompra] [float] NULL,
216     [NumLinComposto] [int] NULL,
217     [Filial] [nvarchar](3) NULL,
218     [Serie] [nvarchar](5) NULL,
219     [VariavelA] [float] NULL,
220     [VariavelB] [float] NULL,
221     [VariavelC] [float] NULL,
222     [QntFormula] [float] NULL,
223     [Lote] [nvarchar](20) NULL,
224     [Descricao] [nvarchar](512) NULL,
225     [VersaoUltAct] [binary](8) NULL,
226     [Id] [uniqueidentifier] NULL,
227     [Unidade] [nvarchar](5) NULL,
228     [Arred] [int] NULL,
229     [Devolucao] [bit] NULL,
230     [PCMDevolucao] [float] NULL,
231     [DifPCMedio] [float] NULL,
232     [VPTTotal] [float] NULL,
233     [IdCabecOrig] [uniqueidentifier] NULL,
234     [Localizacao] [varchar](30) NULL,
235     [IdLinhaOrig] [uniqueidentifier] NULL,
236     [IdLinhaOrdemFabrico] [int] NULL,
237     [StockNegativo] [smallint] NULL,
238     [QtdAcumuladoArtigo] [float] NULL,
239     [QtdAcumuladoArmLote] [float] NULL,
240     [CustoNaoImputado] [float] NULL,
241     [ActPCU] [bit] NULL,
242     [ActPCM] [bit] NULL,
243     [ActUltEntrada] [bit] NULL,
244     [ActUltSaida] [bit] NULL,
245     [TipoDocumento] [tinyint] NULL,
246     [PrecoUnitario] [int] NULL,
247     [Purchase] [float] NULL,
248     [Sale] [float] NULL,
249     [Date] [datetime] NULL,
```

```
250     [Seccao] [nvarchar](2) NULL,
251     [Data] [datetime] NULL
252 ) ON [PRIMARY]
253 GO
254 SET ANSI_NULLS ON
255 GO
256 SET QUOTED_IDENTIFIER ON
257 GO
258 CREATE TABLE [dbo].[ErrorFactPurchases](
259     [Serie] [nvarchar](5) NULL,
260     [TipoDoc] [nvarchar](5) NULL,
261     [NumDoc] [int] NULL,
262     [Entidade] [nvarchar](12) NULL,
263     [DataDoc] [datetime] NULL,
264     [DataVencimento] [datetime] NULL,
265     [TotalMerc] [float] NULL,
266     [TotalIva] [float] NULL,
267     [TotalDesc] [float] NULL,
268     [TotalOutros] [float] NULL,
269     [TotalDespesasAdicionais] [float] NULL,
270     [TipoEntidade] [nvarchar](1) NULL,
271     [Documento] [nvarchar](50) NULL,
272     [TotalDocumento] [float] NULL,
273     [RegimeIva] [nvarchar](1) NULL,
274     [NumContribuinte] [nvarchar](20) NULL,
275     [LocalCarga] [nvarchar](50) NULL,
276     [HoraCarga] [nvarchar](20) NULL,
277     [Armazem] [nvarchar](5) NULL,
278     [Artigo] [nvarchar](48) NULL,
279     [DataEntrada] [datetime] NULL,
280     [Desconto1] [real] NULL,
281     [Desconto2] [real] NULL,
282     [Descricao] [nvarchar](512) NULL,
283     [MovSTK] [nvarchar](1) NULL,
284     [NumDocExterno] [nvarchar](20) NULL,
285     [NumLinha] [smallint] NULL,
286     [PrecoLiquido] [float] NULL,
287     [PrecUnit] [float] NULL,
288     [Quantidade] [float] NULL,
289     [RegimeIva Row] [nvarchar](1) NULL,
290     [TaxaIva] [real] NULL,
291     [TipoLinha] [nvarchar](2) NULL,
292     [TotalIliquido] [float] NULL,
293     [TotalIva Row] [float] NULL,
294     [Estado] [nvarchar](1) NULL,
295     [Anulado] [bit] NULL,
296     [Fechado] [bit] NULL,
297     [Id Roes] [uniqueidentifier] NULL,
298     [Error] [nvarchar](9) NULL
299 ) ON [PRIMARY]
300 GO
301 SET ANSI_NULLS ON
302 GO
303 SET QUOTED_IDENTIFIER ON
304 GO
305 CREATE TABLE [dbo].[ErrorFactSales](
306     [NumLinha] [smallint] NULL,
307     [Artigo] [nvarchar](48) NULL,
308     [TaxaIva] [real] NULL,
309     [Quantidade] [float] NULL,
310     [PCM] [float] NULL,
311     [PrecUnit] [float] NULL,
312     [TipoLinha] [nvarchar](2) NULL,
313     [Armazem] [nvarchar](5) NULL,
314     [PrecoLiquido] [float] NULL,
315     [Id] [uniqueidentifier] NULL,
316     [Descricao] [nvarchar](512) NULL,
```

```
317   [PercentagemMargem] [float] NULL,
318   [Margem] [float] NULL,
319   [Totallliquido] [float] NULL,
320   [TotalIva] [float] NULL,
321   [Data] [datetime] NULL,
322   [Entidade] [nvarchar](12) NULL,
323   [TipoDoc] [nvarchar](5) NULL,
324   [NumDoc] [int] NULL,
325   [Serie] [nvarchar](5) NULL,
326   [Nome] [nvarchar](50) NULL,
327   [Localidade] [nvarchar](50) NULL,
328   [CodPostalLocalidade] [nvarchar](50) NULL,
329   [TipoEntidade] [nvarchar](1) NULL,
330   [Error] [nvarchar](9) NULL
331 ) ON [PRIMARY]
332 GO
333 SET ANSI_NULLS ON
334 GO
335 SET QUOTED_IDENTIFIER ON
336 GO
337 CREATE TABLE [dbo].[Products](
338   [Artigo] [nvarchar](48) NULL,
339   [ArtigoAnulado] [bit] NULL,
340   [DataUltEntrada] [datetime] NULL,
341   [DataUltSaida] [datetime] NULL,
342   [Descricao] [nvarchar](50) NULL,
343   [Familia] [nvarchar](10) NULL,
344   [Iva] [decimal](2, 0) NULL,
345   [Marca] [nvarchar](10) NULL,
346   [MovStock] [nvarchar](1) NULL,
347   [PCMedio] [float] NULL,
348   [PCUltimo] [float] NULL,
349   [STKActual] [decimal](28, 0) NULL,
350   [STKMaximo] [decimal](28, 0) NULL,
351   [STKMinimo] [decimal](28, 0) NULL,
352   [STKReposicao] [decimal](28, 0) NULL,
353   [SubFamilia] [nvarchar](10) NULL,
354   [TipoArtigo] [nvarchar](3) NULL,
355   [UltimoFornecedor] [nvarchar](12) NULL
356 ) ON [PRIMARY]
357 GO
358 SET ANSI_NULLS ON
359 GO
360 SET QUOTED_IDENTIFIER ON
361 GO
362 CREATE TABLE [dbo].[ProductWarehouse](
363   [Artigo] [nvarchar](48) NULL,
364   [Armazem] [nvarchar](5) NULL,
365   [Lote] [nvarchar](20) NULL,
366   [StkActual] [float] NULL,
367   [Localizacao] [varchar](30) NULL,
368   [QtReservada] [float] NULL,
369   [UltimaContagem] [float] NULL,
370   [PCMedio] [float] NULL,
371   [PCUltimo] [float] NULL,
372   [VersaoUltAct] [binary](8) NULL,
373   [Existencia] [float] NULL,
374   [BloqueadoInventario] [bit] NULL,
375   [QtTransito] [float] NULL
376 ) ON [PRIMARY]
377 GO
378 SET ANSI_NULLS ON
379 GO
380 SET QUOTED_IDENTIFIER ON
381 GO
382 CREATE TABLE [dbo].[PurchaseDocuments](
383   [Documento] [nvarchar](5) NULL,
```

```
    [Descricao] [nvarchar](35) NULL,
    [TipoDocumento] [tinyint] NULL,
    [Business] [nvarchar](255) NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Purchases](
    [Serie] [nvarchar](5) NULL,
    [TipoDoc] [nvarchar](5) NULL,
    [NumDoc] [int] NULL,
    [Entidade] [nvarchar](12) NULL,
    [DataDoc] [datetime] NULL,
    [DataVencimento] [datetime] NULL,
    [TotalMerc] [float] NULL,
    [TotalIva] [float] NULL,
    [TotalDesc] [float] NULL,
    [TotalOutros] [float] NULL,
    [TotalDespesasAdicionais] [float] NULL,
    [Id] [uniqueidentifier] NULL,
    [TipoEntidade] [nvarchar](1) NULL,
    [Documento] [nvarchar](50) NULL,
    [TotalDocumento] [float] NULL,
    [RegimeIva] [nvarchar](1) NULL,
    [NumContribuinte] [nvarchar](20) NULL,
    [IdCabecMovCbl] [uniqueidentifier] NULL,
    [LocalCarga] [nvarchar](50) NULL,
    [HoraCarga] [nvarchar](20) NULL,
    [Armazem] [nvarchar](5) NULL,
    [Artigo] [nvarchar](48) NULL,
    [DataEntrada] [datetime] NULL,
    [Desconto1] [real] NULL,
    [Desconto2] [real] NULL,
    [Descricao] [nvarchar](512) NULL,
    [Id Roes] [uniqueidentifier] NULL,
    [IdCabecCompras] [uniqueidentifier] NULL,
    [MovSTK] [nvarchar](1) NULL,
    [NumDocExterno] [nvarchar](20) NULL,
    [NumLinha] [smallint] NULL,
    [PrecoLiquido] [float] NULL,
    [PrecUnit] [float] NULL,
    [Quantidade] [float] NULL,
    [RegimeIva Row] [nvarchar](1) NULL,
    [TaxaIva] [real] NULL,
    [TipoLinha] [nvarchar](2) NULL,
    [TotalIliquido] [float] NULL,
    [TotalIva Row] [float] NULL,
    [Estado] [nvarchar](1) NULL,
    [Anulado] [bit] NULL,
    [Fechado] [bit] NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[SaleDocuments](
    [Documento] [nvarchar](5) NULL,
    [Descricao] [nvarchar](35) NULL,
    [TipoDocumento] [tinyint] NULL,
    [Business] [nvarchar](255) NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
```

```
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Sales](
   [NumLinha] [smallint] NULL,
   [Artigo] [nvarchar](48) NULL,
   [Taxalva] [real] NULL,
   [Quantidade] [float] NULL,
   [PCM] [float] NULL,
   [PrecUnit] [float] NULL,
   [TipoLinha] [nvarchar](2) NULL,
   [Armazem] [nvarchar](5) NULL,
   [PrecoLiquido] [float] NULL,
   [Id] [uniqueidentifier] NULL,
   [Descricao] [nvarchar](512) NULL,
   [PercentagemMargem] [float] NULL,
   [Margem] [float] NULL,
   [Totallliquido] [float] NULL,
   [Totallva] [float] NULL,
   [Data] [datetime] NULL,
   [Entidade] [nvarchar](12) NULL,
   [TipoDoc] [nvarchar](5) NULL,
   [NumDoc] [int] NULL,
   [Serie] [nvarchar](5) NULL,
   [Nome] [nvarchar](50) NULL,
   [Localidade] [nvarchar](50) NULL,
   [CodPostalLocalidade] [nvarchar](50) NULL,
   [TipoEntidade] [nvarchar](1) NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Stock](
   [Modulo] [nvarchar](1) NULL,
   [TipoDoc] [nvarchar](5) NULL,
   [NumDoc] [int] NULL,
   [NumLinha] [int] NULL,
   [Artigo] [nvarchar](48) NULL,
   [Quantidade] [float] NULL,
   [PCM] [float] NULL,
   [PrecUnit] [float] NULL,
   [Data] [datetime] NULL,
   [TipoLinha] [nvarchar](2) NULL,
   [Armazem] [nvarchar](5) NULL,
   [EntradaSaida] [nvarchar](1) NULL,
   [NumLinDocOrig] [int] NULL,
   [DescontoComercial] [float] NULL,
   [DespesaAdicionalCompra] [float] NULL,
   [NumLinComposto] [int] NULL,
   [Filial] [nvarchar](3) NULL,
   [Serie] [nvarchar](5) NULL,
   [VariavelA] [float] NULL,
   [VariavelB] [float] NULL,
   [VariavelC] [float] NULL,
   [QntFormula] [float] NULL,
   [Lote] [nvarchar](20) NULL,
   [Descricao] [nvarchar](512) NULL,
   [VersaoUltAct] [binary](8) NULL,
   [Id] [uniqueidentifier] NULL,
   [Unidade] [nvarchar](5) NULL,
   [Arred] [int] NULL,
   [Devolucao] [bit] NULL,
   [PCMDevolucao] [float] NULL,
   [DifPCMedio] [float] NULL,
   [VPTTotal] [float] NULL,
   [IdCabecOrig] [uniqueidentifier] NULL,
```

```
518   [Localizacao] [varchar](30) NULL,
519   [IdLinhaOrig] [uniqueidentifier] NULL,
520   [IdLinhaOrdemFabrico] [int] NULL,
521   [StockNegativo] [smallint] NULL,
522   [QtdAcumuladoArtigo] [float] NULL,
523   [QtdAcumuladoArmLote] [float] NULL,
524   [CustoNaoImputado] [float] NULL,
525   [ActPCU] [bit] NULL,
526   [ActPCM] [bit] NULL,
527   [ActUltEntrada] [bit] NULL,
528   [ActUltSaida] [bit] NULL,
529   [TipoDocumento] [tinyint] NULL,
530   [PrecoUnitario] [int] NULL
531 ) ON [PRIMARY]
532 GO
533 SET ANSI_NULLS ON
534 GO
535 SET QUOTED_IDENTIFIER ON
536 GO
537 CREATE TABLE [dbo].[Suppliers](
538   [Fornecedor] [nvarchar](12) NULL,
539   [Nome] [nvarchar](50) NULL,
540   [Local] [nvarchar](50) NULL,
541   [CpLoc] [nvarchar](50) NULL,
542   [CondPag] [nvarchar](2) NULL,
543   [ModoPag] [nvarchar](5) NULL,
544   [Pais] [nvarchar](2) NULL,
545   [DataCriacao] [datetime] NULL,
546   [DataUltimaActualizacao] [datetime] NULL,
547   [NomeFiscal] [nvarchar](50) NULL
548 ) ON [PRIMARY]
549 GO
550
551
552 USE [SA]
553 GO
554
555 SET ANSI_NULLS ON
556 GO
557 SET QUOTED_IDENTIFIER ON
558 GO
559 CREATE TABLE [dbo].[Warehouses](
560   [Id] [uniqueidentifier] NULL,
561   [DataUltimaActualizacao] [datetime] NULL,
562   [Armazem] [nvarchar](5) NULL,
563   [Localizacao] [varchar](30) NULL,
564   [Descricao] [nvarchar](20) NULL,
565   [CpLocalidade] [nvarchar](50) NULL,
566   [Localidade] [nvarchar](50) NULL,
567   [Loja] [nvarchar](255) NULL
568 ) ON [PRIMARY]
569 GO
570 SET ANSI_NULLS ON
571 GO
572 SET QUOTED_IDENTIFIER ON
573 GO
574 CREATE PROCEDURE [dbo].[UpdateProduct]
575 @Artigo nvarchar(48)
576 ,@Descricao nvarchar(50)
577 ,@Familia nvarchar(10)
578 ,@SubFamilia nvarchar(10)
579 ,@TipoArtigo nvarchar(3)
580 ,@STKMinimo decimal(18,0)
581 ,@STKMaximo decimal(18,0)
582 ,@STKReposicao decimal(18,0)
583 ,@STKActual decimal(18,0)
584 ,@PCMedio decimal(18,0)
```

```
,@PCUltimo decimal(18,0)
,@DataUltEntrada datetime
,@DataUltSaida datetime
,@UltimoFornecedor nvarchar(12)
,@MovStock nvarchar(1)
,@Marca nvarchar(10)
,@ArtigoAnulado bit
,@CDU_CampoVar1 nvarchar(15)
,@CDU_CampoVar2 nvarchar(15)
,@Iva  nvarchar(2)

AS

BEGIN
SET NOCOUNT ON;

UPDATE [SA].[dbo].[Product]

SET
[Descricao] = @Descricao
,[Familia] = @Familia
,[SubFamilia] = @SubFamilia
,[TipoArtigo] = @TipoArtigo
,[STKMinimo] = @STKMinimo
,[STKMaximo] = @STKMaximo
,[STKReposicao] = @STKReposicao
,[STKActual] = @STKActual
,[PCMedio] = @PCMedio
,[PCUltimo] = @PCUltimo
,[DataUltEntrada] = @DataUltEntrada
,[DataUltSaida] = @DataUltSaida
,[UltimoFornecedor] = @UltimoFornecedor
,[MovStock] = @MovStock
,[Marca] = @Marca
,[ArtigoAnulado] = @ArtigoAnulado
,[CDU_CampoVar1] = @CDU_CampoVar1
,[CDU_CampoVar2] = @CDU_CampoVar2
,[Iva] = @Iva

WHERE [Artigo] = @Artigo

END
GO
USE [master]
GO
ALTER DATABASE [SA] SET  READ_WRITE
GO

```

A.8 SQL ODCOPY Database and Table creation Scripts

```
USE [master]
GO
IF NOT EXISTS ( SELECT [name] FROM sys.databases WHERE [name] = 'ODCOPY' )
CREATE DATABASE [ODCOPY]
 CONTAINMENT = NONE
 ON  PRIMARY
( NAME = N'ODCOPY', FILENAME = N'C:\Program Files\Microsoft SQL Server\MSSQL14.
    MSSQLSERVER\MSSQL\DATA\ODCOPY.mdf' , SIZE = 8192KB , MAXSIZE = UNLIMITED,
    FILEGROWTH = 65536KB )
 LOG ON
```

```
( NAME = N'ODCOPY_log', FILENAME = N'C:\Program Files\Microsoft SQL Server\
    MSSQL14.MSSQLSERVER\MSSQL\DATA\ODCOPY_log.ldf' , SIZE = 8192KB , MAXSIZE =
    2048GB , FILEGROWTH = 65536KB )
GO
ALTER DATABASE [ODCOPY] SET COMPATIBILITY_LEVEL = 140
GO
IF (1 = FULLTEXTSERVICEPROPERTY('IsFullTextInstalled'))
begin
EXEC [ODCOPY].[dbo].[sp_fulltext_database] @action = 'enable'
end
GO
ALTER DATABASE [ODCOPY] SET ANSI_NULL_DEFAULT OFF
GO
ALTER DATABASE [ODCOPY] SET ANSI_NULLS OFF
GO
ALTER DATABASE [ODCOPY] SET ANSI_PADDING OFF
GO
ALTER DATABASE [ODCOPY] SET ANSI_WARNINGS OFF
GO
ALTER DATABASE [ODCOPY] SET ARITHABORT OFF
GO
ALTER DATABASE [ODCOPY] SET AUTO_CLOSE OFF
GO
ALTER DATABASE [ODCOPY] SET AUTO_SHRINK OFF
GO
ALTER DATABASE [ODCOPY] SET AUTO_UPDATE_STATISTICS ON
GO
ALTER DATABASE [ODCOPY] SET CURSOR_CLOSE_ON_COMMIT OFF
GO
ALTER DATABASE [ODCOPY] SET CURSOR_DEFAULT  GLOBAL
GO
ALTER DATABASE [ODCOPY] SET CONCAT_NULL_YIELDS_NULL OFF
GO
ALTER DATABASE [ODCOPY] SET NUMERIC_ROUNDABORT OFF
GO
ALTER DATABASE [ODCOPY] SET QUOTED_IDENTIFIER OFF
GO
ALTER DATABASE [ODCOPY] SET RECURSIVE_TRIGGERS OFF
GO
ALTER DATABASE [ODCOPY] SET  ENABLE_BROKER
GO
ALTER DATABASE [ODCOPY] SET AUTO_UPDATE_STATISTICS_ASYNC OFF
GO
ALTER DATABASE [ODCOPY] SET DATE_CORRELATION_OPTIMIZATION OFF
GO
ALTER DATABASE [ODCOPY] SET TRUSTWORTHY OFF
GO
ALTER DATABASE [ODCOPY] SET ALLOW_SNAPSHOT_ISOLATION OFF
GO
ALTER DATABASE [ODCOPY] SET PARAMETERIZATION SIMPLE
GO
ALTER DATABASE [ODCOPY] SET READ_COMMITTED_SNAPSHOT OFF
GO
ALTER DATABASE [ODCOPY] SET HONOR_BROKER_PRIORITY OFF
GO
ALTER DATABASE [ODCOPY] SET RECOVERY FULL
GO
ALTER DATABASE [ODCOPY] SET  MULTI_USER
GO
ALTER DATABASE [ODCOPY] SET PAGE_VERIFY CHECKSUM
GO
ALTER DATABASE [ODCOPY] SET DB_CHAINING OFF
GO
ALTER DATABASE [ODCOPY] SET FILESTREAM( NON_TRANSACTED_ACCESS = OFF )
GO
ALTER DATABASE [ODCOPY] SET TARGET_RECOVERY_TIME = 60 SECONDS
GO
```

```
ALTER DATABASE [ODCOPY] SET DELAYED_DURABILITY = DISABLED
GO
EXEC sys.sp_db_vardecimal_storage_format N'ODCOPY', N'ON'
GO
ALTER DATABASE [ODCOPY] SET QUERY_STORE = OFF
GO
USE [ODCOPY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Clients](
  [Cliente] [nvarchar](12) NULL,
  [Nome] [nvarchar](50) NULL,
  [Fac_Mor] [nvarchar](50) NULL,
  [Fac_Local] [nvarchar](50) NULL,
  [Fac_Cp] [nvarchar](15) NULL,
  [Fac_Cploc] [nvarchar](50) NULL,
  [Fac_Tel] [nvarchar](20) NULL,
  [Fac_Fax] [nvarchar](20) NULL,
  [Desconto] [real] NULL,
  [TipoPrec] [nvarchar](1) NULL,
  [TipoCred] [nvarchar](1) NULL,
  [LimiteCred] [float] NULL,
  [TotalDeb] [float] NULL,
  [NumContrib] [nvarchar](20) NULL,
  [Pais] [nvarchar](2) NULL,
  [TipoCli] [nvarchar](1) NULL,
  [AvisosVenc] [bit] NULL,
  [ModoPag] [nvarchar](5) NULL,
  [CondPag] [nvarchar](2) NULL,
  [Moeda] [nvarchar](3) NULL,
  [ModoExp] [nvarchar](2) NULL,
  [Vendedor] [nvarchar](3) NULL,
  [Zona] [nvarchar](2) NULL,
  [NumViasDoc] [smallint] NULL,
  [ExcluirRecap] [bit] NULL,
  [EnderecoWeb] [nvarchar](50) NULL,
  [DataCriacao] [datetime] NULL,
  [CriacaoAutomatica] [bit] NULL,
  [RubricaPagamentos] [nvarchar](35) NULL,
  [RubricaRecebimentos] [nvarchar](35) NULL,
  [TipoTerceiro] [nvarchar](3) NULL,
  [ClienteAnulado] [bit] NULL,
  [VendasNaoConvertidas] [float] NULL,
  [EncomendasPendentes] [float] NULL,
  [IntrastatCliente] [bit] NULL,
  [IntrastatPorto] [nvarchar](4) NULL,
  [SuporteAvisosVencimento] [nvarchar](1) NULL,
  [DataUltimaActualizacao] [datetime] NULL,
  [Notas] [nvarchar](max) NULL,
  [EfectuaRetencao] [bit] NULL,
  [Idioma] [nvarchar](3) NULL,
  [UtilizaIdioma] [bit] NULL,
  [TipoOperIntraCom] [nvarchar](2) NULL,
  [VersaoUltAct] [binary](8) NULL,
  [EfectuaOutrasRetencoes] [bit] NULL,
  [IdContactoCob] [uniqueidentifier] NULL,
  [ExcluirAlertasCob] [bit] NULL,
  [AlertaValorSaldoCob] [bit] NULL,
  [ValorSaldoCob] [float] NULL,
  [AlertaIdadeSaldoCob] [bit] NULL,
  [IdadeSaldoCob] [smallint] NULL,
  [CalendarioCob] [nvarchar](max) NULL,
  [Fac_Mor1] [nvarchar](50) NULL,
  [LimiteCredValor] [bit] NULL,
```

```
141     [LimiteCredIdade] [bit] NULL,
142     [LimiteIdadeSaldo] [int] NULL,
143     [LimiteValorSaldo] [float] NULL,
144     [IdGDOC] [uniqueidentifier] NULL,
145     [Telefone2] [nvarchar](20) NULL,
146     [DebitoLetrasNovas] [bit] NULL,
147     [DebitoLetrasReformadas] [bit] NULL,
148     [CondDebitoLetrasParticular] [bit] NULL,
149     [JuroLetras] [float] NULL,
150     [JuroLetrasPostecipado] [bit] NULL,
151     [ComissaoLetras] [float] NULL,
152     [ComissaoLetrasPercent] [bit] NULL,
153     [PortesLetras] [float] NULL,
154     [CondDebitoLetrasParticularRef] [bit] NULL,
155     [JuroLetrasRef] [float] NULL,
156     [JuroLetrasPostecipadoRef] [bit] NULL,
157     [ComissaoLetrasRef] [float] NULL,
158     [ComissaoLetrasPercentRef] [bit] NULL,
159     [PortesLetrasRef] [float] NULL,
160     [B2BTrataTrans] [bit] NULL,
161     [B2BUtilArtigosParceiro] [bit] NULL,
162     [B2BEnvioNaGravacao] [bit] NULL,
163     [B2BEnderecoMail] [nvarchar](100) NULL,
164     [B2BCertificado] [nvarchar](250) NULL,
165     [LocalOperacao] [varchar](2) NULL,
166     [SujeitoRecargo] [bit] NULL,
167     [Toc] [real] NULL,
168     [FuncionarioToc] [nvarchar](10) NULL,
169     [FuncionarioResp] [nvarchar](10) NULL,
170     [CodPRIEMPRE] [nvarchar](10) NULL,
171     [Delegacao] [nvarchar](10) NULL,
172     [CentroOperacional] [nvarchar](10) NULL,
173     [Situacao] [nvarchar](10) NULL,
174     [Equipa] [nvarchar](10) NULL,
175     [Descricao] [varchar](50) NULL,
176     [Distrito] [varchar](2) NULL,
177     [GestaoDiasPag] [bit] NULL,
178     [DiaPagamento1] [tinyint] NULL,
179     [DiaPagamento2] [tinyint] NULL,
180     [DiaPagamento3] [tinyint] NULL,
181     [NumDiasRetrocesso] [tinyint] NULL,
182     [DiaInicPerNaoPag1] [varchar](5) NULL,
183     [DiaFinPerNaoPag1] [varchar](5) NULL,
184     [DiaInicPerNaoPag2] [varchar](5) NULL,
185     [DiaFinPerNaoPag2] [varchar](5) NULL,
186     [PessoaSingular] [bit] NULL,
187     [CodigoGLN] [varchar](13) NULL,
188     [IDB2BFormato] [varchar](10) NULL,
189     [B2BEnderecoEnvio] [varchar](250) NULL,
190     [CDU_CampoVar1] [nvarchar](15) NULL,
191     [CDU_CampoVar2] [nvarchar](15) NULL,
192     [CDU_CampoVar3] [nvarchar](15) NULL,
193     [ModoRec] [nvarchar](5) NULL,
194     [B2BDocDownload] [bit] NULL,
195     [Fac_Mor2] [nvarchar](50) NULL,
196     [NomeFiscal] [nvarchar](50) NULL,
197     [EncargosBanco] [bit] NULL,
198     [B2BArtigosParceiro] [nvarchar](12) NULL,
199     [B2BUtilUnidadesParceiro] [bit] NULL,
200     [B2BUnidadesParceiro] [nvarchar](12) NULL,
201     [B2BIgnoraEnvioParceiro] [bit] NULL,
202     [B2BEnvioParceiro] [nvarchar](12) NULL,
203     [B2BIgnoraTransaccoes] [bit] NULL,
204     [B2BTransaccoes] [nvarchar](130) NULL,
205     [CodigoIEC] [nvarchar](15) NULL,
206     [CodigoIsencaoIEC] [nvarchar](5) NULL,
207     [IsentoIEC] [bit] NULL,
```

```
208   [SegmentoTerceiro] [nvarchar](10) NULL,
209   [RegimeIvaReembolsos] [smallint] NULL,
210   [CambioADataDoc] [bit] NULL,
211   [Factoring] [bit] NULL,
212   [ContribuinteNaoResidente] [nvarchar](20) NULL,
213   [ActividadeEmpresarial] [bit] NULL,
214   [CDU_GLNFornecedor] [varchar](13) NULL,
215   [CDU_IgnoraElemFin] [bit] NULL,
216   [CDU_AplicaDescComercIntegracao] [bit] NULL,
217   [TrataIvaCaixa] [bit] NULL,
218   [IntegraCessaoFactoring] [bit] NULL,
219   [AutoFacturacao] [bit] NULL,
220   [CDU_IgnoraDescArtB2B] [bit] NULL,
221   [CDU_GarantiaAutomatica] [bit] NULL,
222   [VersaoCloud] [int] NULL,
223   [ActualizacaoCloud] [nvarchar](30) NULL,
224   [ActualizacaoERP] [nvarchar](30) NULL,
225   [FacturacaoAgrupadaBilling] [bit] NULL,
226   [CDU_AnaliseGrupo] [bit] NULL,
227   [CDU_Seguro] [bit] NULL,
228   [CDU_ExpedidorCTT] [varchar](20) NULL,
229   [CDU_AnaliseINTRAGrupo] [bit] NULL,
230   [CDU_CategoriaCliente] [nvarchar](10) NULL,
231   [CDU_MTEmailAuto] [bit] NULL,
232   [CDU_MTGuiaPorDocOrigem] [bit] NULL,
233   [CDU_ClienteAUP] [bit] NULL,
234   [CDU_InqueritoSatisfacao] [bit] NULL,
235   [CDU_TTEsEx] [bit] NULL,
236   [eGAR_Isenta] [bit] NULL,
237   [eGAR_TipoProdutor] [varchar](3) NULL,
238   [eGAR_CodigoAPA] [varchar](15) NULL,
239   [eGAR_NumPGL] [varchar](50) NULL,
240   [TipoRemetente] [nvarchar](25) NULL,
241   [CodigoLocal] [nvarchar](20) NULL,
242   [CDU_SerieSugestao] [nvarchar](5) NULL,
243   [CDU_CodDepartamento] [varchar](13) NULL
244 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
245 GO
246
247 SET ANSI_NULLS ON
248 GO
249
250 SET QUOTED_IDENTIFIER ON
251 GO
252
253 CREATE TABLE [dbo].[StockAtual](
254   [Artigo] [nvarchar](48) NULL,
255   [Armazem] [nvarchar](5) NULL,
256   [StkActual] [float] NULL,
257   [Localizacao] [varchar](30) NULL,
258   [QtReservada] [float] NULL,
259   [PCMedio] [float] NULL,
260   [PCUltimo] [float] NULL,
261   [QtTransito] [float] NULL
262 ) ON [PRIMARY]
263 GO
264
265
266 SET ANSI_NULLS ON
267 GO
268 SET QUOTED_IDENTIFIER ON
269 GO
270 CREATE TABLE [dbo].[Localisations](
271   [Id] [uniqueidentifier] NULL,
272   [Localizacao] [varchar](30) NULL,
273   [Armazem] [nvarchar](5) NULL,
274   [Descricao] [varchar](512) NULL,
```

```
    [Activa] [bit] NULL,
    [Manual] [bit] NULL,
    [IdPai] [uniqueidentifier] NULL,
    [VersaoUltAct] [binary](8) NULL,
    [NomeNivel] [varchar](20) NULL,
    [CDU_MTTipoArmazenagem] [int] NULL,
    [CDU_MTPrioridadePicking] [int] NULL,
    [CDU_MTCodBarras] [nvarchar](30) NULL,
    [CDU_CodBarras] [nvarchar](30) NULL
) ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[Products](
    [Artigo] [nvarchar](48) NULL,
    [Descricao] [nvarchar](50) NULL,
    [CodBarras] [nvarchar](48) NULL,
    [UnidadeVenda] [nvarchar](5) NULL,
    [UnidadeBase] [nvarchar](5) NULL,
    [Iva] [nvarchar](2) NULL,
    [Desconto] [real] NULL,
    [Fornecedor] [nvarchar](12) NULL,
    [STKMinimo] [float] NULL,
    [STKMaximo] [float] NULL,
    [STKReposicao] [float] NULL,
    [STKActual] [float] NULL,
    [PCMedio] [float] NULL,
    [PCUltimo] [float] NULL,
    [MovStock] [nvarchar](1) NULL,
    [DataUltEntrada] [datetime] NULL,
    [DataUltSaida] [datetime] NULL,
    [Familia] [nvarchar](10) NULL,
    [ArtSubstituto] [nvarchar](48) NULL,
    [ArtAssociado] [nvarchar](48) NULL,
    [ArmazemSugestao] [nvarchar](5) NULL,
    [TipoArtigo] [nvarchar](3) NULL,
    [TipoComponente] [smallint] NULL,
    [NecessarioRecalcPCM] [bit] NULL,
    [PCPadrao] [float] NULL,
    [SugestaoPrComposto] [smallint] NULL,
    [UltDescontoComercialCompra] [float] NULL,
    [UltDespesaAdicionalCompra] [float] NULL,
    [PrazoEntrega] [smallint] NULL,
    [QtdEconomica] [float] NULL,
    [FormulaVendas] [nvarchar](5) NULL,
    [UltimoFornecedor] [nvarchar](12) NULL,
    [SubFamilia] [nvarchar](10) NULL,
    [UltimoTipoDoc] [nvarchar](5) NULL,
    [UltimoNumDoc] [int] NULL,
    [Peso] [float] NULL,
    [Volume] [float] NULL,
    [Marca] [nvarchar](10) NULL,
    [Garantia] [nvarchar](3) NULL,
    [ArtigoAnulado] [bit] NULL,
    [TratamentoSeries] [bit] NULL,
    [TratamentoLotes] [bit] NULL,
    [LoteFormulaEntradas] [bit] NULL,
    [LoteEntradas] [nvarchar](20) NULL,
    [LoteFormulaSaidas] [bit] NULL,
    [LoteSaidas] [nvarchar](20) NULL,
    [FormulaCompras] [nvarchar](5) NULL,
    [UltimoNumSerie] [nvarchar](50) NULL,
    [UltimoLote] [nvarchar](50) NULL,
    [IntrastatPautal] [nvarchar](9) NULL,
    [IntrastatPeso] [float] NULL,
```

```
342     [DataUltimaActualizacao] [datetime] NULL,
343     [TestaNumSerie] [bit] NULL,
344     [SujeitoRetencao] [bit] NULL,
345     [Observacoes] [nvarchar](max) NULL,
346     [TipoDim1] [nvarchar](15) NULL,
347     [TipoDim2] [nvarchar](15) NULL,
348     [TipoDim3] [nvarchar](15) NULL,
349     [Dim1] [nvarchar](20) NULL,
350     [Dim2] [nvarchar](20) NULL,
351     [Dim3] [nvarchar](20) NULL,
352     [DimLote] [bit] NULL,
353     [TratamentoDim] [smallint] NULL,
354     [Etiqueta] [nvarchar](20) NULL,
355     [VersaoUltAct] [binary](8) NULL,
356     [OperacaoTesouraria] [bit] NULL,
357     [EntidadeOPTesouraria] [nvarchar](12) NULL,
358     [Modelo] [nvarchar](20) NULL,
359     [UnidadeCompra] [nvarchar](5) NULL,
360     [UnidadeEntrada] [nvarchar](5) NULL,
361     [UnidadeSaida] [nvarchar](5) NULL,
362     [UltimaSerieDoc] [nvarchar](5) NULL,
363     [DeduzIvaNoImo] [bit] NULL,
364     [PermiteDevolucao] [bit] NULL,
365     [TipoEntidadeOpTesouraria] [nvarchar](1) NULL,
366     [Imposto] [bit] NULL,
367     [TipoDocOpTesouraria] [nvarchar](5) NULL,
368     [UtilizadoCCOP] [bit] NULL,
369     [Pesar] [bit] NULL,
370     [IdGDOC] [uniqueidentifier] NULL,
371     [SujeitoProRata] [bit] NULL,
372     [PercIvaDedutivel] [real] NULL,
373     [SujeitoEcotaxa] [bit] NULL,
374     [Ecovalor] [float] NULL,
375     [AfectaPCM] [bit] NULL,
376     [LocalizacaoSugestao] [varchar](30) NULL,
377     [ArtigoPai] [nvarchar](48) NULL,
378     [OrdemDim] [int] NULL,
379     [RubDim1] [nvarchar](10) NULL,
380     [RubDim2] [nvarchar](10) NULL,
381     [RubDim3] [nvarchar](10) NULL,
382     [IDTipoOrigemGPR] [tinyint] NULL,
383     [FabCompAutoGPR] [bit] NULL,
384     [CalcNecessidadesGPR] [bit] NULL,
385     [QtReservadaGPR] [real] NULL,
386     [QtReceberGPR] [real] NULL,
387     [IDTipoProducaoGPR] [tinyint] NULL,
388     [DesperdicioGPR] [real] NULL,
389     [UtilizadoGPR] [bit] NULL,
390     [PercIncidencialVA] [float] NULL,
391     [NaturezaAnalitica] [int] NULL,
392     [IdClassificacao] [uniqueidentifier] NULL,
393     [FormulaGPR] [nvarchar](5) NULL,
394     [SequenciaGPR] [int] NULL,
395     [CDU_CampoVar1] [nvarchar](15) NULL,
396     [CDU_CampoVar2] [nvarchar](15) NULL,
397     [CDU_CampoVar3] [nvarchar](15) NULL,
398     [DesactivadoGPR] [bit] NULL,
399     [DataDesactivacaoGPR] [datetime] NULL,
400     [SujeitoIEC] [bit] NULL,
401     [CategoriaIEC] [nvarchar](10) NULL,
402     [CodigoTaric] [nvarchar](14) NULL,
403     [EmbalagemIEC] [nvarchar](2) NULL,
404     [CapacidadeEmbIEC] [float] NULL,
405     [UnidadeTaric] [nvarchar](5) NULL,
406     [FactConvIEC] [float] NULL,
407     [ValorIEC] [float] NULL,
408     [TaxaAlcool] [float] NULL,
```

```
409     [UtilManutencao] [bit] NULL,
410     [CDU_Linear] [bit] NULL,
411     [PesoLiquido] [float] NULL,
412     [GestaoSingular] [bit] NULL,
413     [Selo] [nvarchar](15) NULL,
414     [CodigoBebidaEspirituosa] [varchar](10) NULL,
415     [CodigoEstampilha] [varchar](2) NULL,
416     [FactorUnidadeSup] [real] NULL,
417     [CDU_CodBarras] [nvarchar](25) NULL,
418     [CDU_CodBarrasCaixa] [nvarchar](25) NULL,
419     [GrupoCenariosCompras] [nvarchar](20) NULL,
420     [IsentoPagDireitos] [bit] NULL,
421     [CodigoPautal] [nvarchar](15) NULL,
422     [IsentoIEC] [bit] NULL,
423     [CodigoIsentoIEC] [nvarchar](4) NULL,
424     [CDU_ServicoGenerico] [bit] NULL,
425     [CDU_DisponivelPDA] [bit] NULL,
426     [CDU_PermiteCampanha] [bit] NULL,
427     [CodigoAdicionalAltIEC] [int] NULL,
428     [CDU_GerarEan] [bit] NULL,
429     [CDU_MTFatorAgrupamento] [float] NULL,
430     [SujeitoRetencaoArtigo] [bit] NULL,
431     [RetencaoArtigoValor] [float] NULL,
432     [RetencaoArtigoTipoValor] [bit] NULL,
433     [eGAR_LER] [varchar](128) NULL,
434     [eGAR_Grupo] [varchar](100) NULL,
435     [NumeroONU] [nvarchar](11) NULL,
436     [GrupoEmbalagem] [nvarchar](4) NULL,
437     [CDU_ControloSeriesTEC] [nvarchar](1) NULL,
438     [CDU_MWSNrVol] [int] NULL,
439     [ClasseArtigoTaxFree] [nvarchar](3) NULL
440 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
441 GO
442 SET ANSI_NULLS ON
443 GO
444 SET QUOTED_IDENTIFIER ON
445 GO
446 CREATE TABLE [dbo].[ProductWarehouses](
447     [Artigo] [nvarchar](48) NULL,
448     [Armazem] [nvarchar](5) NULL,
449     [Lote] [nvarchar](20) NULL,
450     [StkActual] [float] NULL,
451     [Localizacao] [varchar](30) NULL,
452     [QtReservada] [float] NULL,
453     [UltimaContagem] [float] NULL,
454     [DataUltimaContagem] [datetime] NULL,
455     [PCMedio] [float] NULL,
456     [PCUltimo] [float] NULL,
457     [VersaoUltAct] [binary](8) NULL,
458     [IdArtigoDim] [uniqueidentifier] NULL,
459     [Estado] [nvarchar](5) NULL,
460     [Existencia] [float] NULL,
461     [BloqueadoInventario] [bit] NULL,
462     [LocalizacaoArmazem] [varchar](30) NULL,
463     [QtTransito] [float] NULL,
464     [CDU_MTPalete] [nvarchar](50) NULL,
465     [CDU_MTReservado] [float] NULL
466 ) ON [PRIMARY]
467 GO
468 SET ANSI_NULLS ON
469 GO
470 SET QUOTED_IDENTIFIER ON
471 GO
472 CREATE TABLE [dbo].[PurchaseDocStatus](
473     [IdCabecCompras] [uniqueidentifier] NULL,
474     [DocImp] [bit] NULL,
475     [MovContab] [smallint] NULL,
```

```
476     [MovImobilizado] [smallint] NULL,
477     [Estado] [nvarchar](1) NULL,
478     [Anulado] [bit] NULL,
479     [Fechado] [bit] NULL,
480     [VersaoUltAct] [binary](8) NULL,
481     [EstadoIEC] [smallint] NULL,
482     [DataImp] [datetime] NULL,
483     [ATDocCodeID] [nvarchar](200) NULL,
484     [MotivoAnulacao] [nvarchar](3) NULL,
485     [DataAnulacao] [datetime] NULL,
486     [UtilizadorAnulacao] [nvarchar](20) NULL,
487     [ATTrataTrans] [smallint] NULL,
488     [CalculoManual] [bit] NULL,
489     [ExportadoSAFTAuditoria] [bit] NULL
490 ) ON [PRIMARY]
491 GO
492 SET ANSI_NULLS ON
493 GO
494 SET QUOTED_IDENTIFIER ON
495 GO
496 CREATE TABLE [dbo].[PurchaseDocuments](
497     [Documento] [nvarchar](5) NULL,
498     [Descricao] [nvarchar](35) NULL,
499     [FornIndiferenciado] [bit] NULL,
500     [SugestaoEstat] [bit] NULL,
501     [LigaStocks] [bit] NULL,
502     [LigaCC] [bit] NULL,
503     [LigaContab] [bit] NULL,
504     [LigaContabMovSTK] [bit] NULL,
505     [PagarReceber] [nvarchar](1) NULL,
506     [TipoDocCC] [nvarchar](2) NULL,
507     [CTBStocksCredito] [nvarchar](20) NULL,
508     [CTBStocksDebito] [nvarchar](20) NULL,
509     [Diario] [nvarchar](5) NULL,
510     [ActPCU] [bit] NULL,
511     [ActPCM] [bit] NULL,
512     [ActUltEntrada] [bit] NULL,
513     [ActUltSaida] [bit] NULL,
514     [TipoDocSTK] [nvarchar](1) NULL,
515     [Recapitulativos] [bit] NULL,
516     [VerDescFornecedor] [bit] NULL,
517     [DiarioMovSTK] [nvarchar](5) NULL,
518     [DocEncomenda] [bit] NULL,
519     [TipoConta] [nvarchar](3) NULL,
520     [Estado] [nvarchar](3) NULL,
521     [LiquidacaoAutomatica] [bit] NULL,
522     [DocumentoLiqAGerar] [nvarchar](5) NULL,
523     [SugereCondPag] [bit] NULL,
524     [CondPagASugerir] [nvarchar](2) NULL,
525     [LigacaoTesouraria] [bit] NULL,
526     [RubricaTesouraria] [nvarchar](15) NULL,
527     [LigaBNC] [bit] NULL,
528     [LimiteCredito] [bit] NULL,
529     [TipoLigacaoBNC] [bit] NULL,
530     [Fluxo] [nvarchar](5) NULL,
531     [VisualizarLigacaoCBL] [bit] NULL,
532     [ClassesIvaCBL] [bit] NULL,
533     [CentrosCustoCBL] [bit] NULL,
534     [AnaliticaCBL] [bit] NULL,
535     [IntrastatDoc] [bit] NULL,
536     [IntrastatCondEnt] [nvarchar](3) NULL,
537     [BalAnalitica] [bit] NULL,
538     [BalFinanceira] [bit] NULL,
539     [SujeitoAProvisoes] [bit] NULL,
540     [LigacaoCBLOnLine] [bit] NULL,
541     [EnviaEmail] [bit] NULL,
542     [EmailTo] [nvarchar](512) NULL,
```

```
543     [EmailFixo] [bit] NULL,
544     [EMailBCC] [nvarchar](512) NULL,
545     [EMailCC] [nvarchar](512) NULL,
546     [EMailTexto] [nvarchar](max) NULL,
547     [EMailConfirmar] [bit] NULL,
548     [EMailVisualizar] [bit] NULL,
549     [FuncionalCBL] [nvarchar](15) NULL,
550     [OrganicaCBL] [nvarchar](15) NULL,
551     [EconomicaCBL] [nvarchar](15) NULL,
552     [BalOrcamental] [bit] NULL,
553     [FuncoesCBL] [bit] NULL,
554     [EstadoLiqAut] [nvarchar](3) NULL,
555     [LigaProcessos] [bit] NULL,
556     [MovimentaEstados] [bit] NULL,
557     [EstadoProcesso] [nvarchar](3) NULL,
558     [SugereCodProcesso] [bit] NULL,
559     [DataUltimaActualizacao] [datetime] NULL,
560     [PermiteAltAposExp] [bit] NULL,
561     [VersaoUltAct] [binary](8) NULL,
562     [SujeitoLiberacao] [bit] NULL,
563     [TipoDocumento] [tinyint] NULL,
564     [DocTesAGerar] [nvarchar](5) NULL,
565     [Fornecedores] [bit] NULL,
566     [OutrosCredores] [bit] NULL,
567     [SujeitoConferencia] [bit] NULL,
568     [DocConferencia] [nvarchar](5) NULL,
569     [SujeitoConversao] [bit] NULL,
570     [ControlaCustosPorObra] [bit] NULL,
571     [RecolhaDE_IL] [bit] NULL,
572     [BalAnaliticaALT] [bit] NULL,
573     [BalFinanceiraALT] [bit] NULL,
574     [BalOrcamentalALT] [bit] NULL,
575     [LiqRetIntroducao] [bit] NULL,
576     [DocLiqRetencao] [nvarchar](5) NULL,
577     [SujeitoRetencaoGarantia] [bit] NULL,
578     [LiqRetGarantiaIntroducao] [bit] NULL,
579     [DocLiqRetencaoGarantia] [nvarchar](5) NULL,
580     [ControlaQtdSatisfeita] [bit] NULL,
581     [NaturezaCCOP] [nvarchar](1) NULL,
582     [ClasseAnalitica] [smallint] NULL,
583     [TransitaEstado] [bit] NULL,
584     [EstadoTransitar] [varchar](4) NULL,
585     [NActualizaPCM] [bit] NULL,
586     [NActualizaPCU] [bit] NULL,
587     [NActualizaUltimaEntrada] [bit] NULL,
588     [NActualizaUltimaSaida] [bit] NULL,
589     [NTipoMovStk] [nvarchar](1) NULL,
590     [PermiteDocNegativo] [bit] NULL,
591     [PermiteLinhasNegativas] [bit] NULL,
592     [ValidaDocExt] [int] NULL,
593     [PermiteEstorno] [bit] NULL,
594     [DocumentoEstorno] [nvarchar](5) NULL,
595     [SerieDocEstorno] [nvarchar](5) NULL,
596     [DeduzLiquidaIVA] [bit] NULL,
597     [PendentePorLinha] [bit] NULL,
598     [BensCirculacao] [bit] NULL,
599     [SAFTTipoDocumento] [varchar](2) NULL,
600     [DocNaoValorizado] [bit] NULL,
601     [OperacaoControlaQtdSatisfeita] [smallint] NULL,
602     [CDU_MTDisponivelMM] [bit] NULL,
603     [LigaSTP] [bit] NULL,
604     [RequerProcessoSTP] [bit] NULL,
605     [AcaoFaturacaoSTP] [smallint] NULL,
606     [TipoIntervencaoSTP] [nvarchar](15) NULL,
607     [SeparaControloQtdSatisfeita] [bit] NULL,
608     [CDU_GeraDocProtecaoStocks] [bit] NULL,
609     [CDU_FazReservaAuto] [bit] NULL,
```

```
610    [CDU_MTPACPreenche] [bit] NULL,
611    [CDU_MTPACTipoLeitura] [int] NULL,
612    [CDU_MTPACTDDest] [nvarchar](5) NULL,
613    [CDU_MTPACSerieDest] [nvarchar](5) NULL,
614    [DocumentoRetificacao] [nvarchar](5) NULL,
615    [SerieDocRetificacao] [nvarchar](5) NULL,
616    [CDU_ValidaPrecosTrans] [bit] NULL,
617    [CDU_PercDifPreco] [float] NULL,
618    [CDU_CriaDocStkCusto] [bit] NULL,
619    [CDU_DocStkCusto] [varchar](5) NULL
620 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
621 GO
622 SET ANSI_NULLS ON
623 GO
624 SET QUOTED_IDENTIFIER ON
625 GO
626 CREATE TABLE [dbo].[PurchaseHeaders](
627    [Filial] [nvarchar](3) NULL,
628    [Serie] [nvarchar](5) NULL,
629    [TipoDoc] [nvarchar](5) NULL,
630    [NumDoc] [int] NULL,
631    [Entidade] [nvarchar](12) NULL,
632    [DataDoc] [datetime] NULL,
633    [DataVencimento] [datetime] NULL,
634    [DataIntroducao] [datetime] NULL,
635    [NumDocExterno] [nvarchar](20) NULL,
636    [CondPag] [nvarchar](2) NULL,
637    [ModoExp] [nvarchar](2) NULL,
638    [ModoPag] [nvarchar](5) NULL,
639    [DescPag] [real] NULL,
640    [TotalMerc] [float] NULL,
641    [TotalIva] [float] NULL,
642    [TotalDesc] [float] NULL,
643    [TotalOutros] [float] NULL,
644    [TotalDespesasAdicionais] [float] NULL,
645    [UtilizaMoradaAltEntrega] [bit] NULL,
646    [MoradaAltEntrega] [nvarchar](10) NULL,
647    [RegimeIva] [nvarchar](1) NULL,
648    [Moeda] [nvarchar](3) NULL,
649    [Cambio] [float] NULL,
650    [Requisicao] [nvarchar](20) NULL,
651    [MoedaDaUEM] [bit] NULL,
652    [Arredondamento] [smallint] NULL,
653    [ArredondamentoIva] [smallint] NULL,
654    [IntrastatNatA] [nvarchar](2) NULL,
655    [IntrastatNatB] [nvarchar](2) NULL,
656    [IntrastatCondEnt] [nvarchar](3) NULL,
657    [IntrastatModoTransp] [nvarchar](1) NULL,
658    [IntrastatPorto] [nvarchar](4) NULL,
659    [Diario] [nvarchar](5) NULL,
660    [NumDiario] [int] NULL,
661    [DataUltimaActualizacao] [datetime] NULL,
662    [NumContribuinte] [nvarchar](20) NULL,
663    [Nome] [nvarchar](50) NULL,
664    [Morada] [nvarchar](50) NULL,
665    [Localidade] [nvarchar](50) NULL,
666    [CodPostal] [nvarchar](15) NULL,
667    [CodPostalLocalidade] [nvarchar](50) NULL,
668    [Utilizador] [nvarchar](20) NULL,
669    [Posto] [nvarchar](3) NULL,
670    [DocsOriginais] [nvarchar](max) NULL,
671    [Observacoes] [nvarchar](max) NULL,
672    [PercentagemRetencao] [float] NULL,
673    [TotalRetencao] [float] NULL,
674    [LocalCarga] [nvarchar](50) NULL,
675    [HoraCarga] [nvarchar](20) NULL,
676    [LocalDescarga] [nvarchar](50) NULL,
```

```
677     [HoraDescarga] [nvarchar](20) NULL,
678     [DataCarga] [nvarchar](20) NULL,
679     [DataDescarga] [nvarchar](20) NULL,
680     [Matricula] [nvarchar](25) NULL,
681     [VersaoUltAct] [binary](8) NULL,
682     [Id] [uniqueidentifier] NULL,
683     [TipoEntidade] [nvarchar](1) NULL,
684     [IdCabecTesouraria] [uniqueidentifier] NULL,
685     [DescEntidade] [real] NULL,
686     [Responsavel] [nvarchar](25) NULL,
687     [Referencia] [nvarchar](20) NULL,
688     [FluxoDocumental] [nvarchar](3) NULL,
689     [AnoCBL] [smallint] NULL,
690     [IdGDOC] [uniqueidentifier] NULL,
691     [IdDocConferencia] [uniqueidentifier] NULL,
692     [ObraID] [uniqueidentifier] NULL,
693     [IdCabecEstorno] [uniqueidentifier] NULL,
694     [IdDocB2B] [uniqueidentifier] NULL,
695     [LocalOperacao] [varchar](2) NULL,
696     [DE_IL] [nvarchar](20) NULL,
697     [TotalEcotaxa] [float] NULL,
698     [CambioMBase] [float] NULL,
699     [CambioMAlt] [float] NULL,
700     [TipoEntidadeEntrega] [nvarchar](1) NULL,
701     [EntidadeEntrega] [nvarchar](12) NULL,
702     [NomeEntrega] [nvarchar](50) NULL,
703     [MoradaEntrega] [nvarchar](50) NULL,
704     [LocalidadeEntrega] [nvarchar](50) NULL,
705     [CodPostalEntrega] [nvarchar](15) NULL,
706     [CodPostalLocalidadeEntrega] [nvarchar](50) NULL,
707     [IdCabecMovCbl] [uniqueidentifier] NULL,
708     [TotalRecargo] [float] NULL,
709     [TotalRetencaoGarantia] [float] NULL,
710     [Versao] [varchar](5) NULL,
711     [ContaDomiciliacao] [varchar](5) NULL,
712     [TipoOperacao] [nvarchar](2) NULL,
713     [Distrito] [varchar](2) NULL,
714     [DistritoEntrega] [varchar](2) NULL,
715     [CDU_CabVar1] [nvarchar](15) NULL,
716     [CDU_CabVar2] [nvarchar](15) NULL,
717     [CDU_CabVar3] [nvarchar](15) NULL,
718     [CDU_CabVar4] [nvarchar](15) NULL,
719     [CDU_CabVar5] [nvarchar](15) NULL,
720     [CDU_CabVar1ENC] [nvarchar](15) NULL,
721     [CDU_CabVar2ENC] [nvarchar](15) NULL,
722     [CDU_CabVar3ENC] [nvarchar](15) NULL,
723     [CDU_CabVar4ENC] [nvarchar](15) NULL,
724     [CDU_CabVar5ENC] [nvarchar](15) NULL,
725     [IntrastatRegEstatistico] [varchar](1) NULL,
726     [Morada2] [nvarchar](50) NULL,
727     [TipoLancamento] [varchar](3) NULL,
728     [TotalIEC] [float] NULL,
729     [DataGravacao] [datetime] NULL,
730     [PendentePorLinha] [bit] NULL,
731     [RegimeIvaReembolsos] [smallint] NULL,
732     [EspacoFiscal] [smallint] NULL,
733     [Morada2Entrega] [nvarchar](50) NULL,
734     [CambioADataDoc] [bit] NULL,
735     [Pais] [nvarchar](2) NULL,
736     [RefDocOrig] [varchar](50) NULL,
737     [Certificado] [varchar](50) NULL,
738     [VersaoAssinatura] [nvarchar](20) NULL,
739     [Assinatura] [nvarchar](255) NULL,
740     [IdDocOrigem] [uniqueidentifier] NULL,
741     [ModuloOrigem] [nvarchar](1) NULL,
742     [PaisEntrega] [nvarchar](2) NULL,
743     [MoradaCarga] [nvarchar](50) NULL,
```

```
744    [Morada2Carga] [nvarchar](50) NULL,
745    [LocalidadeCarga] [nvarchar](50) NULL,
746    [CodPostalCarga] [nvarchar](15) NULL,
747    [CodPostalLocalidadeCarga] [nvarchar](50) NULL,
748    [DistritoCarga] [varchar](2) NULL,
749    [PaisCarga] [nvarchar](2) NULL,
750    [WBSItem] [nvarchar](100) NULL,
751    [B2BTrataTrans] [bit] NULL,
752    [B2BEnvioNaGravacao] [bit] NULL,
753    [CAE] [varchar](15) NULL,
754    [Resumo] [bit] NULL,
755    [IDRegularizacao] [uniqueidentifier] NULL,
756    [TrataIvaCaixa] [bit] NULL,
757    [CDU_CodigoLocalizacao] [nvarchar](13) NULL,
758    [CDU_MTTerminal] [nvarchar](50) NULL,
759    [CDU_IdCabecDest] [nvarchar](100) NULL,
760    [CDU_TipoDocDest] [nvarchar](5) NULL,
761    [CDU_SerieDest] [nvarchar](5) NULL,
762    [CDU_NumDocDest] [int] NULL,
763    [CDU_TipoEntidadeDest] [nvarchar](1) NULL,
764    [CDU_EntidadeDest] [nvarchar](12) NULL,
765    [CDU_CodEmpDest] [nvarchar](10) NULL,
766    [Documento] [nvarchar](50) NULL,
767    [ContratoID] [uniqueidentifier] NULL,
768    [RefTipoDocOrig] [varchar](50) NULL,
769    [RefSerieDocOrig] [varchar](50) NULL,
770    [TotalDocumento] [float] NULL,
771    [CertificadoRecuperacao] [nvarchar](50) NULL,
772    [CDU_MTTranspQTDV] [float] NULL,
773    [CDU_MTTranspPesoVol] [float] NULL,
774    [CDU_MTTranspPesoPal] [float] NULL,
775    [CDU_MTTranspQTDPal] [float] NULL,
776    [CDU_idDocStkPS] [varchar](50) NULL,
777    [CDU_MTPACCBAR] [nvarchar](48) NULL,
778    [TipoFiscal] [varchar](3) NULL,
779    [CDU_MTDocGerado] [nvarchar](100) NULL,
780    [CDU_MTDisponivelConferencia] [bit] NULL,
781    [CDU_CodFornecedor] [varchar](13) NULL,
782    [CDU_DataMaximaEntrega] [nvarchar](20) NULL,
783    [CDU_IDDocStkCusto] [varchar](50) NULL
784 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
785 GO
786 SET ANSI_NULLS ON
787 GO
788 SET QUOTED_IDENTIFIER ON
789 GO
790 CREATE TABLE [dbo].[PurchaseRows](
791    [NumLinha] [smallint] NULL,
792    [NumDocExterno] [nvarchar](20) NULL,
793    [Artigo] [nvarchar](48) NULL,
794    [Desconto1] [real] NULL,
795    [Desconto2] [real] NULL,
796    [Desconto3] [real] NULL,
797    [TaxaIva] [real] NULL,
798    [CodIva] [nvarchar](2) NULL,
799    [Quantidade] [float] NULL,
800    [PrecUnit] [float] NULL,
801    [RegimeIva] [nvarchar](1) NULL,
802    [DataDoc] [datetime] NULL,
803    [TipoLinha] [nvarchar](2) NULL,
804    [Armazem] [nvarchar](5) NULL,
805    [DataEntrada] [datetime] NULL,
806    [CustoAdicionalManual] [float] NULL,
807    [CustoAdicionalRateio] [float] NULL,
808    [MovSTK] [nvarchar](1) NULL,
809    [FactorConv] [float] NULL,
810    [NumLinhaSTKGerada] [int] NULL,
```

```
811     [DescontoComercial] [float] NULL,
812     [Formula] [nvarchar](5) NULL,
813     [VariavelA] [float] NULL,
814     [VariavelB] [float] NULL,
815     [VariavelC] [float] NULL,
816     [QntFormula] [float] NULL,
817     [Lote] [nvarchar](20) NULL,
818     [PrecoLiquido] [float] NULL,
819     [IntrastatPautal] [nvarchar](9) NULL,
820     [IntrastatMassaLiq] [float] NULL,
821     [IntrastatRegiao] [nvarchar](2) NULL,
822     [IntrastatValorLiq] [float] NULL,
823     [Descricao] [nvarchar](512) NULL,
824     [SujeitoRetencao] [bit] NULL,
825     [VersaoUltAct] [binary](8) NULL,
826     [IdCabecCompras] [uniqueidentifier] NULL,
827     [Id] [uniqueidentifier] NULL,
828     [Unidade] [nvarchar](5) NULL,
829     [DataEntrega] [datetime] NULL,
830     [Arred] [int] NULL,
831     [DifPreco] [float] NULL,
832     [DifDesc] [float] NULL,
833     [DifIVA] [float] NULL,
834     [Conferido] [bit] NULL,
835     [CCustoCBL] [nvarchar](20) NULL,
836     [DescValor] [float] NULL,
837     [ContaCBL] [nvarchar](20) NULL,
838     [AnaliticaCBL] [nvarchar](20) NULL,
839     [FuncionalCBL] [nvarchar](15) NULL,
840     [OrganicaCBL] [nvarchar](15) NULL,
841     [ContaOrcamCBL] [nvarchar](20) NULL,
842     [ObraID] [uniqueidentifier] NULL,
843     [ClasseID] [int] NULL,
844     [SubEmpID] [int] NULL,
845     [CategoriaID] [int] NULL,
846     [PercIvaDedutivel] [real] NULL,
847     [TaxaProRata] [real] NULL,
848     [IvaNaoDedutivel] [float] NULL,
849     [Ecotaxa] [float] NULL,
850     [Localizacao] [varchar](30) NULL,
851     [IdLinhaPai] [uniqueidentifier] NULL,
852     [ModuloOrigemCopia] [varchar](1) NULL,
853     [IdLinhaOrigemCopia] [uniqueidentifier] NULL,
854     [TaxaRecargo] [float] NULL,
855     [PercIncidenciaIVA] [float] NULL,
856     [TotalIliquido] [float] NULL,
857     [TotalDA] [float] NULL,
858     [TotalDC] [float] NULL,
859     [TotalDF] [float] NULL,
860     [TotalRecargo] [float] NULL,
861     [TotalIva] [float] NULL,
862     [IdLinhaReqInterna] [uniqueidentifier] NULL,
863     [TipoAuto] [varchar](3) NULL,
864     [AutoID] [uniqueidentifier] NULL,
865     [IDB2BLinhaOrig] [uniqueidentifier] NULL,
866     [B2BNumLinhaOrig] [int] NULL,
867     [CodIvaEcotaxa] [varchar](2) NULL,
868     [TaxaIvaEcotaxa] [real] NULL,
869     [TotalEcotaxa] [float] NULL,
870     [CDU_LinVar1] [nvarchar](15) NULL,
871     [CDU_LinVar2] [nvarchar](15) NULL,
872     [CDU_LinVar3] [nvarchar](15) NULL,
873     [CDU_LinVar4] [nvarchar](15) NULL,
874     [CDU_LinVar5] [nvarchar](15) NULL,
875     [CDU_LinVar1ENC] [nvarchar](15) NULL,
876     [CDU_LinVar2ENC] [nvarchar](15) NULL,
877     [CDU_LinVar3ENC] [nvarchar](15) NULL,
```

```
878   [CDU_LinVar4ENC] [nvarchar](15) NULL,
879   [CDU_LinVar5ENC] [nvarchar](15) NULL,
880   [IntrastatPaisOrigem] [varchar](2) NULL,
881   [IvaRegraCalculo] [smallint] NULL,
882   [MotivoEstorno] [nvarchar](3) NULL,
883   [IDLinhaEstorno] [uniqueidentifier] NULL,
884   [IdHistorico] [uniqueidentifier] NULL,
885   [EstadoPendente] [nvarchar](4) NULL,
886   [CodIvaIEC] [varchar](2) NULL,
887   [TaxaIvaIEC] [float] NULL,
888   [TotalIEC] [float] NULL,
889   [ValorIEC] [float] NULL,
890   [ItemId] [int] NULL,
891   [ItemCod] [nvarchar](20) NULL,
892   [ItemDesc] [varchar](4000) NULL,
893   [TipoOperacao] [nvarchar](2) NULL,
894   [AcertoIVA] [float] NULL,
895   [CDU_UnidadeAlternativa] [nvarchar](5) NULL,
896   [CDU_QuantidadeAlternativa] [float] NULL,
897   [CDU_FactorConversaoAlternativa] [float] NULL,
898   [WBSItem] [nvarchar](100) NULL,
899   [BaseIncidencia] [float] NULL,
900   [BaseCalculoIncidencia] [float] NULL,
901   [RegraCalculoIncidencia] [tinyint] NULL,
902   [MoedaDocOrig] [nvarchar](3) NULL,
903   [CambioDocOrig] [float] NULL,
904   [CambioMBaseDocOrig] [float] NULL,
905   [CambioMAltDocOrig] [float] NULL,
906   [DifCambioMAlt] [float] NULL,
907   [DifCambioMBase] [float] NULL,
908   [DifArredondamentoMAlt] [float] NULL,
909   [DifArredondamentoMBase] [float] NULL,
910   [EstadoAdi] [nvarchar](4) NULL,
911   [CDU_MTLinExcluidaRec] [bit] NULL,
912   [CDU_MTLocalizacao] [nvarchar](50) NULL,
913   [CDU_MTMMDAIdLinhaLeitura] [nvarchar](38) NULL,
914   [CDU_MTIdLinhaOrig] [nvarchar](50) NULL,
915   [ProcessoID] [uniqueidentifier] NULL,
916   [ValorLiquidoDesconto] [float] NULL,
917   [IvaValorDesconto] [float] NULL,
918   [ContratoID] [uniqueidentifier] NULL,
919   [IsentoPagDireitos] [bit] NULL,
920   [CodigoPautal] [nvarchar](15) NULL,
921   [CDU_QtdBonus] [float] NULL,
922   [CDU_MWSQU] [float] NULL,
923   [CDU_MWSNU] [float] NULL,
924   [CDU_LoteFornecedor] [varchar](30) NULL,
925   [CDU_PickingNS_Flag] [bit] NULL,
926   [CDU_PickingNS_Data] [varchar](max) NULL
927 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
928 GO
929 SET ANSI_NULLS ON
930 GO
931 SET QUOTED_IDENTIFIER ON
932 GO
933 CREATE TABLE [dbo].[SaleDocStatus](
934   [IdCabecDoc] [uniqueidentifier] NULL,
935   [DocImp] [bit] NULL,
936   [MovContab] [smallint] NULL,
937   [MovImobilizado] [smallint] NULL,
938   [Estado] [nvarchar](1) NULL,
939   [LigacaoCBLLote] [bit] NULL,
940   [EstadoCBLEntidade] [smallint] NULL,
941   [Anulado] [bit] NULL,
942   [Fechado] [bit] NULL,
943   [VersaoUltAct] [binary](8) NULL,
944   [EstadoIEC] [smallint] NULL,
```

```
945     [DataImp] [datetime] NULL,
946     [ATTrataTrans] [smallint] NULL,
947     [ATDocCodeID] [nvarchar](200) NULL,
948     [MotivoAnulacao] [nvarchar](3) NULL,
949     [DataAnulacao] [datetime] NULL,
950     [UtilizadorAnulacao] [nvarchar](20) NULL,
951     [CalculoManual] [bit] NULL,
952     [ExportadoSAFTAuditoria] [bit] NULL
953 ) ON [PRIMARY]
954 GO
955 SET ANSI_NULLS ON
956 GO
957 SET QUOTED_IDENTIFIER ON
958 GO
959 CREATE TABLE [dbo].[SaleDocuments](
960     [Documento] [nvarchar](5) NULL,
961     [Descricao] [nvarchar](35) NULL,
962     [Diario] [nvarchar](5) NULL,
963     [SugestaoEstat] [bit] NULL,
964     [ClienteIndiferenciado] [bit] NULL,
965     [LigaStocks] [bit] NULL,
966     [LigaCC] [bit] NULL,
967     [LigaContab] [bit] NULL,
968     [LigaContabMovSTK] [bit] NULL,
969     [PagarReceber] [nvarchar](1) NULL,
970     [TipoDocCC] [nvarchar](2) NULL,
971     [CTBStocksCredito] [nvarchar](20) NULL,
972     [CTBStocksDebito] [nvarchar](20) NULL,
973     [ActPCU] [bit] NULL,
974     [ActPCM] [bit] NULL,
975     [ActUltEntrada] [bit] NULL,
976     [ActUltSaida] [bit] NULL,
977     [TipoDocSTK] [nvarchar](1) NULL,
978     [Recapitulativos] [bit] NULL,
979     [CalculaComissoes] [bit] NULL,
980     [TipoConta] [nvarchar](3) NULL,
981     [Estado] [nvarchar](3) NULL,
982     [LiquidacaoAutomatica] [bit] NULL,
983     [DocumentoLiqAGerar] [nvarchar](5) NULL,
984     [SugereCondPag] [bit] NULL,
985     [CondPagASugerir] [nvarchar](2) NULL,
986     [LigacaoTesouraria] [bit] NULL,
987     [RubricaTesouraria] [nvarchar](15) NULL,
988     [LigaBNC] [bit] NULL,
989     [Limitecredito] [bit] NULL,
990     [TipoLigacaoBNC] [bit] NULL,
991     [Fluxo] [nvarchar](5) NULL,
992     [VisualizarLigacaoCBL] [bit] NULL,
993     [ClasseIvaCBL] [bit] NULL,
994     [CentrosCustoCBL] [bit] NULL,
995     [AnaliticaCBL] [bit] NULL,
996     [IntrastatDoc] [bit] NULL,
997     [IntrastatCondEnt] [nvarchar](3) NULL,
998     [BalAnalitica] [bit] NULL,
999     [BalFinanceira] [bit] NULL,
1000    [SujeitoAProvisoes] [bit] NULL,
1001    [LigacaoCBLOnLine] [bit] NULL,
1002    [EnviaEmail] [bit] NULL,
1003    [EmailTo] [nvarchar](512) NULL,
1004    [EmailFixo] [bit] NULL,
1005    [EMailBCC] [nvarchar](512) NULL,
1006    [EMailCC] [nvarchar](512) NULL,
1007    [EMailTexto] [nvarchar](max) NULL,
1008    [EMailConfirmar] [bit] NULL,
1009    [EMailVisualizar] [bit] NULL,
1010    [FuncionalCBL] [nvarchar](15) NULL,
1011    [OrganicaCBL] [nvarchar](15) NULL,
```

```
1012    [EconomicaCBL] [nvarchar](15) NULL,
1013    [BalOrcamental] [bit] NULL,
1014    [FuncoesCBL] [bit] NULL,
1015    [DataUltimaActualizacao] [datetime] NULL,
1016    [PermiteAltAposExp] [bit] NULL,
1017    [VersaoUltAct] [binary](8) NULL,
1018    [EstadoLiqAut] [nvarchar](3) NULL,
1019    [LigaProcessos] [bit] NULL,
1020    [MovimentaEstados] [bit] NULL,
1021    [EstadoProcesso] [nvarchar](3) NULL,
1022    [SugereCodProcesso] [bit] NULL,
1023    [DocTesAGerar] [nvarchar](5) NULL,
1024    [TipoDocumento] [tinyint] NULL,
1025    [SujeitoLiberacao] [bit] NULL,
1026    [Clientes] [bit] NULL,
1027    [OutrosDevedores] [bit] NULL,
1028    [SujeitoConversao] [bit] NULL,
1029    [DebitoTesoureiro] [bit] NULL,
1030    [ControlaCustosPorObra] [bit] NULL,
1031    [VerDescCliente] [bit] NULL,
1032    [RecolhaDE_IL] [bit] NULL,
1033    [BalAnaliticaALT] [bit] NULL,
1034    [BalFinanceiraALT] [bit] NULL,
1035    [BalOrcamentalALT] [bit] NULL,
1036    [LiqRetIntroducao] [bit] NULL,
1037    [DocLiqRetencao] [nvarchar](5) NULL,
1038    [SujeitoRetencaoGarantia] [bit] NULL,
1039    [LiqRetGarantiaIntroducao] [bit] NULL,
1040    [DocLiqRetencaoGarantia] [nvarchar](5) NULL,
1041    [ControlaQtdSatisfeita] [bit] NULL,
1042    [ProcNecessidadesGPR] [bit] NULL,
1043    [NaturezaCCOP] [nvarchar](1) NULL,
1044    [DisponivelPMS] [bit] NULL,
1045    [ClasseAnalitica] [smallint] NULL,
1046    [TransitaEstado] [bit] NULL,
1047    [EstadoTransitar] [varchar](4) NULL,
1048    [NActualizaPCM] [bit] NULL,
1049    [NActualizaPCU] [bit] NULL,
1050    [NActualizaUltimaEntrada] [bit] NULL,
1051    [NActualizaUltimaSaida] [bit] NULL,
1052    [NTipoMovStk] [nvarchar](1) NULL,
1053    [PermiteDocNegativo] [bit] NULL,
1054    [PermiteLinhasNegativas] [bit] NULL,
1055    [PermiteEstorno] [bit] NULL,
1056    [DocumentoEstorno] [nvarchar](5) NULL,
1057    [SerieDocEstorno] [nvarchar](5) NULL,
1058    [DeduzLiquidaIVA] [bit] NULL,
1059    [PendentePorLinha] [bit] NULL,
1060    [DocumentoFactura] [bit] NULL,
1061    [GeraAssinatura] [bit] NULL,
1062    [SAFTTipoDocumento] [varchar](2) NULL,
1063    [BensCirculacao] [bit] NULL,
1064    [EntidadesExternas] [bit] NULL,
1065    [Inactivo] [bit] NULL,
1066    [ValorLimite] [float] NULL,
1067    [DesignacaoFiscal] [varchar](50) NULL,
1068    [DocNaoValorizado] [bit] NULL,
1069    [OperacaoControlaQtdSatisfeita] [smallint] NULL,
1070    [CDU_MTDisponivelMM] [bit] NULL,
1071    [CDU_MTFechaEnc] [bit] NULL,
1072    [CDU_MTTranspDestFich] [nvarchar](300) NULL,
1073    [LigaSTP] [bit] NULL,
1074    [RequerProcessoSTP] [bit] NULL,
1075    [AcaoFaturacaoSTP] [smallint] NULL,
1076    [TipoIntervencaoSTP] [nvarchar](15) NULL,
1077    [SeparaControloQtdSatisfeita] [bit] NULL,
1078    [CDU_GeraDocProtecaoStocks] [bit] NULL,
```

```
1079    [CDU_UsaMorArmSug] [bit] NULL,
1080    [CDU_ExcluiAvisos] [bit] NULL,
1081    [CDU_Campanha] [bit] NULL,
1082    [CDU_LibertaReservaAuto] [bit] NULL,
1083    [CDU_ReservaAuto] [bit] NULL,
1084    [CDU_MTPACPreenche] [bit] NULL,
1085    [CDU_MTPACTipoLeitura] [int] NULL,
1086    [CDU_MTPACTDDest] [nvarchar](5) NULL,
1087    [CDU_MTPACSerieDest] [nvarchar](5) NULL,
1088    [CDU_ValidaReferencia] [bit] NULL,
1089    [CDU_ValidaAdiantamento] [bit] NULL,
1090    [DocumentoRetificacao] [nvarchar](5) NULL,
1091    [SerieDocRetificacao] [nvarchar](5) NULL,
1092    [CDU_AtivaVouchers] [bit] NULL,
1093    [CDU_UtilizaVouchers] [bit] NULL,
1094    [CDU_ValidaInquerito] [bit] NULL,
1095    [CDU_TipoVale] [bit] NULL,
1096    [CDU_ValidadeVale_Dias] [int] NULL,
1097    [CDU_TTEsEx] [bit] NULL,
1098    [CDU_SerieCliente] [bit] NULL,
1099    [CDU_EnviaNCMail] [bit] NULL,
1100    [CDU_EnviaNCMailCC] [varchar](100) NULL,
1101    [CDU_ImprimeFolhaRosto] [bit] NULL
1102 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
1103 GO
1104 SET ANSI_NULLS ON
1105 GO
1106 SET QUOTED_IDENTIFIER ON
1107 GO
1108 CREATE TABLE [dbo].[SaleHeaders](
1109    [Data] [datetime] NULL,
1110    [Zona] [nvarchar](2) NULL,
1111    [Entidade] [nvarchar](12) NULL,
1112    [TipoDoc] [nvarchar](5) NULL,
1113    [NumDoc] [int] NULL,
1114    [CondPag] [nvarchar](2) NULL,
1115    [DescPag] [real] NULL,
1116    [TotalMerc] [float] NULL,
1117    [TotalIva] [float] NULL,
1118    [TotalDesc] [float] NULL,
1119    [TotalOutros] [float] NULL,
1120    [ModoExp] [nvarchar](2) NULL,
1121    [ModoPag] [nvarchar](5) NULL,
1122    [UtilizaMoradaAltEntrega] [bit] NULL,
1123    [MoradaAltEntrega] [nvarchar](10) NULL,
1124    [Seccao] [nvarchar](2) NULL,
1125    [RegimeIva] [nvarchar](1) NULL,
1126    [Moeda] [nvarchar](3) NULL,
1127    [Cambio] [float] NULL,
1128    [Requisicao] [nvarchar](20) NULL,
1129    [DataVencimento] [datetime] NULL,
1130    [LocalCarga] [nvarchar](50) NULL,
1131    [HoraCarga] [nvarchar](5) NULL,
1132    [LocalDescarga] [nvarchar](50) NULL,
1133    [HoraDescarga] [nvarchar](5) NULL,
1134    [Matricula] [nvarchar](25) NULL,
1135    [Filial] [nvarchar](3) NULL,
1136    [Serie] [nvarchar](5) NULL,
1137    [MoedaDaUEM] [bit] NULL,
1138    [Arredondamento] [smallint] NULL,
1139    [ArredondamentoIva] [smallint] NULL,
1140    [IntrastatNatA] [nvarchar](2) NULL,
1141    [IntrastatNatB] [nvarchar](2) NULL,
1142    [IntrastatCondEnt] [nvarchar](3) NULL,
1143    [IntrastatModoTransp] [nvarchar](1) NULL,
1144    [IntrastatPorto] [nvarchar](4) NULL,
1145    [Diario] [nvarchar](5) NULL,
```

```
1146    [NumDiario] [int] NULL,
1147    [DataUltimaActualizacao] [datetime] NULL,
1148    [RespCobranca] [nvarchar](3) NULL,
1149    [NumContribuinte] [nvarchar](20) NULL,
1150    [Nome] [nvarchar](50) NULL,
1151    [Morada] [nvarchar](50) NULL,
1152    [Localidade] [nvarchar](50) NULL,
1153    [CodPostal] [nvarchar](15) NULL,
1154    [CodPostalLocalidade] [nvarchar](50) NULL,
1155    [Utilizador] [nvarchar](20) NULL,
1156    [Posto] [nvarchar](3) NULL,
1157    [DocsOriginais] [nvarchar](max) NULL,
1158    [Observacoes] [nvarchar](max) NULL,
1159    [PercentagemRetencao] [float] NULL,
1160    [TotalRetencao] [float] NULL,
1161    [DataCarga] [nvarchar](20) NULL,
1162    [DataDescarga] [nvarchar](20) NULL,
1163    [TipoOperacao] [nvarchar](2) NULL,
1164    [VersaoUltAct] [binary](8) NULL,
1165    [Id] [uniqueidentifier] NULL,
1166    [IdCabecTesouraria] [uniqueidentifier] NULL,
1167    [TipoEntidade] [nvarchar](1) NULL,
1168    [DescEntidade] [real] NULL,
1169    [Responsavel] [nvarchar](25) NULL,
1170    [Referencia] [nvarchar](20) NULL,
1171    [FluxoDocumental] [nvarchar](3) NULL,
1172    [AnoCBL] [smallint] NULL,
1173    [IdGDOC] [uniqueidentifier] NULL,
1174    [ObraID] [uniqueidentifier] NULL,
1175    [IdCabecEstorno] [uniqueidentifier] NULL,
1176    [IdDocB2B] [uniqueidentifier] NULL,
1177    [LocalOperacao] [varchar](2) NULL,
1178    [TotalEcotaxa] [float] NULL,
1179    [DE_IL] [nvarchar](20) NULL,
1180    [CambioMBase] [float] NULL,
1181    [CambioMAlt] [float] NULL,
1182    [IDDiarioCaixa] [uniqueidentifier] NULL,
1183    [TipoEntidadeEntrega] [nvarchar](1) NULL,
1184    [EntidadeEntrega] [nvarchar](12) NULL,
1185    [NomeEntrega] [nvarchar](50) NULL,
1186    [MoradaEntrega] [nvarchar](50) NULL,
1187    [LocalidadeEntrega] [nvarchar](50) NULL,
1188    [CodPostalEntrega] [nvarchar](15) NULL,
1189    [CodPostalLocalidadeEntrega] [nvarchar](50) NULL,
1190    [IdCabecMovCbl] [uniqueidentifier] NULL,
1191    [TotalRecargo] [float] NULL,
1192    [TotalRetencaoGarantia] [float] NULL,
1193    [Grupo] [varchar](30) NULL,
1194    [Origem] [varchar](15) NULL,
1195    [OrigemPOS] [bit] NULL,
1196    [Versao] [varchar](5) NULL,
1197    [IDAvenca] [uniqueidentifier] NULL,
1198    [ContaDomiciliacao] [varchar](5) NULL,
1199    [Distrito] [varchar](2) NULL,
1200    [DistritoEntrega] [varchar](2) NULL,
1201    [CDU_CabVar1] [nvarchar](15) NULL,
1202    [CDU_CabVar2] [nvarchar](15) NULL,
1203    [CDU_CabVar3] [nvarchar](15) NULL,
1204    [CDU_CabVar4] [nvarchar](15) NULL,
1205    [CDU_CabVar5] [nvarchar](15) NULL,
1206    [CDU_CabVar1ENC] [nvarchar](15) NULL,
1207    [CDU_CabVar2ENC] [nvarchar](15) NULL,
1208    [CDU_CabVar3ENC] [nvarchar](15) NULL,
1209    [CDU_CabVar4ENC] [nvarchar](15) NULL,
1210    [CDU_CabVar5ENC] [nvarchar](15) NULL,
1211    [IntrastatRegEstatistico] [varchar](1) NULL,
1212    [Morada2] [nvarchar](50) NULL,
```

```
1213    [TipoLancamento] [varchar](3) NULL,
1214    [TipoEntidadeFac] [nvarchar](1) NULL,
1215    [EntidadeFac] [nvarchar](12) NULL,
1216    [NomeFac] [nvarchar](50) NULL,
1217    [MoradaFac] [nvarchar](50) NULL,
1218    [Morada2Fac] [nvarchar](50) NULL,
1219    [LocalidadeFac] [nvarchar](50) NULL,
1220    [CodigoPostalFac] [nvarchar](15) NULL,
1221    [LocalidadeCodigoPostalFac] [nvarchar](50) NULL,
1222    [NumContribuinteFac] [nvarchar](20) NULL,
1223    [DistritoFac] [varchar](2) NULL,
1224    [EntidadeDescarga] [nvarchar](12) NULL,
1225    [TotalIEC] [float] NULL,
1226    [DataGravacao] [datetime] NULL,
1227    [PendentePorLinha] [bit] NULL,
1228    [Assinatura] [nvarchar](255) NULL,
1229    [VersaoAssinatura] [nvarchar](20) NULL,
1230    [RegimeIvaReembolsos] [smallint] NULL,
1231    [EspacoFiscal] [smallint] NULL,
1232    [Morada2Entrega] [nvarchar](50) NULL,
1233    [PaisFac] [nvarchar](2) NULL,
1234    [CambioADataDoc] [bit] NULL,
1235    [IdOportunidade] [uniqueidentifier] NULL,
1236    [NumProposta] [smallint] NULL,
1237    [Pais] [nvarchar](2) NULL,
1238    [RefDocOrig] [varchar](50) NULL,
1239    [Certificado] [varchar](50) NULL,
1240    [IdDocOrigem] [uniqueidentifier] NULL,
1241    [ModuloOrigem] [nvarchar](1) NULL,
1242    [PaisEntrega] [nvarchar](2) NULL,
1243    [MoradaCarga] [nvarchar](50) NULL,
1244    [Morada2Carga] [nvarchar](50) NULL,
1245    [LocalidadeCarga] [nvarchar](50) NULL,
1246    [CodPostalCarga] [nvarchar](15) NULL,
1247    [CodPostalLocalidadeCarga] [nvarchar](50) NULL,
1248    [DistritoCarga] [varchar](2) NULL,
1249    [PaisCarga] [nvarchar](2) NULL,
1250    [TrataIvaCaixa] [bit] NULL,
1251    [WBSItem] [nvarchar](100) NULL,
1252    [B2BTrataTrans] [bit] NULL,
1253    [B2BEnvioNaGravacao] [bit] NULL,
1254    [CAE] [varchar](15) NULL,
1255    [Resumo] [bit] NULL,
1256    [IDRegularizacao] [uniqueidentifier] NULL,
1257    [TotalIS] [float] NULL,
1258    [CDU_CodigoLocalizacao] [varchar](13) NULL,
1259    [CDU_MTTerminal] [nvarchar](50) NULL,
1260    [CDU_MTIDInterno] [nvarchar](50) NULL,
1261    [CDU_MTTranspQTDV] [float] NULL,
1262    [CDU_MTTranspPesoVol] [float] NULL,
1263    [CDU_MTTranspPesoPal] [float] NULL,
1264    [CDU_MTTranspQTDPal] [float] NULL,
1265    [CDU_Exportado] [bit] NULL,
1266    [CDU_IdCabecDest] [nvarchar](100) NULL,
1267    [CDU_TipoDocDest] [nvarchar](5) NULL,
1268    [CDU_SerieDest] [nvarchar](5) NULL,
1269    [CDU_NumDocDest] [int] NULL,
1270    [CDU_TipoEntidadeDest] [nvarchar](1) NULL,
1271    [CDU_EntidadeDest] [nvarchar](12) NULL,
1272    [CDU_CodEmpDest] [nvarchar](10) NULL,
1273    [ContratoID] [uniqueidentifier] NULL,
1274    [Documento] [nvarchar](50) NULL,
1275    [RefTipoDocOrig] [varchar](50) NULL,
1276    [RefSerieDocOrig] [varchar](50) NULL,
1277    [TotalDocumento] [float] NULL,
1278    [CertificadoRecuperacao] [nvarchar](50) NULL,
1279    [MargemDoc] [float] NULL,
```

```
    [CDU_DocCobrancaCTT] [varchar](50) NULL,
    [CDU_NomePessoaCTT] [varchar](50) NULL,
    [CDU_NrVolumesCTT] [int] NULL,
    [CDU_PesoVolumesCTT] [int] NULL,
    [CDU_SabadoCTT] [bit] NULL,
    [CDU_ServicoCTT] [varchar](50) NULL,
    [CDU_TituloCTT] [varchar](50) NULL,
    [CDU_idDocStkPS] [varchar](50) NULL,
    [CDU_SMSCTT] [bit] NULL,
    [CDU_MTPACCBAR] [nvarchar](48) NULL,
    [CDU_DataHoraExpedir] [datetime] NULL,
    [CDU_Expedir] [bit] NULL,
    [CDU_Prioridade] [nvarchar](30) NULL,
    [CDU_IdECLONL] [varchar](50) NULL,
    [CDU_NumDocECLONL] [int] NULL,
    [CDU_SerieECLONL] [varchar](5) NULL,
    [CDU_TipoDocECLONL] [varchar](5) NULL,
    [CDU_MTIdPendente] [nvarchar](50) NULL,
    [CDU_Voucher] [nvarchar](64) NULL,
    [TipoFiscal] [varchar](3) NULL,
    [CDU_MTDocGerado] [nvarchar](100) NULL,
    [CDU_MTDisponivelConferencia] [bit] NULL,
    [CDU_MTImpressoAgrupado] [bit] NULL,
    [CDU_ValeProcessado] [bit] NULL,
    [CDU_ValidadeVale_Dias] [int] NULL,
    [CDU_DocumentoAnterior] [nvarchar](100) NULL,
    [CDU_ModoPagExpVendas] [nvarchar](5) NULL,
    [CDU_PRAZOPREVISTO] [datetime] NULL,
    [CDU_CataloguePurpose] [varchar](13) NULL,
    [CDU_CodFornecedor] [varchar](13) NULL,
    [CDU_DataMaximaEntrega] [nvarchar](20) NULL,
    [CDU_RefFacturaOrig] [nvarchar](30) NULL,
    [CDU_RefGuiaRemessa] [nvarchar](30) NULL,
    [CDU_TTE_OrdemAlteracao] [int] NULL,
    [CDU_TTE_DataAlteracao] [nvarchar](50) NULL,
    [CDU_TTE_NumeroAlteracao] [nvarchar](50) NULL,
    [CDU_MWSExportadoTranp] [bit] NULL,
    [CDU_MWSTotalDocumento] [float] NULL,
    [CDU_MWSDocPortes] [varchar](50) NULL,
    [CDU_MWSOrig] [bit] NULL
) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
GO
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TABLE [dbo].[SaleRows](
    [NumLinha] [smallint] NULL,
    [Artigo] [nvarchar](48) NULL,
    [Desconto1] [real] NULL,
    [Desconto2] [real] NULL,
    [Desconto3] [real] NULL,
    [TaxaIva] [real] NULL,
    [CodIva] [nvarchar](2) NULL,
    [Quantidade] [float] NULL,
    [PCM] [float] NULL,
    [PrecUnit] [float] NULL,
    [RegimeIva] [nvarchar](1) NULL,
    [Data] [datetime] NULL,
    [TipoLinha] [nvarchar](2) NULL,
    [Seccao] [nvarchar](2) NULL,
    [Armazem] [nvarchar](5) NULL,
    [MovSTK] [nvarchar](1) NULL,
    [FactorConv] [float] NULL,
    [NumLinhaSTKGerada] [smallint] NULL,
    [DataSaida] [datetime] NULL,
    [DescontoComercial] [float] NULL,
```

```
1347    [Formula] [nvarchar](5) NULL,
1348    [VariavelA] [float] NULL,
1349    [VariavelB] [float] NULL,
1350    [VariavelC] [float] NULL,
1351    [QntFormula] [float] NULL,
1352    [Comissao] [float] NULL,
1353    [Lote] [nvarchar](20) NULL,
1354    [PrecoLiquido] [float] NULL,
1355    [Vendedor] [nvarchar](3) NULL,
1356    [IntrastatPautal] [nvarchar](9) NULL,
1357    [IntrastatMassaLiq] [float] NULL,
1358    [IntrastatRegiao] [nvarchar](2) NULL,
1359    [IntrastatValorLiq] [float] NULL,
1360    [Descricao] [nvarchar](512) NULL,
1361    [SujeitoRetencao] [bit] NULL,
1362    [VersaoUltAct] [binary](8) NULL,
1363    [IdCabecDoc] [uniqueidentifier] NULL,
1364    [Id] [uniqueidentifier] NULL,
1365    [Unidade] [nvarchar](5) NULL,
1366    [DataEntrega] [datetime] NULL,
1367    [IdHistorico] [uniqueidentifier] NULL,
1368    [Arred] [int] NULL,
1369    [Devolucao] [bit] NULL,
1370    [PCMDevolucao] [float] NULL,
1371    [ContaCBL] [nvarchar](20) NULL,
1372    [CCustoCBL] [nvarchar](15) NULL,
1373    [AnaliticaCBL] [nvarchar](20) NULL,
1374    [FuncionalCBL] [nvarchar](15) NULL,
1375    [OrganicaCBL] [nvarchar](15) NULL,
1376    [ContaOrcamCBL] [nvarchar](20) NULL,
1377    [ObraID] [uniqueidentifier] NULL,
1378    [ClasseID] [int] NULL,
1379    [SubEmpID] [int] NULL,
1380    [CategoriaID] [int] NULL,
1381    [DifPCMedio] [float] NULL,
1382    [PercIvaDedutivel] [real] NULL,
1383    [IvaNaoDedutivel] [float] NULL,
1384    [Ecotaxa] [float] NULL,
1385    [Localizacao] [varchar](30) NULL,
1386    [IdLinhaPai] [uniqueidentifier] NULL,
1387    [ModuloOrigemCopia] [varchar](1) NULL,
1388    [IdLinhaOrigemCopia] [uniqueidentifier] NULL,
1389    [TaxaRecargo] [float] NULL,
1390    [PercIncidenciaIVA] [float] NULL,
1391    [TotalIliquido] [float] NULL,
1392    [TotalDA] [float] NULL,
1393    [TotalDC] [float] NULL,
1394    [TotalDF] [float] NULL,
1395    [TotalRecargo] [float] NULL,
1396    [TotalIva] [float] NULL,
1397    [TipoCustoPrevisto] [tinyint] NULL,
1398    [CustoPrevisto] [float] NULL,
1399    [Margem] [float] NULL,
1400    [PercentagemMargem] [float] NULL,
1401    [TipoAuto] [varchar](3) NULL,
1402    [AutoID] [uniqueidentifier] NULL,
1403    [IDB2BLinhaOrig] [uniqueidentifier] NULL,
1404    [B2BNumLinhaOrig] [int] NULL,
1405    [CodIvaEcotaxa] [varchar](2) NULL,
1406    [TaxaIvaEcotaxa] [real] NULL,
1407    [TotalEcotaxa] [float] NULL,
1408    [CDU_LinVar1] [nvarchar](15) NULL,
1409    [CDU_LinVar2] [nvarchar](15) NULL,
1410    [CDU_LinVar3] [nvarchar](15) NULL,
1411    [CDU_LinVar4] [nvarchar](15) NULL,
1412    [CDU_LinVar5] [nvarchar](15) NULL,
1413    [CDU_LinVar1ENC] [nvarchar](15) NULL,
```

```
1414    [CDU_LinVar2ENC] [nvarchar](15) NULL,
1415    [CDU_LinVar3ENC] [nvarchar](15) NULL,
1416    [CDU_LinVar4ENC] [nvarchar](15) NULL,
1417    [CDU_LinVar5ENC] [nvarchar](15) NULL,
1418    [IntrastatPaisOrigem] [varchar](2) NULL,
1419    [IvaRegraCalculo] [smallint] NULL,
1420    [MotivoEstorno] [nvarchar](3) NULL,
1421    [IDLinhaEstorno] [uniqueidentifier] NULL,
1422    [EstadoPendente] [nvarchar](4) NULL,
1423    [CodIvaIEC] [varchar](2) NULL,
1424    [TaxaIvaIEC] [float] NULL,
1425    [TotalIEC] [float] NULL,
1426    [ValorIEC] [float] NULL,
1427    [ItemId] [int] NULL,
1428    [ItemCod] [nvarchar](20) NULL,
1429    [ItemDesc] [varchar](4000) NULL,
1430    [TipoOperacao] [nvarchar](2) NULL,
1431    [CDU_UnidadeAlternativa] [nvarchar](5) NULL,
1432    [CDU_QuantidadeAlternativa] [float] NULL,
1433    [CDU_FactorConversaoAlternativa] [float] NULL,
1434    [WBSItem] [nvarchar](100) NULL,
1435    [AlternativaGPR] [nvarchar](2) NULL,
1436    [BaseIncidencia] [float] NULL,
1437    [BaseCalculoIncidencia] [float] NULL,
1438    [RegraCalculoIncidencia] [tinyint] NULL,
1439    [MoedaDocOrig] [nvarchar](3) NULL,
1440    [CambioDocOrig] [float] NULL,
1441    [CambioMBaseDocOrig] [float] NULL,
1442    [CambioMAltDocOrig] [float] NULL,
1443    [DifCambioMAlt] [float] NULL,
1444    [DifCambioMBase] [float] NULL,
1445    [DifArredondamentoMAlt] [float] NULL,
1446    [DifArredondamentoMBase] [float] NULL,
1447    [EstadoAdi] [nvarchar](4) NULL,
1448    [Ano] [smallint] NULL,
1449    [Selo] [nvarchar](15) NULL,
1450    [IncidenciaIS] [float] NULL,
1451    [ValorIS] [float] NULL,
1452    [CDU_MTEstado] [varchar](1) NULL,
1453    [CDU_MTLinExcluidaExp] [bit] NULL,
1454    [CDU_MTLocalizacao] [nvarchar](50) NULL,
1455    [CDU_MTMMDAIdLinhaLeitura] [nvarchar](38) NULL,
1456    [CDU_MTIdLinhaOrig] [nvarchar](50) NULL,
1457    [ContratoID] [uniqueidentifier] NULL,
1458    [ValorLiquidoDesconto] [float] NULL,
1459    [IvaValorDesconto] [float] NULL,
1460    [ProcessoID] [uniqueidentifier] NULL,
1461    [CDU_CentroCusto] [nvarchar](15) NULL,
1462    [CDU_IdVoucher] [varchar](50) NULL,
1463    [CDU_CopiaArtigo] [varchar](48) NULL,
1464    [CDU_CopiaValor] [float] NULL,
1465    [CDU_UltFornecedor] [nvarchar](12) NULL,
1466    [CDU_ArtSubstituido] [varchar](13) NULL,
1467    [CDU_QtdBonus] [float] NULL,
1468    [CDU_MWSQU] [float] NULL,
1469    [CDU_MWSNU] [float] NULL,
1470    [CDU_preco_depreciado] [bit] NULL,
1471    [CDU_PickingNS_Flag] [bit] NULL,
1472    [CDU_PickingNS_Data] [varchar](max) NULL
1473 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
1474 GO
1475 SET ANSI_NULLS ON
1476 GO
1477 SET QUOTED_IDENTIFIER ON
1478 GO
1479 CREATE TABLE [dbo].[Stock](
1480    [Modulo] [nvarchar](1) NULL,
```

```
1481    [TipoDoc] [nvarchar](5) NULL,
1482    [NumDoc] [int] NULL,
1483    [NumLinha] [int] NULL,
1484    [Artigo] [nvarchar](48) NULL,
1485    [Quantidade] [float] NULL,
1486    [PCM] [float] NULL,
1487    [PrecUnit] [float] NULL,
1488    [Data] [datetime] NULL,
1489    [TipoLinha] [nvarchar](2) NULL,
1490    [Seccao] [nvarchar](2) NULL,
1491    [Armazem] [nvarchar](5) NULL,
1492    [FactorConv] [float] NULL,
1493    [EntradaSaida] [nvarchar](1) NULL,
1494    [NumLinDocOrig] [int] NULL,
1495    [DescontoComercial] [float] NULL,
1496    [DespesaAdicionalCompra] [float] NULL,
1497    [NumLinComposto] [int] NULL,
1498    [Filial] [nvarchar](3) NULL,
1499    [Serie] [nvarchar](5) NULL,
1500    [Formula] [nvarchar](5) NULL,
1501    [VariavelA] [float] NULL,
1502    [VariavelB] [float] NULL,
1503    [VariavelC] [float] NULL,
1504    [QntFormula] [float] NULL,
1505    [Lote] [nvarchar](20) NULL,
1506    [Descricao] [nvarchar](512) NULL,
1507    [VersaoUltAct] [binary](8) NULL,
1508    [Id] [uniqueidentifier] NULL,
1509    [Unidade] [nvarchar](5) NULL,
1510    [Arred] [int] NULL,
1511    [Devolucao] [bit] NULL,
1512    [PCMDevolucao] [float] NULL,
1513    [CCustoCBL] [nvarchar](20) NULL,
1514    [ContaCBL] [nvarchar](20) NULL,
1515    [AnaliticaCBL] [nvarchar](20) NULL,
1516    [FuncionalCBL] [nvarchar](15) NULL,
1517    [OrganicaCBL] [nvarchar](15) NULL,
1518    [EconomicaCBL] [nvarchar](15) NULL,
1519    [ContaOrcamCBL] [nvarchar](20) NULL,
1520    [ObraID] [uniqueidentifier] NULL,
1521    [ClasseID] [int] NULL,
1522    [SubEmpID] [int] NULL,
1523    [CategoriaID] [int] NULL,
1524    [DifPCMedio] [float] NULL,
1525    [VPTTotal] [float] NULL,
1526    [IdCabecOrig] [uniqueidentifier] NULL,
1527    [Localizacao] [varchar](30) NULL,
1528    [IdLinhaOrig] [uniqueidentifier] NULL,
1529    [IdLinhaPai] [uniqueidentifier] NULL,
1530    [ModuloOrigemCopia] [varchar](1) NULL,
1531    [IdLinhaOrigemCopia] [uniqueidentifier] NULL,
1532    [LocalizacaoOrigem] [varchar](30) NULL,
1533    [IdLinhaOrdemFabrico] [int] NULL,
1534    [IdLinhaReqInterna] [uniqueidentifier] NULL,
1535    [StockNegativo] [smallint] NULL,
1536    [QtdAcumuladoArtigo] [float] NULL,
1537    [QtdAcumuladoArmLote] [float] NULL,
1538    [CustoNaoImputado] [float] NULL,
1539    [ActPCU] [bit] NULL,
1540    [ActPCM] [bit] NULL,
1541    [ActUltEntrada] [bit] NULL,
1542    [ActUltSaida] [bit] NULL,
1543    [TipoDocumento] [tinyint] NULL,
1544    [PrecoUnitario] [int] NULL,
1545    [LoteOrigem] [nvarchar](20) NULL,
1546    [ItemId] [int] NULL,
1547    [ItemCod] [nvarchar](20) NULL,
```

```
1548    [ItemDesc] [varchar](4000) NULL,
1549    [WBSItem] [nvarchar](100) NULL,
1550    [CDU_MTMovPicking] [bit] NULL,
1551    [CDU_MTPalete] [nvarchar](50) NULL,
1552    [CDU_MTMMDADataStockLeitura] [datetime] NULL,
1553    [CDU_MTMMDAHoraStockLeitura] [nvarchar](8) NULL,
1554    [CDU_MTMMDAIdLinhaLeitura] [nvarchar](38) NULL,
1555    [CDU_MTLinExcluidaExp] [bit] NULL,
1556    [CDU_MTLinExcluidaRec] [bit] NULL,
1557    [CDU_MTTipoMov] [nvarchar](3) NULL,
1558    [CDU_MWSQU] [float] NULL,
1559    [CDU_MWSNU] [float] NULL,
1560    [CDU_Valor] [float] NULL,
1561    [CDU_TokenD] [varchar](20) NULL,
1562    [CDU_TokenE] [varchar](20) NULL
1563 ) ON [PRIMARY]
1564 GO
1565 SET ANSI_NULLS ON
1566 GO
1567 SET QUOTED_IDENTIFIER ON
1568 GO
1569 CREATE TABLE [dbo].[Suppliers](
1570    [Fornecedor] [nvarchar](12) NULL,
1571    [Nome] [nvarchar](50) NULL,
1572    [Morada] [nvarchar](50) NULL,
1573    [Local] [nvarchar](50) NULL,
1574    [Cp] [nvarchar](15) NULL,
1575    [CpLoc] [nvarchar](50) NULL,
1576    [Tel] [nvarchar](20) NULL,
1577    [Fax] [nvarchar](20) NULL,
1578    [Desconto] [real] NULL,
1579    [PrazoEnt] [nvarchar](3) NULL,
1580    [TotalDeb] [float] NULL,
1581    [LimiteCred] [float] NULL,
1582    [NumContrib] [nvarchar](20) NULL,
1583    [Pais] [nvarchar](2) NULL,
1584    [TipoFor] [nvarchar](1) NULL,
1585    [CondPag] [nvarchar](2) NULL,
1586    [ModoPag] [nvarchar](5) NULL,
1587    [Moeda] [nvarchar](3) NULL,
1588    [ModoExp] [nvarchar](2) NULL,
1589    [NumViasDoc] [smallint] NULL,
1590    [ExcluirRecap] [bit] NULL,
1591    [EnderecoWeb] [nvarchar](50) NULL,
1592    [DataCriacao] [datetime] NULL,
1593    [CriacaoAutomatica] [bit] NULL,
1594    [RubricaPagamentos] [nvarchar](35) NULL,
1595    [RubricaRecebimentos] [nvarchar](35) NULL,
1596    [TipoTerceiro] [nvarchar](3) NULL,
1597    [FornecedorAnulado] [bit] NULL,
1598    [RegimeEspecial] [bit] NULL,
1599    [ComprasNaoConvertidas] [float] NULL,
1600    [EncomendasPendentes] [float] NULL,
1601    [IntrastatFornecedor] [bit] NULL,
1602    [IntrastatPorto] [nvarchar](4) NULL,
1603    [DataUltimaActualizacao] [datetime] NULL,
1604    [Notas] [nvarchar](max) NULL,
1605    [EfectuaRetencao] [bit] NULL,
1606    [ValorRetencao] [float] NULL,
1607    [TextoExcepcaoRetencao] [nvarchar](100) NULL,
1608    [Idioma] [nvarchar](3) NULL,
1609    [UtilizaIdioma] [bit] NULL,
1610    [VersaoUltAct] [binary](8) NULL,
1611    [TipoRendimento] [nvarchar](5) NULL,
1612    [EfectuaOutrasRetencoes] [bit] NULL,
1613    [Morada1] [nvarchar](50) NULL,
1614    [LimiteCredValor] [bit] NULL,
```

```
    [LimiteCredIdade] [bit] NULL,
    [LimiteIdadeSaldo] [int] NULL,
    [LimiteValorSaldo] [float] NULL,
    [IdGDOC] [uniqueidentifier] NULL,
    [PosCustosBalSoc] [tinyint] NULL,
    [B2BTrataTrans] [bit] NULL,
    [B2BUtilArtigosParceiro] [bit] NULL,
    [B2BEnvioNaGravacao] [bit] NULL,
    [B2BEnderecoMail] [nvarchar](100) NULL,
    [B2BCertificado] [nvarchar](250) NULL,
    [LocalOperacao] [varchar](2) NULL,
    [Descricao] [varchar](50) NULL,
    [Distrito] [varchar](2) NULL,
    [GestaoDiasPag] [bit] NULL,
    [DiaPagamento1] [tinyint] NULL,
    [DiaPagamento2] [tinyint] NULL,
    [DiaPagamento3] [tinyint] NULL,
    [NumDiasRetrocesso] [tinyint] NULL,
    [PessoaSingular] [bit] NULL,
    [CodigoGLN] [varchar](13) NULL,
    [IDB2BFormato] [varchar](10) NULL,
    [B2BEnderecoEnvio] [varchar](250) NULL,
    [CDU_CampoVar1] [nvarchar](15) NULL,
    [CDU_CampoVar2] [nvarchar](15) NULL,
    [CDU_CampoVar3] [nvarchar](15) NULL,
    [ModoRec] [nvarchar](5) NULL,
    [B2BDocDownload] [bit] NULL,
    [Morada2] [nvarchar](50) NULL,
    [NomeFiscal] [nvarchar](50) NULL,
    [B2BArtigosParceiro] [nvarchar](12) NULL,
    [B2BUtilUnidadesParceiro] [bit] NULL,
    [B2BUnidadesParceiro] [nvarchar](12) NULL,
    [B2BIgnoraEnvioParceiro] [bit] NULL,
    [B2BEnvioParceiro] [nvarchar](12) NULL,
    [B2BIgnoraTransaccoes] [bit] NULL,
    [B2BTransaccoes] [nvarchar](130) NULL,
    [CodigoIEC] [nvarchar](15) NULL,
    [CodigoIsencaoIEC] [nvarchar](5) NULL,
    [IsentoIEC] [bit] NULL,
    [SegmentoTerceiro] [nvarchar](10) NULL,
    [RegimeIvaReembolsos] [smallint] NULL,
    [CambioADataDoc] [bit] NULL,
    [ContribuinteNaoResidente] [nvarchar](20) NULL,
    [CDU_IgnoraElemFin] [bit] NULL,
    [CDU_AplicaDescComercIntegracao] [bit] NULL,
    [AutoFacturacao] [bit] NULL,
    [SubUtilizadorAT] [varchar](50) NULL,
    [SenhaSubUtilizadorAT] [varchar](200) NULL,
    [Matricula] [varchar](50) NULL,
    [Conservatoria] [varchar](50) NULL,
    [CapitalSocial] [float] NULL,
    [TratalvaCaixa] [bit] NULL,
    [CDU_IgnoraDescArtB2B] [bit] NULL,
    [CDU_GLNFornecedor] [varchar](13) NULL,
    [VersaoCloud] [int] NULL,
    [ActualizacaoCloud] [nvarchar](30) NULL,
    [ActualizacaoERP] [nvarchar](30) NULL,
    [ActividadeEmpresarial] [bit] NULL,
    [CDU_AnaliseINTRAGrupo] [bit] NULL,
    [CDU_idbackoffice] [nvarchar](50) NULL,
    [CDU_FormatoEmail] [nvarchar](10) NULL,
    [eGAR_Isenta] [bit] NULL,
    [eGAR_TipoProdutor] [varchar](3) NULL,
    [eGAR_CodigoAPA] [varchar](15) NULL,
    [eGAR_NumPGL] [varchar](50) NULL,
    [TipoRemetente] [nvarchar](25) NULL,
    [CodigoLocal] [nvarchar](20) NULL,
```

```
1682    [CDU_PercDifPreco] [float] NULL,
1683    [CDU_NaoValidaPrecosTrans] [bit] NULL,
1684    [CDU_MWSRecSubCriaTRA] [varchar](5) NULL,
1685    [CDU_MWSRecSubDocTRA] [varchar](5) NULL,
1686    [CDU_MWSRecSubSerieTRA] [varchar](5) NULL,
1687    [CDU_MWSRecSubArmTRA] [varchar](5) NULL,
1688    [CDU_MWSRecSubLocTRA] [varchar](30) NULL
1689 ) ON [PRIMARY] TEXTIMAGE_ON [PRIMARY]
1690 GO
1691 SET ANSI_NULLS ON
1692 GO
1693 SET QUOTED_IDENTIFIER ON
1694 GO
1695 CREATE TABLE [dbo].[Warehouses](
1696    [Armazem] [nvarchar](5) NULL,
1697    [Descricao] [nvarchar](20) NULL,
1698    [Morada] [nvarchar](50) NULL,
1699    [Localidade] [nvarchar](50) NULL,
1700    [Cp] [nvarchar](15) NULL,
1701    [CpLocalidade] [nvarchar](50) NULL,
1702    [Telefone] [nvarchar](20) NULL,
1703    [Fax] [nvarchar](20) NULL,
1704    [DataUltimaActualizacao] [datetime] NULL,
1705    [VersaoUltAct] [binary](8) NULL,
1706    [BloqueioEntradas] [bit] NULL,
1707    [BloqueioSaidas] [bit] NULL,
1708    [ExcluiCNGPR] [bit] NULL,
1709    [Pais] [nvarchar](2) NULL,
1710    [Morada2] [nvarchar](50) NULL,
1711    [Distrito] [varchar](2) NULL,
1712    [CDU_TrataEstatisticas] [bit] NULL,
1713    [CDU_ReservaAuto] [bit] NULL,
1714    [eGAR_CodigoAPA] [varchar](15) NULL,
1715    [eGAR_TipoRemetente] [nvarchar](25) NULL,
1716    [eGAR_NumPGL] [varchar](50) NULL,
1717    [eGAR_TipoProdutor] [varchar](3) NULL,
1718    [TrataIEC] [bit] NULL,
1719    [TipoOperadorIEC] [tinyint] NULL,
1720    [NumOperadorIEC] [nvarchar](15) NULL,
1721    [EntrepostoFiscalIEC] [nvarchar](20) NULL
1722 ) ON [PRIMARY]
1723 GO
1724 USE [master]
1725 GO
1726 ALTER DATABASE [ODCOPY] SET  READ_WRITE
1727 GO
1728
1729
```

Appendix B

Supervisor meetings

This Appendix logs the supervisor meeting related to the development of the Thesis.

B.1 Meeting 1

Table B.1: Meeting 1

Date	04/12/2018
Participants	Dr. Paulo Oliveira Eduardo Silva
Subject	Thesis formalisation and related discussion.
Duration	60 minutes

B.2 Meeting 2

Table B.2: Meeting 2

Date	28/01/2019
Participants	Dr. Paulo Oliveira Eduardo Silva
Subject	Discuss issues related to the P1 delivery.
Duration	45 minutes

B.3 Meeting 3

Table B.3: Meeting 3

Date	08/05/2019
Participants	Dr. Paulo Oliveira Eduardo Silva
Subject	Discussion of design details and dimensional model for solution implementation.
Duration	85 minutes

B.4 Meeting 4

Table B.4: Meeting 4

Date	19/06/2019
Participants	Dr. Paulo Oliveira Eduardo Silva
Subject	Presentation of functional model. Clarification of key points regarding the implementation phase.
Duration	90 minutes

B.5 Meeting 5

Table B.5: Meeting 5

Date	29/07/2019
Participants	Dr. Paulo Oliveira Eduardo Silva
Subject	Validation of the ETL process regarding the use of the IS and Cube deployment using AS. Also demonstration of some Dashboards in PowerBI.
Duration	110 minutes

Appendix C

Auxiliary Excel Files

This Appendix illustrates the auxiliary files used in the project in the form of Excel or CSV.

C.1 Stores and Types of Business

Table C.1: Stores and types of Business

area_negocio	Loja	ano	empresa	documento	serie
B2C	Arrábida Shopping	2019	CN	VCA	
B2C	Espaço Guimarães	2019	CN	AEG	
B2C	Espaço Guimarães	2019	CN	CEG	2019
reparacoesCN	Espaço Guimarães	2019	CN	CEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	CEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	CEG	
B2C	Espaço Guimarães	2019	CN	EEG	
B2C	Espaço Guimarães	2019	CN	EFEG	
B2C	Espaço Guimarães	2019	CN	FEG	2019
reparacoesCN	Espaço Guimarães	2019	CN	FEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	FEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	FEG	
B2C	Espaço Guimarães	2019	CN	GEG	
B2C	Espaço Guimarães	2019	CN	MEG	
B2C	Espaço Guimarães	2019	CN	OEG	
B2C	Espaço Guimarães	2019	CN	PEG	
B2C	Espaço Guimarães	2019	CN	REG	
B2C	Espaço Guimarães	2019	CN	VCEG	
B2C	Espaço Guimarães	2019	CN	VEG	2019
reparacoesCN	Espaço Guimarães	2019	CN	VEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	VEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	VEG	
B2C	Espaço Guimarães	2019	CN	VFEG	
B2C	Espaço Guimarães	2019	CN	YEG	
B2C	Espaço Guimarães	2019	CN	ZEG	2019
reparacoesCN	Espaço Guimarães	2019	CN	ZEG	TEC19
reparacoesCN	Espaço Guimarães	2019	CN	ZEG	TEC19
B2C	Espaço Guimarães	2019	CN	ZEG	
B2C	Fórum Coimbra	2019	CN	AFC	
B2C	Fórum Coimbra	2019	CN	CFC	2019
reparacoesCN	Fórum Coimbra	2019	CN	CFC	TEC19
reparacoesCN	Fórum Coimbra	2019	CN	CFC	TEC19

reparacoesCN	Fórum Coimbra	2019	CN	CFC	
B2C	Fórum Coimbra	2019	CN	EFC	
B2C	Fórum Coimbra	2019	CN	EFG	
B2C	Fórum Coimbra	2019	CN	FFC	2019
reparacoesCN	Fórum Coimbra	2019	CN	FFC	TEC19
reparacoesCN	Fórum Coimbra	2019	CN	FFC	TEC19
reparacoesCN	Fórum Coimbra	2019	CN	FFC	
B2C	Fórum Coimbra	2019	CN	GFC	
B2C	Fórum Coimbra	2019	CN	MFC	
B2C	Fórum Coimbra	2019	CN	OFC	
B2C	Fórum Coimbra	2019	CN	PFC	
B2C	Fórum Coimbra	2019	CN	RFC	
B2C	Fórum Coimbra	2019	CN	TFC	
B2C	Fórum Coimbra	2019	CN	VCC	
B2C	Fórum Coimbra	2019	CN	VFC	2019
reparacoesCN	Fórum Coimbra	2019	CN	VFC	TEC19
reparacoesCN	Fórum Coimbra	2019	CN	VFC	TEC19
reparacoesCN	Fórum Coimbra	2019	CN	VFC	
B2C	Fórum Coimbra	2019	CN	VGRC	
B2C	Fórum Coimbra	2019	CN	YFC	
B2C	Fórum Coimbra	2019	CN	ZFC	2019
reparacoesCN	Fórum Coimbra	2019	CN	ZFC	TEC19
reparacoesCN	Fórum Coimbra	2019	CN	ZFC	TEC19
B2C	Fórum Coimbra	2019	CN	ZFC	
B2C	CN-4	2019	CN	VCF	
B2C	CN-4	2019	CN	VFF	
B2C	Gaia Shopping	2019	CN	AGS	
B2C	Gaia Shopping	2019	CN	CGS	2019
reparacoesCN	Gaia Shopping	2019	CN	CGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	CGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	CGS	
B2C	Gaia Shopping	2019	CN	EGS	
B2C	Gaia Shopping	2019	CN	FGS	2019
reparacoesCN	Gaia Shopping	2019	CN	FGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	FGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	FGS	
B2C	Gaia Shopping	2019	CN	GGS	
B2C	Gaia Shopping	2019	CN	MGS	
B2C	Gaia Shopping	2019	CN	OGS	
B2C	Gaia Shopping	2019	CN	PGS	
B2C	Gaia Shopping	2019	CN	RGS	
B2C	Gaia Shopping	2019	CN	VCG	
B2C	Gaia Shopping	2019	CN	VFG	
B2C	Gaia Shopping	2019	CN	VGRG	
B2C	Gaia Shopping	2019	CN	VGS	2019
reparacoesCN	Gaia Shopping	2019	CN	VGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	VGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	VGS	
B2C	Gaia Shopping	2019	CN	YGS	
B2C	Gaia Shopping	2019	CN	ZGS	2019
reparacoesCN	Gaia Shopping	2019	CN	ZGS	TEC19
reparacoesCN	Gaia Shopping	2019	CN	ZGS	TEC19
B2C	Gaia Shopping	2019	CN	ZGS	

B2B2C	Grupo	2019	CN	CGR	BBC19
corporate	Grupo	2019	CN	CGR	COR19
distribuicao	Grupo	2019	CN	CGR	DI19
exportacao	Grupo	2019	CN	CGR	EI19
Rebates	Grupo	2019	CN	CGR	FOP19
Intra-Grupo	Grupo	2019	CN	CGR	GR19
Intra-Grupo	Grupo	2019	CN	CGR	GR19
Rebates	Grupo	2019	CN	CGR	APP19
Rebates	Grupo	2019	CN	CGR	OF19
Rebates	Grupo	2019	CN	CGR	OP19
parceiros	Grupo	2019	CN	CGR	PAR19
projetos	Grupo	2019	CN	CGR	PRO19
retalho	Grupo	2019	CN	CGR	RE19
sistemas	Grupo	2019	CN	CGR	SIS19
Grupo	Grupo	2019	CN	DGR	
B2B2C	Grupo	2019	CN	FGR	BBC19
corporate	Grupo	2019	CN	FGR	COR19
distribuicao	Grupo	2019	CN	FGR	DI19
exportacao	Grupo	2019	CN	FGR	EI19
Rebates	Grupo	2019	CN	FGR	FOP19
Intra-Grupo	Grupo	2019	CN	FGR	GR19
Intra-Grupo	Grupo	2019	CN	FGR	GR19
Rebates	Grupo	2019	CN	FGR	APP19
Rebates	Grupo	2019	CN	FGR	OF19
Rebates	Grupo	2019	CN	FGR	OP19
parceiros	Grupo	2019	CN	FGR	PAR19
projetos	Grupo	2019	CN	FGR	PRO19
retalho	Grupo	2019	CN	FGR	RE19
sistemas	Grupo	2019	CN	FGR	SIS19
B2C	Madeira Shopping	2019	CN	AMS	
B2C	Madeira Shopping	2019	CN	CMS	2019
reparacoesCN	Madeira Shopping	2019	CN	CMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	CMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	CMS	
B2C	Madeira Shopping	2019	CN	EFM	
B2C	Madeira Shopping	2019	CN	EMS	
B2C	Madeira Shopping	2019	CN	FMS	2019
reparacoesCN	Madeira Shopping	2019	CN	FMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	FMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	FMS	
B2C	Madeira Shopping	2019	CN	GMS	
B2C	Madeira Shopping	2019	CN	MMS	
B2C	Madeira Shopping	2019	CN	OMS	
B2C	Madeira Shopping	2019	CN	PMS	
B2C	Madeira Shopping	2019	CN	RMS	
B2C	Madeira Shopping	2019	CN	VCM	
B2C	Madeira Shopping	2019	CN	VFM	
B2C	Madeira Shopping	2019	CN	VGRM	
B2C	Madeira Shopping	2019	CN	VMS	2019
reparacoesCN	Madeira Shopping	2019	CN	VMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	VMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	VMS	
B2C	Madeira Shopping	2019	CN	YMS	

B2C	Madeira Shopping	2019	CN	ZMS	2019
reparacoesCN	Madeira Shopping	2019	CN	ZMS	TEC19
reparacoesCN	Madeira Shopping	2019	CN	ZMS	TEC19
B2C	Marketplace	2019	CN	AMKP	
lojaonlineCN	Marketplace	2019	CN	CMKP	
B2C	Marketplace	2019	CN	EMKP	
lojaonlineCN	Marketplace	2019	CN	FMKP	
lojaonlineCN	Marketplace	2019	CN	VMKP	
lojaonlineCN	Marketplace	2019	CN	YMKP	
B2C	Norte Shopping	2019	CN	ANS	
B2C	Norte Shopping	2019	CN	CNS	2019
reparacoesCN	Norte Shopping	2019	CN	CNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	CNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	CNS	
B2C	Norte Shopping	2019	CN	EFN	
B2C	Norte Shopping	2019	CN	ENS	
B2C	Norte Shopping	2019	CN	FNS	2019
reparacoesCN	Norte Shopping	2019	CN	FNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	FNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	FNS	
B2C	Norte Shopping	2019	CN	GNS	
B2C	Norte Shopping	2019	CN	MNS	
B2C	Norte Shopping	2019	CN	ONS	
B2C	Norte Shopping	2019	CN	PNS	
B2C	Norte Shopping	2019	CN	RNS	
B2C	Norte Shopping	2019	CN	TNS	
B2C	Norte Shopping	2019	CN	VCN	
B2C	Norte Shopping	2019	CN	VFN	
B2C	Norte Shopping	2019	CN	VGRN	
B2C	Norte Shopping	2019	CN	VNS	2019
reparacoesCN	Norte Shopping	2019	CN	VNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	VNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	VNS	
B2C	Norte Shopping	2019	CN	YNS	
B2C	Norte Shopping	2019	CN	ZNS	2019
reparacoesCN	Norte Shopping	2019	CN	ZNS	TEC19
reparacoesCN	Norte Shopping	2019	CN	ZNS	TEC19
B2C	Oeiras Parque	2019	CN	AOP	
B2C	Oeiras Parque	2019	CN	COP	2019
reparacoesCN	Oeiras Parque	2019	CN	COP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	COP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	COP	
B2C	Oeiras Parque	2019	CN	EFO	
B2C	Oeiras Parque	2019	CN	EOP	
B2C	Oeiras Parque	2019	CN	FOP	2019
reparacoesCN	Oeiras Parque	2019	CN	FOP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	FOP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	FOP	
B2C	Oeiras Parque	2019	CN	GOP	
B2C	Oeiras Parque	2019	CN	OOP	
B2C	Oeiras Parque	2019	CN	POP	
B2C	Oeiras Parque	2019	CN	ROP	
B2C	Oeiras Parque	2019	CN	VCO	

B2C	Oeiras Parque	2019	CN	VFO	
B2C	Oeiras Parque	2019	CN	VGRO	
B2C	Oeiras Parque	2019	CN	VOP	2019
reparacoesCN	Oeiras Parque	2019	CN	VOP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	VOP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	VOP	
B2C	Oeiras Parque	2019	CN	YOP	
B2C	Oeiras Parque	2019	CN	ZOP	2019
reparacoesCN	Oeiras Parque	2019	CN	ZOP	TEC19
reparacoesCN	Oeiras Parque	2019	CN	ZOP	TEC19
lojaonlineCN	Online	2019	CN	AIS	
lojaonlineCN	Online	2019	CN	CIS	2019
lojaonlineCN	Online	2019	CN	CIS	
lojaonlineCN	Online	2019	CN	EIS	
lojaonlineCN	Online	2019	CN	FIS	2019
lojaonlineCN	Online	2019	CN	FIS	
lojaonlineCN	Online	2019	CN	GIS	
lojaonlineCN	Online	2019	CN	PIS	
lojaonlineCN	Online	2019	CN	RIS	
lojaonlineCN	Online	2019	CN	VCI	
exportacao	Online	2019	CN	VCIC	
exportacao	Online	2019	CN	VCOM	
lojaonlineCN	Online	2019	CN	VFI	
exportacao	Online	2019	CN	VFIC	
exportacao	Online	2019	CN	VFOM	
lojaonlineCN	Online	2019	CN	VIS	2019
lojaonlineCN	Online	2019	CN	VIS	
lojaonlineCN	Online	2019	CN	YIS	
lojaonlineCN	Online	2019	CN	ZIS	2019
Outros	Outros	2019	CN	ACM	
Outros	Outros	2019	CN	ADD	
Outros	Outros	2019	CN	CAS	
reparacoesCN	Outros	2019	CN	CFD	
Outros	Outros	2019	CN	CS	
Outros	Outros	2019	CN	DPS	
Outros	Outros	2019	CN	EAS	
Outros	Outros	2019	CN	EFD	
Outros	Outros	2019	CN	FAD	
Outros	Outros	2019	CN	FAS	
Outros	Outros	2019	CN	FFD	
Outros	Outros	2019	CN	FR	
Outros	Outros	2019	CN	FS	
Outros	Outros	2019	CN	G99	
Outros	Outros	2019	CN	GPPS	
Outros	Outros	2019	CN	GX1	
Outros	Outros	2019	CN	MFD	
Outros	Outros	2019	CN	MOS	
Outros	Outros	2019	CN	NCDES	
Outros	Outros	2019	CN	NCPS	
Outros	Outros	2019	CN	NGD	
Outros	Outros	2019	CN	NGDF	
Outros	Outros	2019	CN	NVAL	
Outros	Outros	2019	CN	OAS	

Outros	Outros	2019	CN	OFD	
Outros	Outros	2019	CN	PAS	
Outros	Outros	2019	CN	PFD	
Outros	Outros	2019	CN	RAS	
Outros	Outros	2019	CN	RFD	
Outros	Outros	2019	CN	T02	
Outros	Outros	2019	CN	TAS	
Outros	Outros	2019	CN	TFD	
Outros	Outros	2019	CN	VAL	
Outros	Outros	2019	CN	VAS	
Outros	Outros	2019	CN	VCR	
Outros	Outros	2019	CN	VCRO	
Outros	Outros	2019	CN	VFA	
reparacoesCN	Outros	2019	CN	VFD	
Outros	Outros	2019	CN	VGT	
Outros	Outros	2019	CN	ZT2	
B2C	Parque Nascente	2019	CN	APN	
B2C	Parque Nascente	2019	CN	CPN	2019
reparacoesCN	Parque Nascente	2019	CN	CPN	TEC19
reparacoesCN	Parque Nascente	2019	CN	CPN	TEC19
reparacoesCN	Parque Nascente	2019	CN	CPN	
B2C	Parque Nascente	2019	CN	EFPN	
B2C	Parque Nascente	2019	CN	EPN	
B2C	Parque Nascente	2019	CN	FPN	2019
reparacoesCN	Parque Nascente	2019	CN	FPN	TEC19
reparacoesCN	Parque Nascente	2019	CN	FPN	TEC19
reparacoesCN	Parque Nascente	2019	CN	FPN	
B2C	Parque Nascente	2019	CN	GPN	
B2C	Parque Nascente	2019	CN	MPN	
B2C	Parque Nascente	2019	CN	OPN	
B2C	Parque Nascente	2019	CN	PPN	
B2C	Parque Nascente	2019	CN	RPN	
B2C	Parque Nascente	2019	CN	VCPN	
B2C	Parque Nascente	2019	CN	VFPN	
B2C	Parque Nascente	2019	CN	VPN	2019
reparacoesCN	Parque Nascente	2019	CN	VPN	TEC19
reparacoesCN	Parque Nascente	2019	CN	VPN	TEC19
B2C	Parque Nascente	2019	CN	VPN	
B2C	Parque Nascente	2019	CN	YPN	
B2C	Parque Nascente	2019	CN	ZPN	2019
reparacoesCN	Parque Nascente	2019	CN	ZPN	TEC19
reparacoesCN	Parque Nascente	2019	CN	ZPN	TEC19
B2C		2019	CN-2	C03	2019
reparacoeslojasCN-2		2019	CN-2	C03	TEC19
reparacoeslojasCN-2		2019	CN-2	C03	TEC19
B2C		2019	CN-2	C05	2019
reparacoeslojasCN-2		2019	CN-2	C05	TEC19
reparacoeslojasCN-2		2019	CN-2	C05	TEC19

lojaonlineCN-2	2019	CN-2	C13	2019
B2C	2019	CN-2	C16	2019
reparacoeslojasCN-2	2019	CN-2	C16	TEC19
reparacoeslojasCN-2	2019	CN-2	C16	TEC19
B2B2C	2019	CN-2	C19	BBC19
corporate	2019	CN-2	C19	COR19
distribuicao	2019	CN-2	C19	DI19
exportacao	2019	CN-2	C19	EI19
Rebates	2019	CN-2	C19	FOP19
Intra-Grupo	2019	CN-2	C19	GR19
reparacoesCN	2019	CN-2	C19	GR19
Rebates	2019	CN-2	C19	APP19
Rebates	2019	CN-2	C19	OF19
Rebates	2019	CN-2	C19	OP19
parceiros	2019	CN-2	C19	PAR19
projetos	2019	CN-2	C19	PRO19
retalho	2019	CN-2	C19	RE19
sistemas	2019	CN-2	C19	SIS19
exportacao	2019	CN-2	CI1	2019
exportacao	2019	CN-3	CI1	2019
exportacao	2019	CN-2	CO1	2019
exportacao	2019	CN-3	CO1	2019
B2C	2019	CN-2	F03	2019
reparacoeslojasCN-2	2019	CN-2	F03	TEC19
reparacoeslojasCN-2	2019	CN-2	F03	TEC19
B2C	2019	CN-2	F05	2019
reparacoeslojasCN-2	2019	CN-2	F05	TEC19
reparacoeslojasCN-2	2019	CN-2	F05	TEC19
lojaonlineCN-2	2019	CN-2	F13	2019
B2C	2019	CN-2	F16	2019
reparacoeslojasCN-2	2019	CN-2	F16	TEC19
reparacoeslojasCN-2	2019	CN-2	F16	TEC19
B2B2C	2019	CN-2	F19	BBC19
corporate	2019	CN-2	F19	COR19
distribuicao	2019	CN-2	F19	DI19
exportacao	2019	CN-2	F19	EI19
Rebates	2019	CN-2	F19	FOP19
Intra-Grupo	2019	CN-2	F19	GR19
reparacoesCN	2019	CN-2	F19	GR19
Rebates	2019	CN-2	F19	APP19
Rebates	2019	CN-2	F19	OF19
Rebates	2019	CN-2	F19	OP19
parceiros	2019	CN-2	F19	PAR19

projetos	2019	CN-2	F19	PRO19
retalho	2019	CN-2	F19	RE19
sistemas	2019	CN-2	F19	SIS19
B2B2C	2019	CN-3	FA1	BBC19
corporate	2019	CN-3	FA1	COR19
distribuicao	2019	CN-3	FA1	DI19
Rebates	2019	CN-3	FA1	AP19
Rebates	2019	CN-3	FA1	FOP19
Rebates	2019	CN-3	FA1	APP19
Rebates	2019	CN-3	FA1	OF19
Rebates	2019	CN-3	FA1	OP19
parceiros	2019	CN-3	FA1	PAR19
projetos	2019	CN-3	FA1	PRO19
retalho	2019	CN-3	FA1	RE19
sistemas	2019	CN-3	FA1	SIS19
Intra-Grupo	2019	CN-3	FA2	2019
Intra-Grupo	2019	CN-3	FA2	2019
exportacao	2019	CN-2	FI1	2019
exportacao	2019	CN-3	FI1	2019
exportacao	2019	CN-2	FO1	2019
exportacao	2019	CN-3	FO1	2019
corporate	2019	CN-2	GPE	2019
corporate	2019	CN-2	GPS	2019
Outros	2019	CN-3	NC1	BBC19
corporate	2019	CN-3	NC1	COR19
distribuicao	2019	CN-3	NC1	DI19
Rebates	2019	CN-3	NC1	AP19
Rebates	2019	CN-3	NC1	FOP19
Rebates	2019	CN-3	NC1	APP19
Rebates	2019	CN-3	NC1	OF19
Rebates	2019	CN-3	NC1	OP19
parceiros	2019	CN-3	NC1	PAR19
projetos	2019	CN-3	NC1	PRO19
retalho	2019	CN-3	NC1	RE19
sistemas	2019	CN-3	NC1	SIS19
Intra-Grupo	2019	CN-3	NC2	2019
Intra-Grupo	2019	CN-3	NC2	2019
B2C	2019	CN-2	V03	2019
reparacoeslojasCN-2	2019	CN-2	V03	TEC19
reparacoeslojasCN-2	2019	CN-2	V03	TEC19
B2C	2019	CN-2	V05	2019
reparacoeslojasCN-2	2019	CN-2	V05	TEC19
reparacoeslojasCN-2	2019	CN-2	V05	TEC19
lojaonlineCN-2	2019	CN-2	V13	2019
B2C	2019	CN-2	V16	2019
reparacoeslojasCN-2	2019	CN-2	V16	TEC19

reparacoeslojasCN-2	2019	CN-2	V16	TEC19
B2B2C	2019	CN-2	V19	BBC19
corporate	2019	CN-2	V19	COR19
distribuicao	2019	CN-2	V19	DI19
Intra-Grupo	2019	CN-2	V19	GR19
reparacoesCN	2019	CN-2	V19	GR19
parceiros	2019	CN-2	V19	PAR19
projetos	2019	CN-2	V19	PRO19
retalho	2019	CN-2	V19	RE19
sistemas	2019	CN-2	V19	SIS19
B2B2C	2019	CN-3	VD1	BBC19
corporate	2019	CN-3	VD1	COR19
distribuicao	2019	CN-3	VD1	DI19
parceiros	2019	CN-3	VD1	PAR19
projetos	2019	CN-3	VD1	PRO19
retalho	2019	CN-3	VD1	RE19
sistemas	2019	CN-3	VD1	SIS19
B2C	2019	CN-2	Z03	2019
reparacoeslojasCN-2	2019	CN-2	Z03	TEC19
reparacoeslojasCN-2	2019	CN-2	Z03	TEC19
B2C	2019	CN-2	Z05	2019
reparacoeslojasCN-2	2019	CN-2	Z05	TEC19
reparacoeslojasCN-2	2019	CN-2	Z05	TEC19
lojaonlineCN-2	2019	CN-2	Z13	2019
B2C	2019	CN-2	Z16	2019
reparacoeslojasCN-2	2019	CN-2	Z16	TEC19
reparacoeslojasCN-2	2019	CN-2	Z16	TEC19
B2B2C	2019	CN-2	Z19	BBC19
corporate	2019	CN-2	Z19	COR19
distribuicao	2019	CN-2	Z19	DI19
Intra-Grupo	2019	CN-2	Z19	GR19
reparacoesCN	2019	CN-2	Z19	GR19
parceiros	2019	CN-2	Z19	PAR19
projetos	2019	CN-2	Z19	PRO19
retalho	2019	CN-2	Z19	RE19
sistemas	2019	CN-2	Z19	SIS19
B2B2C	2019	CN-3	ZD1	BBC19
corporate	2019	CN-3	ZD1	COR19
distribuicao	2019	CN-3	ZD1	DI19
parceiros	2019	CN-3	ZD1	PAR19
projetos	2019	CN-3	ZD1	PRO19
retalho	2019	CN-3	ZD1	RE19
sistemas	2019	CN-3	ZD1	SIS19

C.2 Stores Localisations

Table C.2: Store-Localisations

Armazem	Localizacao	Localidade	Descricao	Loja
AS	AS	Arrábida	Arrábida Shopping	Arrábida Shopping
IAS	IAS	Arrábida	Imo ArrabidaShopping	Arrábida Shopping
TAS	TAS	Arrábida	Trânsito Arrábida Sh	Arrábida Shopping
EFC	EFC	Coimbra	Exposicão Forum Coim	Fórum Coimbra
AFC	AFC	Coimbra	Forum Coimbra	Fórum Coimbra
FC	FC	Coimbra	Forum Coimbra	Fórum Coimbra
IFC	IFC	Coimbra	Imo Forum Coimbra	Fórum Coimbra
ILFC	ILFC	Coimbra	Laboratório Forum C	Fórum Coimbra
SFC	SFC	Coimbra	Service APPLE ForumC	Fórum Coimbra
SPAFC	SPAFC	Coimbra	Service APPLE ForumC	Fórum Coimbra
TFC	TFC	Coimbra	Trânsito Forum Coimb	Fórum Coimbra
AEG	AEG	Guimarães	Espaço Guimarães	Espaço Guimarães
EEG	EEG	Guimarães	Exposição E.Guimarãe	Espaço Guimarães
IEG	IEG	Guimarães	Imo E.Guimarães	Espaço Guimarães
ILEG	ILEG	Guimarães	Laboratório E.Guimar	Espaço Guimarães
SEG	SEG	Guimarães	Service E.Guimarães	Espaço Guimarães
TEG	TEG	Guimarães	Trânsito E.Guimarães	Espaço Guimarães
EMS	EMS	Madeira	Exposição Madeira Sh	Madeira Shopping
IMS	IMS	Madeira	Imo Madeira Shopping	Madeira Shopping
ILMS	ILMS	Madeira	Laboratório Madeira	Madeira Shopping
AMS	AMS	Madeira	Madeira Shopping	Madeira Shopping
MS	MS	Madeira	Madeira Shopping	Madeira Shopping
SMS	SMS	Madeira	Service APPLE MadS	Madeira Shopping
SPAMS	SPAMS	Madeira	Service APPLE MadS	Madeira Shopping
TMS	TMS	Madeira	Trânsito Madeira Sh	Madeira Shopping
ENS	ENS	Matosinhos	Exposição Norte Shop	Norte Shopping
INS	INS	Matosinhos	Imo Norte Shopping	Norte Shopping
ILNS	ILNS	Matosinhos	Laboratório Norte Sh	Norte Shopping
ANS	ANS	Matosinhos	Norte Shopping	Norte Shopping
NS	NS	Matosinhos	Norte Shopping	Norte Shopping
ANST	ANST	Matosinhos	Norte Shopping Temp.	Norte Shopping
SNS	SNS	Matosinhos	Service APPLE NorteS	Norte Shopping
SPANS	SPANS	Matosinhos	Service APPLE NorteS	Norte Shopping
TNS	TNS	Matosinhos	Trânsito Norte Shopp	Norte Shopping
EOP	EOP	Oeiras	Exposição Oeiras P	Oeiras Parque
IOP	IOP	Oeiras	Imo Oeiras Parque	Oeiras Parque
ILOP	ILOP	Oeiras	Laboratório Oeiras P	Oeiras Parque
AOP	AOP	Oeiras	Oeiras Parque	Oeiras Parque
SOP	SOP	Oeiras	Service APPLE Oeiras	Oeiras Parque
TOP	TOP	Oeiras	Trânsito Oeiras P	Oeiras Parque
PAMO	PAMO	Perafita	Amostras	Sede
PDEV	PDEV	Perafita	Armazem Devoluçoes	Sede
PCR	SER	Perafita	Creditos a receber	Sede
PCR	TD	Perafita	Creditos a receber	Sede
PCR	PCR	Perafita	Creditos a receber	Sede
AFD	AFD	Perafita	CN-4	Sede
FD	FD	Perafita	CN-4	Sede
AG	AG	Perafita	grossista	Sede

IFD	IFD	Perafita	Imo CN-4	Sede
IIS	IIS	Perafita	Imo CN online	Sede
AIS	AIS	Perafita	CN online	Sede
IS	IS	Perafita	CN online	Sede
PCN-2	PCN-2	Perafita	Pendentes CN-2	Sede
PSUPR	PSUPR	Perafita	Pendentes Suprides	Sede
RMA	RMA	Perafita	RMA	Sede
RMAE	RMAE	Perafita	RMA fora garantia	Sede
TIS	TIS	Perafita	Trânsi CN online	Sede
TFD	TFD	Perafita	Trânsito CN-4	Sede
EPN	EPN	Rio Tinto	Exposição P.Nascent	Parque Nascente
IPN	IPN	Rio Tinto	Imo P.Nascente	Parque Nascente
ILPN	ILPN	Rio Tinto	Laboratório P.Nascen	Parque Nascente
APN	APN	Rio Tinto	Parque Nascente	Parque Nascente
SPN	SPN	Rio Tinto	Service P.Nascente	Parque Nascente
TPN	TPN	Rio Tinto	Trânsito P.Nascente	Parque Nascente
EGS	EGS	Vila Nova de Gaia	Exposição Gaia Shopp	Gaia Shopping
AGS	AGS	Vila Nova de Gaia	Gaia Shopping	Gaia Shopping
GS	GS	Vila Nova de Gaia	Gaia Shopping	Gaia Shopping
IGS	IGS	Vila Nova de Gaia	Imo Gaia Shopping	Gaia Shopping
ILGS	ILGS	Vila Nova de Gaia	Laboratório Gaia Sh	Gaia Shopping
SGS	SGS	Vila Nova de Gaia	Service APPLE GaiaS	Gaia Shopping
SPAGS	SPAGS	Vila Nova de Gaia	Service APPLE GaiaS	Gaia Shopping
TGS	TGS	Vila Nova de Gaia	Trânsito Gaia Shopp	Gaia Shopping

C.3 Null Analysis

Table C.3: Null Analysis

TableName	ColumnName	ColumnPosition	NullCount	NonNullCount	Total	% non null
SaleRows	Formula	21	3665156	0	3665156	0,00%
SaleRows	IntrastatRegiao	32	3665156	0	3665156	0,00%
SaleRows	ContaCBL	45	3665156	0	3665156	0,00%
SaleRows	CCustoCBL	46	3665156	0	3665156	0,00%
SaleRows	AnaliticaCBL	47	3665156	0	3665156	0,00%
SaleRows	FuncionalCBL	48	3665156	0	3665156	0,00%
SaleRows	OrganicaCBL	49	3665156	0	3665156	0,00%
SaleRows	ContaOrcamCBL	50	3665156	0	3665156	0,00%
SaleRows	ObraID	51	3665156	0	3665156	0,00%
SaleRows	ClasseID	52	3665156	0	3665156	0,00%
SaleRows	SubEmpID	53	3665156	0	3665156	0,00%
SaleRows	CategoriaID	54	3665156	0	3665156	0,00%
SaleRows	IdLinhaPai	60	3665156	0	3665156	0,00%
SaleRows	TipoAuto	75	3665156	0	3665156	0,00%
SaleRows	AutoID	76	3665156	0	3665156	0,00%
SaleRows	IDB2BLinhaOrig	77	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar4	85	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar5	86	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar1ENC	87	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar2ENC	88	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar3ENC	89	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar4ENC	90	3665156	0	3665156	0,00%
SaleRows	CDU_LinVar5ENC	91	3665156	0	3665156	0,00%
SaleRows	IntrastatPaisOrigem	92	3665156	0	3665156	0,00%
SaleRows	ItemId	101	3665156	0	3665156	0,00%
SaleRows	ItemCod	102	3665156	0	3665156	0,00%
SaleRows	ItemDesc	103	3665156	0	3665156	0,00%
SaleRows	CDU_UnidadeAlternativa	105	3665156	0	3665156	0,00%
SaleRows	WBSItem	108	3665156	0	3665156	0,00%
SaleRows	AlternativaGPR	109	3665156	0	3665156	0,00%
SaleRows	Selo	123	3665156	0	3665156	0,00%
SaleRows	CDU_MTLocalizacao	128	3665156	0	3665156	0,00%
SaleRows	CDU_MTIdLinhaOrig	130	3665156	0	3665156	0,00%
SaleRows	ContratoID	131	3665156	0	3665156	0,00%

Table C.3 continued from previous page

SaleRows	ProcessoID	134	3665156	0	3665156	0,00%
SaleRows	CDU_CopiaArtigo	137	3665156	0	3665156	0,00%
SaleRows	CDU_ArtSubstituido	140	3665156	0	3665156	0,00%
SaleRows	CDU_PickingNS_Data	146	3665156	0	3665156	0,00%
PurchaseRows	Formula	22	644847	0	644847	0,00%
PurchaseRows	IntrastatRegiao	31	644847	0	644847	0,00%
PurchaseRows	CCustoCBL	45	644847	0	644847	0,00%
PurchaseRows	ContaCBL	47	644847	0	644847	0,00%
PurchaseRows	AnaliticaCBL	48	644847	0	644847	0,00%
PurchaseRows	FuncionalCBL	49	644847	0	644847	0,00%
PurchaseRows	OrganicaCBL	50	644847	0	644847	0,00%
PurchaseRows	ContaOrcamCBL	51	644847	0	644847	0,00%
PurchaseRows	ObraID	52	644847	0	644847	0,00%
PurchaseRows	ClasseID	53	644847	0	644847	0,00%
PurchaseRows	SubEmpID	54	644847	0	644847	0,00%
PurchaseRows	CategoriaID	55	644847	0	644847	0,00%
PurchaseRows	IdLinhaPai	61	644847	0	644847	0,00%
PurchaseRows	IdLinhaReqInterna	72	644847	0	644847	0,00%
PurchaseRows	TipoAuto	73	644847	0	644847	0,00%
PurchaseRows	AutoID	74	644847	0	644847	0,00%
PurchaseRows	IDB2BLinhaOrig	75	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar4	83	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar5	84	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar1ENC	85	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar2ENC	86	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar3ENC	87	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar4ENC	88	644847	0	644847	0,00%
PurchaseRows	CDU_LinVar5ENC	89	644847	0	644847	0,00%
PurchaseRows	IdHistorico	94	644847	0	644847	0,00%
PurchaseRows	EstadoPendente	95	644847	0	644847	0,00%
PurchaseRows	ItemId	100	644847	0	644847	0,00%
PurchaseRows	ItemCod	101	644847	0	644847	0,00%
PurchaseRows	ItemDesc	102	644847	0	644847	0,00%
PurchaseRows	CDU_UnidadeAlternativa	105	644847	0	644847	0,00%
PurchaseRows	WBSItem	108	644847	0	644847	0,00%
PurchaseRows	MoedaDocOrig	112	644847	0	644847	0,00%
PurchaseRows	EstadoAdi	120	644847	0	644847	0,00%
PurchaseRows	CDU_MTLocalizacao	122	644847	0	644847	0,00%
PurchaseRows	CDU_MTIdLinhaOrig	124	644847	0	644847	0,00%
PurchaseRows	ProcessoID	125	644847	0	644847	0,00%
PurchaseRows	ContratoID	128	644847	0	644847	0,00%
PurchaseRows	CodigoPautal	130	644847	0	644847	0,00%
PurchaseRows	CDU_LoteFornecedor	134	644847	0	644847	0,00%
SaleHeaders	IntrastatNatA	32	520774	0	520774	0,00%
SaleHeaders	IntrastatNatB	33	520774	0	520774	0,00%
SaleHeaders	IntrastatCondEnt	34	520774	0	520774	0,00%
SaleHeaders	IntrastatModoTransp	35	520774	0	520774	0,00%
SaleHeaders	IntrastatPorto	36	520774	0	520774	0,00%
SaleHeaders	Posto	48	520774	0	520774	0,00%
SaleHeaders	DocsOriginais	49	520774	0	520774	0,00%
SaleHeaders	IdCabecTesouraria	58	520774	0	520774	0,00%
SaleHeaders	FluxoDocumental	63	520774	0	520774	0,00%
SaleHeaders	IdGDOC	65	520774	0	520774	0,00%
SaleHeaders	ObraID	66	520774	0	520774	0,00%
SaleHeaders	IdDocB2B	68	520774	0	520774	0,00%
SaleHeaders	IDDiarioCaixa	74	520774	0	520774	0,00%
SaleHeaders	Origem	86	520774	0	520774	0,00%
SaleHeaders	IDAvenca	89	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar1	93	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar2	94	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar3	95	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar4	96	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar5	97	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar1ENC	98	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar2ENC	99	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar3ENC	100	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar4ENC	101	520774	0	520774	0,00%
SaleHeaders	CDU_CabVar5ENC	102	520774	0	520774	0,00%
SaleHeaders	IntrastatRegEstatistico	103	520774	0	520774	0,00%
SaleHeaders	IdOportunidade	127	520774	0	520774	0,00%
SaleHeaders	NumProposta	128	520774	0	520774	0,00%
SaleHeaders	RefDocOrig	130	520774	0	520774	0,00%
SaleHeaders	WBSItem	143	520774	0	520774	0,00%
SaleHeaders	CDU_CodigoLocalizacao	150	520774	0	520774	0,00%
SaleHeaders	CDU_MTIDInterno	152	520774	0	520774	0,00%
SaleHeaders	CDU_IdCabecDest	158	520774	0	520774	0,00%
SaleHeaders	CDU_TipoDocDest	159	520774	0	520774	0,00%
SaleHeaders	CDU_SerieDest	160	520774	0	520774	0,00%
SaleHeaders	CDU_NumDocDest	161	520774	0	520774	0,00%
SaleHeaders	CDU_TipoEntidadeDest	162	520774	0	520774	0,00%
SaleHeaders	CDU_EntidadeDest	163	520774	0	520774	0,00%
SaleHeaders	CDU_CodEmpDest	164	520774	0	520774	0,00%

Table C.3 continued from previous page

SaleHeaders	ContratoID	165	520774	0	520774	0,00%
SaleHeaders	RefTipoDocOrig	167	520774	0	520774	0,00%
SaleHeaders	RefSerieDocOrig	168	520774	0	520774	0,00%
SaleHeaders	CertificadoRecuperacao	170	520774	0	520774	0,00%
SaleHeaders	CDU_DocCobrancaCTT	172	520774	0	520774	0,00%
SaleHeaders	CDU_TituloCTT	178	520774	0	520774	0,00%
SaleHeaders	CDU_MTPACCBAR	181	520774	0	520774	0,00%
SaleHeaders	TipoFiscal	191	520774	0	520774	0,00%
SaleHeaders	CDU_MTDocGerado	192	520774	0	520774	0,00%
SaleHeaders	CDU_ValeProcessado	195	520774	0	520774	0,00%
SaleHeaders	CDU_DocumentoAnterior	197	520774	0	520774	0,00%
SaleHeaders	CDU_CataloguePurpose	200	520774	0	520774	0,00%
SaleHeaders	CDU_CodFornecedor	201	520774	0	520774	0,00%
SaleHeaders	CDU_DataMaximaEntrega	202	520774	0	520774	0,00%
SaleHeaders	CDU_RefFacturaOrig	203	520774	0	520774	0,00%
SaleHeaders	CDU_RefGuiaRemessa	204	520774	0	520774	0,00%
SaleHeaders	CDU_TTE_DataAlteracao	206	520774	0	520774	0,00%
SaleHeaders	CDU_TTE_NumeroAlteracao	207	520774	0	520774	0,00%
SaleHeaders	CDU_MWSDocPortes	210	520774	0	520774	0,00%
PurchaseHeaders	Requisicao	24	82674	0	82674	0,00%
PurchaseHeaders	IntrastatNatA	28	82674	0	82674	0,00%
PurchaseHeaders	IntrastatNatB	29	82674	0	82674	0,00%
PurchaseHeaders	IntrastatCondEnt	30	82674	0	82674	0,00%
PurchaseHeaders	IntrastatModoTransp	31	82674	0	82674	0,00%
PurchaseHeaders	IntrastatPorto	32	82674	0	82674	0,00%
PurchaseHeaders	Posto	43	82674	0	82674	0,00%
PurchaseHeaders	DocsOriginais	44	82674	0	82674	0,00%
PurchaseHeaders	Matricula	54	82674	0	82674	0,00%
PurchaseHeaders	IdCabecTesouraria	58	82674	0	82674	0,00%
PurchaseHeaders	Responsavel	60	82674	0	82674	0,00%
PurchaseHeaders	Referencia	61	82674	0	82674	0,00%
PurchaseHeaders	FluxoDocumental	62	82674	0	82674	0,00%
PurchaseHeaders	IdGDOC	64	82674	0	82674	0,00%
PurchaseHeaders	IdDocConferencia	65	82674	0	82674	0,00%
PurchaseHeaders	ObraID	66	82674	0	82674	0,00%
PurchaseHeaders	IdDocB2B	68	82674	0	82674	0,00%
PurchaseHeaders	DE_IL	70	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar1	89	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar2	90	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar3	91	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar4	92	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar5	93	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar1ENC	94	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar2ENC	95	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar3ENC	96	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar4ENC	97	82674	0	82674	0,00%
PurchaseHeaders	CDU_CabVar5ENC	98	82674	0	82674	0,00%
PurchaseHeaders	IntrastatRegEstatistico	99	82674	0	82674	0,00%
PurchaseHeaders	RefDocOrig	110	82674	0	82674	0,00%
PurchaseHeaders	WBSItem	124	82674	0	82674	0,00%
PurchaseHeaders	IDRegularizacao	129	82674	0	82674	0,00%
PurchaseHeaders	CDU_CodigoLocalizacao	131	82674	0	82674	0,00%
PurchaseHeaders	ContratoID	141	82674	0	82674	0,00%
PurchaseHeaders	RefTipoDocOrig	142	82674	0	82674	0,00%
PurchaseHeaders	RefSerieDocOrig	143	82674	0	82674	0,00%
PurchaseHeaders	CertificadoRecuperacao	145	82674	0	82674	0,00%
PurchaseHeaders	CDU_MTPACCBAR	151	82674	0	82674	0,00%
PurchaseHeaders	TipoFiscal	152	82674	0	82674	0,00%
PurchaseHeaders	CDU_MTDocGerado	153	82674	0	82674	0,00%
PurchaseHeaders	CDU_CodFornecedor	155	82674	0	82674	0,00%
PurchaseHeaders	CDU_DataMaximaEntrega	156	82674	0	82674	0,00%
Suppliers	TipoTerceiro	9	63	0	63	0,00%
SaleHeaders	DE_IL	71	520773	1	520774	0,00%
SaleHeaders	CDU_idDocStkPS	179	520773	1	520774	0,00%
PurchaseRows	CDU_PickingNS_Data	136	644845	2	644847	0,00%
PurchaseHeaders	MoradaAltEntrega	20	82673	1	82674	0,00%
PurchaseHeaders	CDU_IDDocStkCusto	157	82673	1	82674	0,00%
SaleHeaders	Grupo	85	520767	7	520774	0,00%
SaleRows	TipoOperacao	104	3665093	63	3665156	0,00%
SaleHeaders	ContaDomiciliacao	90	520764	10	520774	0,00%
SaleHeaders	TipoOperacao	55	520757	17	520774	0,00%
SaleHeaders	CDU_NomePessoaCTT	173	520757	17	520774	0,00%
PurchaseHeaders	IdCabecEstorno	67	82671	3	82674	0,00%
PurchaseRows	MotivoEstorno	92	644817	30	644847	0,00%
PurchaseRows	IDLinhaEstorno	93	644817	30	644847	0,00%
SaleRows	CDU_MTMMDAIdLinhaLeitura	129	3664631	525	3665156	0,01%
SaleHeaders	MoradaAltEntrega	15	520670	104	520774	0,02%
SaleHeaders	Matricula	26	520657	117	520774	0,02%
SaleHeaders	CDU_MTTerminal	151	520638	136	520774	0,03%
PurchaseHeaders	CDU_idDocStkPS	150	82652	22	82674	0,03%
SaleRows	CDU_IdVoucher	136	3663802	1354	3665156	0,04%
SaleHeaders	CDU_Voucher	190	520577	197	520774	0,04%

Table C.3 continued from previous page

SaleHeaders	CDU_MWSExportadoTranp	208	520570	204	520774	0,04%
SaleHeaders	CDU_MWSOrig	211	520559	215	520774	0,04%
PurchaseStatus	MotivoAnulacao	12	82639	35	82674	0,04%
PurchaseStatus	DataAnulacao	13	82639	35	82674	0,04%
PurchaseStatus	UtilizadorAnulacao	14	82639	35	82674	0,04%
PurchaseStatus	ATDocCodeID	11	82601	73	82674	0,09%
PurchaseHeaders	ModoExp	11	82574	100	82674	0,12%
PurchaseHeaders	IdDocOrigem	114	82566	108	82674	0,13%
PurchaseHeaders	ModuloOrigem	115	82566	108	82674	0,13%
PurchaseHeaders	CDU_MTTerminal	132	82525	149	82674	0,18%
PurchaseRows	CDU_LinVar3	82	643585	1262	644847	0,20%
SaleHeaders	IdCabecEstorno	67	519477	1297	520774	0,25%
SaleRows	EstadoPendente	96	3655257	9899	3665156	0,27%
PurchaseHeaders	Certificado	111	82445	229	82674	0,28%
PurchaseHeaders	VersaoAssinatura	112	82445	229	82674	0,28%
PurchaseHeaders	Assinatura	113	82445	229	82674	0,28%
SaleRows	IdHistorico	41	3654616	10540	3665156	0,29%
SaleRows	EstadoAdi	121	3654616	10540	3665156	0,29%
SaleRows	MoedaDocOrig	113	3654603	10553	3665156	0,29%
SaleHeaders	CDU_DataHoraExpedir	182	519092	1682	520774	0,32%
PurchaseHeaders	NomeEntrega	76	82379	295	82674	0,36%
SaleRows	MotivoEstorno	94	3651576	13580	3665156	0,37%
SaleRows	IDLinhaEstorno	95	3651462	13694	3665156	0,37%
SaleHeaders	CDU_IdECLONL	185	518165	2609	520774	0,50%
SaleHeaders	CDU_SerieECLONL	187	518165	2609	520774	0,50%
SaleHeaders	CDU_TipoDocECLONL	188	518165	2609	520774	0,50%
SaleHeaders	CDU_MTIdPendente	189	517184	3590	520774	0,69%
SaleStatus	MotivoAnulacao	15	516910	3864	520774	0,74%
SaleStatus	DataAnulacao	16	516816	3958	520774	0,76%
SaleStatus	UtilizadorAnulacao	17	516816	3958	520774	0,76%
SaleHeaders	NomeEntrega	77	516784	3990	520774	0,77%
PurchaseHeaders	TipoOperacao	86	81959	715	82674	0,86%
SaleHeaders	CDU_SMSCTT	180	515012	5762	520774	1,11%
SaleHeaders	CDU_PesoVolumesCTT	175	515006	5768	520774	1,11%
SaleHeaders	CDU_NrVolumesCTT	174	514898	5876	520774	1,13%
PurchaseRows	TipoOperacao	103	637184	7663	644847	1,19%
SaleHeaders	CDU_ServicoCTT	177	514252	6522	520774	1,25%
PurchaseStatus	EstadoIEC	9	81628	1046	82674	1,27%
SaleRows	CDU_LinVar3	84	3612062	53094	3665156	1,45%
PurchaseRows	CodIvaIEC	96	635494	9353	644847	1,45%
SaleHeaders	ModoExp	12	513175	7599	520774	1,46%
SaleStatus	EstadoIEC	11	512846	7928	520774	1,52%
SaleHeaders	HoraDescarga	25	510773	10001	520774	1,92%
SaleHeaders	CDU_SabadoCTT	176	510550	10224	520774	1,96%
SaleHeaders	IDRegularizacao	148	510417	10357	520774	1,99%
SaleHeaders	Zona	2	510264	10510	520774	2,02%
SaleRows	IdLinhaOrigemCopia	62	3590947	74209	3665156	2,02%
PurchaseRows	IdLinhaOrigemCopia	63	630981	13866	644847	2,15%
PurchaseRows	ModuloOrigemCopia	62	630905	13942	644847	2,16%
SaleRows	ModuloOrigemCopia	61	3567777	97379	3665156	2,66%
SaleRows	IntrastatPautal	30	3564934	100222	3665156	2,73%
SaleRows	CDU_LinVar2	83	3542406	122750	3665156	3,35%
PurchaseHeaders	DistritoCarga	122	79883	2791	82674	3,38%
PurchaseRows	IntrastatPautal	29	619379	25468	644847	3,95%
SaleHeaders	Requisicao	20	500074	20700	520774	3,97%
SaleRows	CDU_LinVar1	82	3515627	149529	3665156	4,08%
SaleRows	CodIvaIEC	97	3506103	159053	3665156	4,34%
SaleHeaders	Observacoes	50	496606	24168	520774	4,64%
PurchaseHeaders	Morada2Carga	118	78593	4081	82674	4,94%
SaleHeaders	Referencia	62	494925	25849	520774	4,96%
PurchaseRows	IntrastatPaisOrigem	90	611372	33475	644847	5,19%
PurchaseRows	CDU_PickingNS_Flag	135	609908	34939	644847	5,42%
SaleHeaders	IdDocOrigem	132	490140	30634	520774	5,88%
SaleHeaders	ModuloOrigem	133	490140	30634	520774	5,88%
PurchaseRows	CDU_LinVar2	81	606463	38384	644847	5,95%
SaleStatus	ATDocCodeID	14	488969	31805	520774	6,11%
PurchaseHeaders	Distrito	87	77413	5261	82674	6,36%
PurchaseRows	CodIvaEcotaxa	77	603627	41220	644847	6,39%
SaleRows	CDU_UltFornecedor	139	3405042	260114	3665156	7,10%
SaleRows	CDU_PickingNS_Flag	145	3399172	265984	3665156	7,26%
SaleRows	CodIvaEcotaxa	79	3385497	279659	3665156	7,63%
SaleHeaders	DistritoCarga	140	479243	41531	520774	7,97%
PurchaseRows	CDU_LinVar1	80	588479	56368	644847	8,74%
PurchaseHeaders	ContaDomiciliacao	85	75400	7274	82674	8,80%
PurchaseHeaders	CDU_IdCabecDest	133	74022	8652	82674	10,47%
PurchaseHeaders	CDU_TipoDocDest	134	74022	8652	82674	10,47%
PurchaseHeaders	CDU_SerieDest	135	74022	8652	82674	10,47%
PurchaseHeaders	CDU_NumDocDest	136	74022	8652	82674	10,47%
PurchaseHeaders	CDU_TipoEntidadeDest	137	74022	8652	82674	10,47%
PurchaseHeaders	CDU_EntidadeDest	138	74022	8652	82674	10,47%
PurchaseHeaders	CDU_CodEmpDest	139	74022	8652	82674	10,47%
PurchaseRows	CDU_MWSQU	132	571046	73801	644847	11,44%

Table C.3 continued from previous page

PurchaseRows	CDU_MWSNU	133	571046	73801	644847	11,44%
SaleHeaders	DistritoEntrega	92	457200	63574	520774	12,21%
SaleHeaders	Morada2Carga	136	455768	65006	520774	12,48%
SaleHeaders	Distrito	91	448612	72162	520774	13,86%
SaleHeaders	DistritoFac	115	448327	72447	520774	13,91%
SaleHeaders	CDU_MWSTotalDocumento	209	447730	73044	520774	14,03%
PurchaseStatus	DataImp	10	70518	12156	82674	14,70%
SaleHeaders	DataDescarga	54	441216	79558	520774	15,28%
SaleRows	CDU_preco_depreciado	144	3093292	571864	3665156	15,60%
PurchaseHeaders	Morada2	100	69673	13001	82674	15,73%
SaleRows	CDU_MWSQU	142	3057634	607522	3665156	16,58%
SaleRows	CDU_MWSNU	143	3057634	607522	3665156	16,58%
PurchaseHeaders	HoraDescarga	51	65686	16988	82674	20,55%
Products	UltimoFornecedor	20	63849	16816	80665	20,85%
PurchaseRows	CDU_MTMMDAIdLinhaLeitura	123	504577	140270	644847	21,75%
SaleHeaders	CDU_TTE_OrdemAlteracao	205	403582	117192	520774	22,50%
SaleRows	CDU_QtdBonus	141	2778908	886248	3665156	24,18%
SaleHeaders	CDU_PRAZOPREVISTO	199	390380	130394	520774	25,04%
PurchaseRows	CDU_QtdBonus	131	474290	170557	644847	26,45%
SaleRows	Vendedor	29	2655406	1009750	3665156	27,55%
SaleHeaders	CDU_MTImpressoAgrupado	194	369086	151688	520774	29,13%
SaleRows	CDU_CopiaValor	138	2566998	1098158	3665156	29,96%
SaleHeaders	CDU_ValidadeVale_Dias	196	363881	156893	520774	30,13%
SaleHeaders	RespCobranca	40	363102	157672	520774	30,28%
SaleHeaders	Responsavel	61	363102	157672	520774	30,28%
PurchaseHeaders	DistritoEntrega	88	52444	30230	82674	36,57%
PurchaseHeaders	Observacoes	45	51709	30965	82674	37,45%
PurchaseHeaders	CDU_MTTranspQTDV	146	51430	31244	82674	37,79%
PurchaseHeaders	CDU_MTTranspPesoVol	147	51430	31244	82674	37,79%
PurchaseHeaders	CDU_MTTranspPesoPal	148	51430	31244	82674	37,79%
PurchaseHeaders	CDU_MTTranspQTDPal	149	51430	31244	82674	37,79%
SaleHeaders	CDU_MTDisponivelConferencia	193	321686	199088	520774	38,23%
PurchaseHeaders	DataDescarga	53	50555	32119	82674	38,85%
SaleStatus	ExportadoSAFTAuditoria	19	308229	212545	520774	40,81%
SaleHeaders	Morada2Entrega	124	300148	220626	520774	42,37%
SaleHeaders	CDU_NumDocECLONL	186	296215	224559	520774	43,12%
SaleHeaders	CDU_Prioridade	184	290271	230503	520774	44,26%
SaleHeaders	CDU_Expedir	183	289870	230904	520774	44,34%
PurchaseRows	DataEntrega	39	350082	294765	644847	45,71%
PurchaseHeaders	Morada2Entrega	107	43364	39310	82674	47,55%
SaleHeaders	Morada2	104	272713	248061	520774	47,63%
SaleHeaders	Morada2Fac	110	272639	248135	520774	47,65%
PurchaseRows	CDU_MTLinExcluidaRec	121	329679	315168	644847	48,87%
SaleRows	CDU_CentroCusto	135	1813568	1851588	3665156	50,52%
SaleHeaders	CDU_Exportado	157	249409	271365	520774	52,11%
SaleHeaders	CDU_MTTranspQTDV	153	243305	277469	520774	53,28%
SaleHeaders	CDU_MTTranspPesoVol	154	243305	277469	520774	53,28%
SaleHeaders	CDU_MTTranspPesoPal	155	243305	277469	520774	53,28%
SaleHeaders	CDU_MTTranspQTDPal	156	243305	277469	520774	53,28%
Warehouses	Localidade	3	33	39	72	54,17%
SaleHeaders	CodPostalLocalidadeEntrega	81	237193	283581	520774	54,45%
SaleHeaders	LocalidadeEntrega	79	220047	300727	520774	57,75%
SaleHeaders	MoradaEntrega	78	219594	301180	520774	57,83%
SaleHeaders	LocalidadeCodigoPostalFac	113	218806	301968	520774	57,98%
SaleHeaders	CodPostalLocalidade	46	218625	302149	520774	58,02%
SaleHeaders	CodPostalEntrega	80	216001	304773	520774	58,52%
SaleRows	CDU_MTLinExcluidaExp	127	1517062	2148094	3665156	58,61%
PurchaseHeaders	CDU_MTDisponivelConferencia	154	34043	48631	82674	58,82%
Warehouses	CpLocalidade	4	29	43	72	59,72%
SaleHeaders	LocalidadeFac	111	208271	312503	520774	60,01%
SaleHeaders	Localidade	44	207910	312864	520774	60,08%
SaleRows	CDU_MTEstado	126	1453495	2211661	3665156	60,34%
PurchaseHeaders	IdCabecMovCbl	81	32376	50298	82674	60,84%
PurchaseHeaders	Diario	33	32173	50501	82674	61,08%
Sales	CodPostalLocalidade	23	254616	401796	656412	61,21%
SaleHeaders	CodPostal	45	199739	321035	520774	61,65%
SaleHeaders	CodigoPostalFac	112	199315	321459	520774	61,73%
Sales	Localidade	22	243065	413347	656412	62,97%
PurchaseStatus	ExportadoSAFTAuditoria	17	29745	52929	82674	64,02%
SaleHeaders	MoradaFac	109	183623	337151	520774	64,74%
SaleHeaders	Morada	43	182121	338653	520774	65,03%
Clients	Fac_Mor	3	53753	102577	156330	65,62%
PurchaseRows	CDU_QuantidadeAlternativa	106	184211	460636	644847	71,43%
PurchaseRows	CDU_FactorConversaoAlternativa	107	184211	460636	644847	71,43%
SaleHeaders	IdCabecMovCbl	82	132146	388628	520774	74,63%
SaleHeaders	Diario	37	132081	388693	520774	74,64%
Clients	Fac_Local	4	39191	117139	156330	74,93%
Clients	Fac_Cploc	5	39190	117140	156330	74,93%
StockAtual	Seccao	11	1560548	5406016	6966564	77,60%
Stock	Seccao	11	780343	2704159	3484502	77,61%
SaleRows	Armazem	15	790012	2875144	3665156	78,45%
SaleRows	Localizacao	59	789802	2875354	3665156	78,45%

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SaleRows	Artigo	2	775845	2889311	3665156	78,83%
SaleRows	Arred	42	775845	2889311	3665156	78,83%
SaleRows	Unidade	39	775838	2889318	3665156	78,83%
SaleRows	MovSTK	16	775516	2889640	3665156	78,84%
SaleRows	CodIva	7	754229	2910927	3665156	79,42%
PurchaseHeaders	Utilizador	42	14892	67782	82674	81,99%
PurchaseRows	Armazem	14	101902	542945	644847	84,20%
PurchaseRows	Localizacao	60	101902	542945	644847	84,20%
SaleHeaders	B2BEnvioNaGravacao	145	75605	445169	520774	85,48%
SaleHeaders	Resumo	147	75605	445169	520774	85,48%
PurchaseRows	Unidade	38	93224	551623	644847	85,54%
PurchaseRows	MovSTK	18	93203	551644	644847	85,55%
PurchaseRows	Artigo	3	93190	551657	644847	85,55%
PurchaseRows	Arred	40	93190	551657	644847	85,55%
PurchaseRows	CodIva	8	92062	552785	644847	85,72%
SaleRows	Descricao	34	485752	3179404	3665156	86,75%
SaleRows	CambioDocOrig	114	472025	3193131	3665156	87,12%
SaleRows	CambioMBaseDocOrig	115	472025	3193131	3665156	87,12%
SaleRows	CambioMAltDocOrig	116	472025	3193131	3665156	87,12%
SaleRows	DifCambioMAlt	117	472025	3193131	3665156	87,12%
SaleRows	DifCambioMBase	118	472025	3193131	3665156	87,12%
SaleRows	DifArredondamentoMAlt	119	472025	3193131	3665156	87,12%
SaleRows	DifArredondamentoMBase	120	472025	3193131	3665156	87,12%
SaleRows	Ano	122	472025	3193131	3665156	87,12%
SaleHeaders	Assinatura	120	66127	454647	520774	87,30%
SaleHeaders	VersaoAssinatura	121	65214	455560	520774	87,48%
SaleHeaders	Certificado	131	65167	455607	520774	87,49%
SaleHeaders	LocalidadeCarga	137	63912	456862	520774	87,73%
PurchaseHeaders	HoraCarga	49	9215	73459	82674	88,85%
PurchaseRows	CambioDocOrig	113	71065	573782	644847	88,98%
PurchaseRows	CambioMBaseDocOrig	114	71065	573782	644847	88,98%
PurchaseRows	CambioMAltDocOrig	115	71065	573782	644847	88,98%
PurchaseRows	DifCambioMAlt	116	71065	573782	644847	88,98%
PurchaseRows	DifCambioMBase	117	71065	573782	644847	88,98%
PurchaseRows	DifArredondamentoMAlt	118	71065	573782	644847	88,98%
PurchaseRows	DifArredondamentoMBase	119	71065	573782	644847	88,98%
SaleRows	CDU_QuantidadeAlternativa	106	395401	3269755	3665156	89,21%
SaleRows	CDU_FactorConversaoAlternativa	107	395401	3269755	3665156	89,21%
StockAtual	Artigo	5	739151	6227413	6966564	89,39%
StockAtual	Armazem	12	739145	6227419	6966564	89,39%
StockAtual	Localizacao	35	739145	6227419	6966564	89,39%
Stock	Artigo	5	369673	3114829	3484502	89,39%
Stock	Armazem	12	369670	3114832	3484502	89,39%
Stock	Localizacao	35	369670	3114832	3484502	89,39%
SaleHeaders	PaisEntrega	134	55222	465552	520774	89,40%
SaleHeaders	NumContribuinte	41	55071	465703	520774	89,43%
SaleHeaders	CodPostalLocalidadeCarga	139	54927	465847	520774	89,45%
SaleHeaders	CodPostalCarga	138	53732	467042	520774	89,68%
SaleHeaders	MoradaCarga	135	52115	468659	520774	89,99%
PurchaseHeaders	DataCarga	52	8264	74410	82674	90,00%
SaleHeaders	NumContribuinteFac	114	51187	469587	520774	90,17%
SaleHeaders	PaisCarga	141	50932	469842	520774	90,22%
PurchaseRows	NumDocExterno	2	62909	581938	644847	90,24%
SaleHeaders	EntidadeEntrega	76	49762	471012	520774	90,44%
SaleHeaders	EntidadeDescarga	116	49762	471012	520774	90,44%
Suppliers	ModoPag	6	6	57	63	90,48%
SaleHeaders	TipoEntidadeEntrega	75	47893	472881	520774	90,80%
PurchaseHeaders	ModoPag	12	7358	75316	82674	91,10%
PurchaseHeaders	B2BEnvioNaGravacao	126	6599	76075	82674	92,02%
PurchaseHeaders	Resumo	128	6599	76075	82674	92,02%
PurchaseHeaders	LocalidadeCarga	119	6202	76472	82674	92,50%
SaleHeaders	Nome	42	38022	482752	520774	92,70%
SaleHeaders	NomeFac	108	37790	482984	520774	92,74%
PurchaseHeaders	NumDocExterno	9	5870	76804	82674	92,90%
Sales	Nome	21	45105	611307	656412	93,13%
PurchaseHeaders	LocalidadeEntrega	78	5396	77278	82674	93,47%
PurchaseHeaders	PaisEntrega	116	5077	77597	82674	93,86%
Products	SubFamilia	18	4947	75718	80665	93,87%
PurchaseRows	Descricao	33	39329	605518	644847	93,90%
PurchaseHeaders	CodPostalEntrega	79	4596	78078	82674	94,44%
PurchaseHeaders	CodPostalLocalidadeEntrega	80	4594	78080	82674	94,44%
PurchaseHeaders	MoradaEntrega	77	4503	78171	82674	94,55%
PurchaseHeaders	CodPostalCarga	120	4479	78195	82674	94,58%
PurchaseHeaders	MoradaCarga	117	4478	78196	82674	94,58%
PurchaseHeaders	CodPostalLocalidadeCarga	121	4478	78196	82674	94,58%
PurchaseHeaders	PaisCarga	123	4477	78197	82674	94,58%
PurchaseHeaders	EntidadeEntrega	75	4461	78213	82674	94,60%
PurchaseHeaders	TipoEntidadeEntrega	74	4415	78259	82674	94,66%
Products	Familia	8	4156	76509	80665	94,85%
SaleStatus	DataImp	12	26581	494193	520774	94,90%
Products	Marca	10	4022	76643	80665	95,01%
StockAtual	Descricao	25	337478	6629086	6966564	95,16%

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Stock	Descricao	25	168775	3315727	3484502	95,16%
Suppliers	CondPag	5	3	60	63	95,24%
PurchaseRows	AcertoIVA	104	23361	621486	644847	96,38%
SaleHeaders	HoraCarga	23	18493	502281	520774	96,45%
SaleHeaders	DataCarga	53	16663	504111	520774	96,80%
PurchaseHeaders	Localidade	39	2402	80272	82674	97,09%
Clients	NumContrib	6	4149	152181	156330	97,35%
PurchaseRows	RegimeIva	11	14127	630720	644847	97,81%
Clients	Pais	7	2942	153388	156330	98,12%
Suppliers	Local	3	1	62	63	98,41%
Suppliers	CpLoc	4	1	62	63	98,41%
Suppliers	Pais	7	1	62	63	98,41%
Products	DataUltSaida	6	1173	79492	80665	98,55%
SaleHeaders	Pais	129	5717	515057	520774	98,90%
SaleHeaders	PaisFac	125	5710	515064	520774	98,90%
SaleHeaders	ModoPag	13	4976	515798	520774	99,04%
SaleHeaders	CDU_ModoPagExpVendas	198	4976	515798	520774	99,04%
PurchaseHeaders	Pais	109	673	82001	82674	99,19%
Clients	DataCriacao	8	1102	155228	156330	99,30%
StockAtual	Unidade	28	47948	6918616	6966564	99,31%
Stock	Unidade	28	23975	3460527	3484502	99,31%
SaleHeaders	LocalOperacao	69	3145	517629	520774	99,40%
SaleRows	Lote	27	19608	3645548	3665156	99,47%
SaleHeaders	Utilizador	47	2029	518745	520774	99,61%
SaleHeaders	LocalDescarga	24	1871	518903	520774	99,64%
SaleHeaders	LocalCarga	22	1862	518912	520774	99,64%
Products	DataUltEntrada	5	164	80501	80665	99,80%
PurchaseHeaders	LocalCarga	48	90	82584	82674	99,89%
PurchaseHeaders	LocalDescarga	50	90	82584	82674	99,89%
PurchaseHeaders	CodPostal	40	82	82592	82674	99,90%
PurchaseHeaders	LocalOperacao	69	81	82593	82674	99,90%
PurchaseHeaders	Morada	38	80	82594	82674	99,90%
PurchaseHeaders	CodPostalLocalidade	41	79	82595	82674	99,90%
Sales	Descricao	11	531	655881	656412	99,92%
PurchaseRows	Lote	27	66	644781	644847	99,99%
Sales	Armazem	8	67	656345	656412	99,99%
Clients	TipoCli	10	12	156318	156330	99,99%
Clients	Nome	2	11	156319	156330	99,99%
Products	Descricao	7	4	80661	80665	100,00%
PurchaseHeaders	CAE	127	4	82670	82674	100,00%
Clients	Cliente	1	0	156330	156330	100,00%
Clients	DataUltimaActualizacao	9	0	156330	156330	100,00%
Products	Artigo	1	0	80665	80665	100,00%
Products	ArtigoAnulado	2	0	80665	80665	100,00%
Products	Iva	9	0	80665	80665	100,00%
Products	MovStock	11	0	80665	80665	100,00%
Products	PCMedio	12	0	80665	80665	100,00%
Products	PCUltimo	13	0	80665	80665	100,00%
Products	STKActual	14	0	80665	80665	100,00%
Products	STKMaximo	15	0	80665	80665	100,00%
Products	STKMinimo	16	0	80665	80665	100,00%
Products	STKReposicao	17	0	80665	80665	100,00%
Products	TipoArtigo	19	0	80665	80665	100,00%
ProductWarehouse	Artigo	1	0	91198	91198	100,00%
ProductWarehouse	Armazem	2	0	91198	91198	100,00%
ProductWarehouse	Lote	3	0	91198	91198	100,00%
ProductWarehouse	StkActual	4	0	91198	91198	100,00%
ProductWarehouse	Localizacao	5	0	91198	91198	100,00%
ProductWarehouse	QtReservada	6	0	91198	91198	100,00%
ProductWarehouse	UltimaContagem	7	0	91198	91198	100,00%
ProductWarehouse	PCMedio	8	0	91198	91198	100,00%
ProductWarehouse	PCUltimo	9	0	91198	91198	100,00%
ProductWarehouse	VersaoUltAct	10	0	91198	91198	100,00%
ProductWarehouse	Existencia	11	0	91198	91198	100,00%
ProductWarehouse	BloqueadoInventario	12	0	91198	91198	100,00%
ProductWarehouse	QtTransito	13	0	91198	91198	100,00%
PurchaseDocuments	Documento	1	0	52	52	100,00%
PurchaseDocuments	Descricao	2	0	52	52	100,00%
PurchaseDocuments	TipoDocumento	3	0	52	52	100,00%
PurchaseHeaders	Filial	1	0	82674	82674	100,00%
PurchaseHeaders	Serie	2	0	82674	82674	100,00%
PurchaseHeaders	TipoDoc	3	0	82674	82674	100,00%
PurchaseHeaders	NumDoc	4	0	82674	82674	100,00%
PurchaseHeaders	Entidade	5	0	82674	82674	100,00%
PurchaseHeaders	DataDoc	6	0	82674	82674	100,00%
PurchaseHeaders	DataVencimento	7	0	82674	82674	100,00%
PurchaseHeaders	DataIntroducao	8	0	82674	82674	100,00%
PurchaseHeaders	CondPag	10	0	82674	82674	100,00%
PurchaseHeaders	DescPag	13	0	82674	82674	100,00%
PurchaseHeaders	TotalMerc	14	0	82674	82674	100,00%
PurchaseHeaders	TotalIva	15	0	82674	82674	100,00%
PurchaseHeaders	TotalDesc	16	0	82674	82674	100,00%

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PurchaseHeaders	TotalOutros	17	0	82674	82674	100,00%
PurchaseHeaders	TotalDespesasAdicionais	18	0	82674	82674	100,00%
PurchaseHeaders	UtilizaMoradaAltEntrega	19	0	82674	82674	100,00%
PurchaseHeaders	RegimeIva	21	0	82674	82674	100,00%
PurchaseHeaders	Moeda	22	0	82674	82674	100,00%
PurchaseHeaders	Cambio	23	0	82674	82674	100,00%
PurchaseHeaders	MoedaDaUEM	25	0	82674	82674	100,00%
PurchaseHeaders	Arredondamento	26	0	82674	82674	100,00%
PurchaseHeaders	ArredondamentoIva	27	0	82674	82674	100,00%
PurchaseHeaders	NumDiario	34	0	82674	82674	100,00%
PurchaseHeaders	DataUltimaActualizacao	35	0	82674	82674	100,00%
PurchaseHeaders	NumContribuinte	36	0	82674	82674	100,00%
PurchaseHeaders	Nome	37	0	82674	82674	100,00%
PurchaseHeaders	PercentagemRetencao	46	0	82674	82674	100,00%
PurchaseHeaders	TotalRetencao	47	0	82674	82674	100,00%
PurchaseHeaders	VersaoUltAct	55	0	82674	82674	100,00%
PurchaseHeaders	Id	56	0	82674	82674	100,00%
PurchaseHeaders	TipoEntidade	57	0	82674	82674	100,00%
PurchaseHeaders	DescEntidade	59	0	82674	82674	100,00%
PurchaseHeaders	AnoCBL	63	0	82674	82674	100,00%
PurchaseHeaders	TotalEcotaxa	71	0	82674	82674	100,00%
PurchaseHeaders	CambioMBase	72	0	82674	82674	100,00%
PurchaseHeaders	CambioMAlt	73	0	82674	82674	100,00%
PurchaseHeaders	TotalRecargo	82	0	82674	82674	100,00%
PurchaseHeaders	TotalRetencaoGarantia	83	0	82674	82674	100,00%
PurchaseHeaders	Versao	84	0	82674	82674	100,00%
PurchaseHeaders	TipoLancamento	101	0	82674	82674	100,00%
PurchaseHeaders	TotalIEC	102	0	82674	82674	100,00%
PurchaseHeaders	DataGravacao	103	0	82674	82674	100,00%
PurchaseHeaders	PendentePorLinha	104	0	82674	82674	100,00%
PurchaseHeaders	RegimeIvaReembolsos	105	0	82674	82674	100,00%
PurchaseHeaders	EspacoFiscal	106	0	82674	82674	100,00%
PurchaseHeaders	CambioADataDoc	108	0	82674	82674	100,00%
PurchaseHeaders	B2BTrataTrans	125	0	82674	82674	100,00%
PurchaseHeaders	TrataIvaCaixa	130	0	82674	82674	100,00%
PurchaseHeaders	Documento	140	0	82674	82674	100,00%
PurchaseHeaders	TotalDocumento	144	0	82674	82674	100,00%
PurchaseRows	NumLinha	1	0	644847	644847	100,00%
PurchaseRows	Desconto1	4	0	644847	644847	100,00%
PurchaseRows	Desconto2	5	0	644847	644847	100,00%
PurchaseRows	Desconto3	6	0	644847	644847	100,00%
PurchaseRows	TaxaIva	7	0	644847	644847	100,00%
PurchaseRows	Quantidade	9	0	644847	644847	100,00%
PurchaseRows	PrecUnit	10	0	644847	644847	100,00%
PurchaseRows	DataDoc	12	0	644847	644847	100,00%
PurchaseRows	TipoLinha	13	0	644847	644847	100,00%
PurchaseRows	DataEntrada	15	0	644847	644847	100,00%
PurchaseRows	CustoAdicionalManual	16	0	644847	644847	100,00%
PurchaseRows	CustoAdicionalRateio	17	0	644847	644847	100,00%
PurchaseRows	FactorConv	19	0	644847	644847	100,00%
PurchaseRows	NumLinhaSTKGerada	20	0	644847	644847	100,00%
PurchaseRows	DescontoComercial	21	0	644847	644847	100,00%
PurchaseRows	VariavelA	23	0	644847	644847	100,00%
PurchaseRows	VariavelB	24	0	644847	644847	100,00%
PurchaseRows	VariavelC	25	0	644847	644847	100,00%
PurchaseRows	QntFormula	26	0	644847	644847	100,00%
PurchaseRows	PrecoLiquido	28	0	644847	644847	100,00%
PurchaseRows	IntrastatMassaLiq	30	0	644847	644847	100,00%
PurchaseRows	IntrastatValorLiq	32	0	644847	644847	100,00%
PurchaseRows	SujeitoRetencao	34	0	644847	644847	100,00%
PurchaseRows	VersaoUltAct	35	0	644847	644847	100,00%
PurchaseRows	IdCabecCompras	36	0	644847	644847	100,00%
PurchaseRows	Id	37	0	644847	644847	100,00%
PurchaseRows	DifPreco	41	0	644847	644847	100,00%
PurchaseRows	DifDesc	42	0	644847	644847	100,00%
PurchaseRows	DifIVA	43	0	644847	644847	100,00%
PurchaseRows	Conferido	44	0	644847	644847	100,00%
PurchaseRows	DescValor	46	0	644847	644847	100,00%
PurchaseRows	PercIvaDedutivel	56	0	644847	644847	100,00%
PurchaseRows	TaxaProRata	57	0	644847	644847	100,00%
PurchaseRows	IvaNaoDedutivel	58	0	644847	644847	100,00%
PurchaseRows	Ecotaxa	59	0	644847	644847	100,00%
PurchaseRows	TaxaRecargo	64	0	644847	644847	100,00%
PurchaseRows	PercIncidenciaIVA	65	0	644847	644847	100,00%
PurchaseRows	TotalIliquido	66	0	644847	644847	100,00%
PurchaseRows	TotalDA	67	0	644847	644847	100,00%
PurchaseRows	TotalDC	68	0	644847	644847	100,00%
PurchaseRows	TotalDF	69	0	644847	644847	100,00%
PurchaseRows	TotalRecargo	70	0	644847	644847	100,00%
PurchaseRows	TotalIva	71	0	644847	644847	100,00%
PurchaseRows	B2BNumLinhaOrig	76	0	644847	644847	100,00%
PurchaseRows	TaxaIvaEcotaxa	78	0	644847	644847	100,00%

Table C.3 continued from previous page

PurchaseRows	TotalEcotaxa	79	0	644847	644847	100,00%
PurchaseRows	IvaRegraCalculo	91	0	644847	644847	100,00%
PurchaseRows	TaxaIvaIEC	97	0	644847	644847	100,00%
PurchaseRows	TotalIEC	98	0	644847	644847	100,00%
PurchaseRows	ValorIEC	99	0	644847	644847	100,00%
PurchaseRows	BaseIncidencia	109	0	644847	644847	100,00%
PurchaseRows	BaseCalculoIncidencia	110	0	644847	644847	100,00%
PurchaseRows	RegraCalculoIncidencia	111	0	644847	644847	100,00%
PurchaseRows	ValorLiquidoDesconto	126	0	644847	644847	100,00%
PurchaseRows	IvaValorDesconto	127	0	644847	644847	100,00%
PurchaseRows	IsentoPagDireitos	129	0	644847	644847	100,00%
PurchaseStatus	IdCabecCompras	1	0	82674	82674	100,00%
PurchaseStatus	DocImp	2	0	82674	82674	100,00%
PurchaseStatus	MovContab	3	0	82674	82674	100,00%
PurchaseStatus	MovImobilizado	4	0	82674	82674	100,00%
PurchaseStatus	Estado	5	0	82674	82674	100,00%
PurchaseStatus	Anulado	6	0	82674	82674	100,00%
PurchaseStatus	Fechado	7	0	82674	82674	100,00%
PurchaseStatus	VersaoUltAct	8	0	82674	82674	100,00%
PurchaseStatus	ATTrataTrans	15	0	82674	82674	100,00%
PurchaseStatus	CalculoManual	16	0	82674	82674	100,00%
SaleDocuments	Documento	1	0	123	123	100,00%
SaleDocuments	Descricao	2	0	123	123	100,00%
SaleDocuments	TipoDocumento	3	0	123	123	100,00%
SaleHeaders	Data	1	0	520774	520774	100,00%
SaleHeaders	Entidade	3	0	520774	520774	100,00%
SaleHeaders	TipoDoc	4	0	520774	520774	100,00%
SaleHeaders	NumDoc	5	0	520774	520774	100,00%
SaleHeaders	CondPag	6	0	520774	520774	100,00%
SaleHeaders	DescPag	7	0	520774	520774	100,00%
SaleHeaders	TotalMerc	8	0	520774	520774	100,00%
SaleHeaders	TotalIva	9	0	520774	520774	100,00%
SaleHeaders	TotalDesc	10	0	520774	520774	100,00%
SaleHeaders	TotalOutros	11	0	520774	520774	100,00%
SaleHeaders	UtilizaMoradaAltEntrega	14	0	520774	520774	100,00%
SaleHeaders	Seccao	16	0	520774	520774	100,00%
SaleHeaders	RegimeIva	17	0	520774	520774	100,00%
SaleHeaders	Moeda	18	0	520774	520774	100,00%
SaleHeaders	Cambio	19	0	520774	520774	100,00%
SaleHeaders	DataVencimento	21	0	520774	520774	100,00%
SaleHeaders	Filial	27	0	520774	520774	100,00%
SaleHeaders	Serie	28	0	520774	520774	100,00%
SaleHeaders	MoedaDaUEM	29	0	520774	520774	100,00%
SaleHeaders	Arredondamento	30	0	520774	520774	100,00%
SaleHeaders	ArredondamentoIva	31	0	520774	520774	100,00%
SaleHeaders	NumDiario	38	0	520774	520774	100,00%
SaleHeaders	DataUltimaActualizacao	39	0	520774	520774	100,00%
SaleHeaders	PercentagemRetencao	51	0	520774	520774	100,00%
SaleHeaders	TotalRetencao	52	0	520774	520774	100,00%
SaleHeaders	VersaoUltAct	56	0	520774	520774	100,00%
SaleHeaders	Id	57	0	520774	520774	100,00%
SaleHeaders	TipoEntidade	59	0	520774	520774	100,00%
SaleHeaders	DescEntidade	60	0	520774	520774	100,00%
SaleHeaders	AnoCBL	64	0	520774	520774	100,00%
SaleHeaders	TotalEcotaxa	70	0	520774	520774	100,00%
SaleHeaders	CambioMBase	72	0	520774	520774	100,00%
SaleHeaders	CambioMAlt	73	0	520774	520774	100,00%
SaleHeaders	TotalRecargo	83	0	520774	520774	100,00%
SaleHeaders	TotalRetencaoGarantia	84	0	520774	520774	100,00%
SaleHeaders	OrigemPOS	87	0	520774	520774	100,00%
SaleHeaders	Versao	88	0	520774	520774	100,00%
SaleHeaders	TipoLancamento	105	0	520774	520774	100,00%
SaleHeaders	TipoEntidadeFac	106	0	520774	520774	100,00%
SaleHeaders	EntidadeFac	107	0	520774	520774	100,00%
SaleHeaders	TotalIEC	117	0	520774	520774	100,00%
SaleHeaders	DataGravacao	118	0	520774	520774	100,00%
SaleHeaders	PendentePorLinha	119	0	520774	520774	100,00%
SaleHeaders	RegimeIvaReembolsos	122	0	520774	520774	100,00%
SaleHeaders	EspacoFiscal	123	0	520774	520774	100,00%
SaleHeaders	CambioADataDoc	126	0	520774	520774	100,00%
SaleHeaders	TratalvaCaixa	142	0	520774	520774	100,00%
SaleHeaders	B2BTrataTrans	144	0	520774	520774	100,00%
SaleHeaders	CAE	146	0	520774	520774	100,00%
SaleHeaders	TotalIS	149	0	520774	520774	100,00%
SaleHeaders	Documento	166	0	520774	520774	100,00%
SaleHeaders	TotalDocumento	169	0	520774	520774	100,00%
SaleHeaders	MargemDoc	171	0	520774	520774	100,00%
SaleRows	NumLinha	1	0	3665156	3665156	100,00%
SaleRows	Desconto1	3	0	3665156	3665156	100,00%
SaleRows	Desconto2	4	0	3665156	3665156	100,00%
SaleRows	Desconto3	5	0	3665156	3665156	100,00%
SaleRows	TaxaIva	6	0	3665156	3665156	100,00%

Table C.3 continued from previous page

SaleRows	Quantidade	8	0	3665156	3665156	100,00%
SaleRows	PCM	9	0	3665156	3665156	100,00%
SaleRows	PrecUnit	10	0	3665156	3665156	100,00%
SaleRows	Regimelva	11	0	3665156	3665156	100,00%
SaleRows	Data	12	0	3665156	3665156	100,00%
SaleRows	TipoLinha	13	0	3665156	3665156	100,00%
SaleRows	Seccao	14	0	3665156	3665156	100,00%
SaleRows	FactorConv	17	0	3665156	3665156	100,00%
SaleRows	NumLinhaSTKGerada	18	0	3665156	3665156	100,00%
SaleRows	DataSaida	19	0	3665156	3665156	100,00%
SaleRows	DescontoComercial	20	0	3665156	3665156	100,00%
SaleRows	VariavelA	22	0	3665156	3665156	100,00%
SaleRows	VariavelB	23	0	3665156	3665156	100,00%
SaleRows	VariavelC	24	0	3665156	3665156	100,00%
SaleRows	QntFormula	25	0	3665156	3665156	100,00%
SaleRows	Comissao	26	0	3665156	3665156	100,00%
SaleRows	PrecoLiquido	28	0	3665156	3665156	100,00%
SaleRows	IntrastatMassaLiq	31	0	3665156	3665156	100,00%
SaleRows	IntrastatValorLiq	33	0	3665156	3665156	100,00%
SaleRows	SujeitoRetencao	35	0	3665156	3665156	100,00%
SaleRows	VersaoUltAct	36	0	3665156	3665156	100,00%
SaleRows	IdCabecDoc	37	0	3665156	3665156	100,00%
SaleRows	Id	38	0	3665156	3665156	100,00%
SaleRows	DataEntrega	40	0	3665156	3665156	100,00%
SaleRows	Devolucao	43	0	3665156	3665156	100,00%
SaleRows	PCMDevolucao	44	0	3665156	3665156	100,00%
SaleRows	DifPCMedio	55	0	3665156	3665156	100,00%
SaleRows	PerclvaDedutivel	56	0	3665156	3665156	100,00%
SaleRows	IvaNaoDedutivel	57	0	3665156	3665156	100,00%
SaleRows	Ecotaxa	58	0	3665156	3665156	100,00%
SaleRows	TaxaRecargo	63	0	3665156	3665156	100,00%
SaleRows	PercIncidenciaIVA	64	0	3665156	3665156	100,00%
SaleRows	TotalIliquido	65	0	3665156	3665156	100,00%
SaleRows	TotalDA	66	0	3665156	3665156	100,00%
SaleRows	TotalDC	67	0	3665156	3665156	100,00%
SaleRows	TotalDF	68	0	3665156	3665156	100,00%
SaleRows	TotalRecargo	69	0	3665156	3665156	100,00%
SaleRows	Totalva	70	0	3665156	3665156	100,00%
SaleRows	TipoCustoPrevisto	71	0	3665156	3665156	100,00%
SaleRows	CustoPrevisto	72	0	3665156	3665156	100,00%
SaleRows	Margem	73	0	3665156	3665156	100,00%
SaleRows	PercentagemMargem	74	0	3665156	3665156	100,00%
SaleRows	B2BNumLinhaOrig	78	0	3665156	3665156	100,00%
SaleRows	TaxaIvaEcotaxa	80	0	3665156	3665156	100,00%
SaleRows	TotalEcotaxa	81	0	3665156	3665156	100,00%
SaleRows	IvaRegraCalculo	93	0	3665156	3665156	100,00%
SaleRows	TaxaIvaIEC	98	0	3665156	3665156	100,00%
SaleRows	TotalIEC	99	0	3665156	3665156	100,00%
SaleRows	ValorIEC	100	0	3665156	3665156	100,00%
SaleRows	BaseIncidencia	110	0	3665156	3665156	100,00%
SaleRows	BaseCalculoIncidencia	111	0	3665156	3665156	100,00%
SaleRows	RegraCalculoIncidencia	112	0	3665156	3665156	100,00%
SaleRows	IncidenciaIS	124	0	3665156	3665156	100,00%
SaleRows	ValorIS	125	0	3665156	3665156	100,00%
SaleRows	ValorLiquidoDesconto	132	0	3665156	3665156	100,00%
SaleRows	IvaValorDesconto	133	0	3665156	3665156	100,00%
Sales	NumLinha	1	0	656412	656412	100,00%
Sales	Artigo	2	0	656412	656412	100,00%
Sales	Taxalva	3	0	656412	656412	100,00%
Sales	Quantidade	4	0	656412	656412	100,00%
Sales	PCM	5	0	656412	656412	100,00%
Sales	PrecUnit	6	0	656412	656412	100,00%
Sales	TipoLinha	7	0	656412	656412	100,00%
Sales	PrecoLiquido	9	0	656412	656412	100,00%
Sales	Id	10	0	656412	656412	100,00%
Sales	PercentagemMargem	12	0	656412	656412	100,00%
Sales	Margem	13	0	656412	656412	100,00%
Sales	TotalIliquido	14	0	656412	656412	100,00%
Sales	Totalva	15	0	656412	656412	100,00%
Sales	Data	16	0	656412	656412	100,00%
Sales	Entidade	17	0	656412	656412	100,00%
Sales	TipoDoc	18	0	656412	656412	100,00%
Sales	NumDoc	19	0	656412	656412	100,00%
Sales	Serie	20	0	656412	656412	100,00%
Sales	TipoEntidade	24	0	656412	656412	100,00%
SaleStatus	IdCabecDoc	1	0	520774	520774	100,00%
SaleStatus	DocImp	2	0	520774	520774	100,00%
SaleStatus	MovContab	3	0	520774	520774	100,00%
SaleStatus	MovImobilizado	4	0	520774	520774	100,00%
SaleStatus	Estado	5	0	520774	520774	100,00%
SaleStatus	LigacaoCBLLote	6	0	520774	520774	100,00%
SaleStatus	EstadoCBLEntidade	7	0	520774	520774	100,00%

Table C.3 continued from previous page

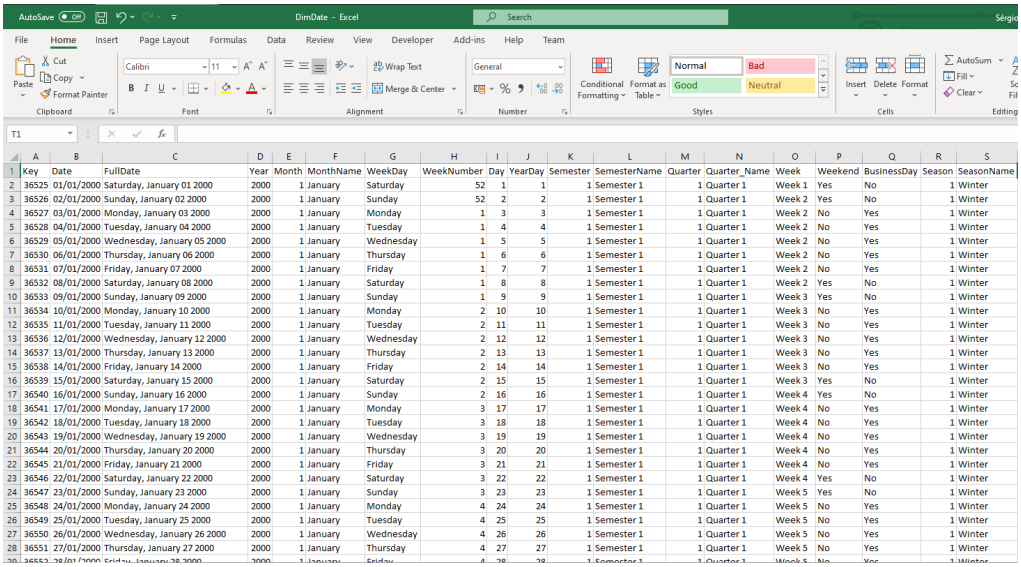
SaleStatus	Anulado	8	0	520774	520774	100,00%
SaleStatus	Fechado	9	0	520774	520774	100,00%
SaleStatus	VersaoUltAct	10	0	520774	520774	100,00%
SaleStatus	ATTrataTrans	13	0	520774	520774	100,00%
SaleStatus	CalculoManual	18	0	520774	520774	100,00%
Stock	Modulo	1	0	3484502	3484502	100,00%
Stock	TipoDoc	2	0	3484502	3484502	100,00%
Stock	NumDoc	3	0	3484502	3484502	100,00%
Stock	NumLinha	4	0	3484502	3484502	100,00%
Stock	Quantidade	6	0	3484502	3484502	100,00%
Stock	PCM	7	0	3484502	3484502	100,00%
Stock	PrecUnit	8	0	3484502	3484502	100,00%
Stock	Data	9	0	3484502	3484502	100,00%
Stock	TipoLinha	10	0	3484502	3484502	100,00%
Stock	EntradaSaida	13	0	3484502	3484502	100,00%
Stock	NumLinDocOrig	14	0	3484502	3484502	100,00%
Stock	DescontoComercial	15	0	3484502	3484502	100,00%
Stock	DespesaAdicionalCompra	16	0	3484502	3484502	100,00%
Stock	NumLinComposto	17	0	3484502	3484502	100,00%
Stock	Filial	18	0	3484502	3484502	100,00%
Stock	Serie	19	0	3484502	3484502	100,00%
Stock	VariavelA	20	0	3484502	3484502	100,00%
Stock	VariavelB	21	0	3484502	3484502	100,00%
Stock	VariavelC	22	0	3484502	3484502	100,00%
Stock	QntFormula	23	0	3484502	3484502	100,00%
Stock	Lote	24	0	3484502	3484502	100,00%
Stock	VersaoUltAct	26	0	3484502	3484502	100,00%
Stock	Id	27	0	3484502	3484502	100,00%
Stock	Arred	29	0	3484502	3484502	100,00%
Stock	Devolucao	30	0	3484502	3484502	100,00%
Stock	PCMDevolucao	31	0	3484502	3484502	100,00%
Stock	DifPCMedio	32	0	3484502	3484502	100,00%
Stock	VPTTotal	33	0	3484502	3484502	100,00%
Stock	IdCabecOrig	34	0	3484502	3484502	100,00%
Stock	IdLinhaOrig	36	0	3484502	3484502	100,00%
Stock	IdLinhaOrdemFabrico	37	0	3484502	3484502	100,00%
Stock	StockNegativo	38	0	3484502	3484502	100,00%
Stock	QtdAcumuladoArtigo	39	0	3484502	3484502	100,00%
Stock	QtdAcumuladoArmLote	40	0	3484502	3484502	100,00%
Stock	CustoNaoImputado	41	0	3484502	3484502	100,00%
Stock	ActPCU	42	0	3484502	3484502	100,00%
Stock	ActPCM	43	0	3484502	3484502	100,00%
Stock	ActUltEntrada	44	0	3484502	3484502	100,00%
Stock	ActUltSaida	45	0	3484502	3484502	100,00%
Stock	TipoDocumento	46	0	3484502	3484502	100,00%
Stock	PrecoUnitario	47	0	3484502	3484502	100,00%
StockAtual	Modulo	1	0	6966564	6966564	100,00%
StockAtual	TipoDoc	2	0	6966564	6966564	100,00%
StockAtual	NumDoc	3	0	6966564	6966564	100,00%
StockAtual	NumLinha	4	0	6966564	6966564	100,00%
StockAtual	Quantidade	6	0	6966564	6966564	100,00%
StockAtual	PCM	7	0	6966564	6966564	100,00%
StockAtual	PrecUnit	8	0	6966564	6966564	100,00%
StockAtual	Data	9	0	6966564	6966564	100,00%
StockAtual	TipoLinha	10	0	6966564	6966564	100,00%
StockAtual	EntradaSaida	13	0	6966564	6966564	100,00%
StockAtual	NumLinDocOrig	14	0	6966564	6966564	100,00%
StockAtual	DescontoComercial	15	0	6966564	6966564	100,00%
StockAtual	DespesaAdicionalCompra	16	0	6966564	6966564	100,00%
StockAtual	NumLinComposto	17	0	6966564	6966564	100,00%
StockAtual	Filial	18	0	6966564	6966564	100,00%
StockAtual	Serie	19	0	6966564	6966564	100,00%
StockAtual	VariavelA	20	0	6966564	6966564	100,00%
StockAtual	VariavelB	21	0	6966564	6966564	100,00%
StockAtual	VariavelC	22	0	6966564	6966564	100,00%
StockAtual	QntFormula	23	0	6966564	6966564	100,00%
StockAtual	Lote	24	0	6966564	6966564	100,00%
StockAtual	VersaoUltAct	26	0	6966564	6966564	100,00%
StockAtual	Id	27	0	6966564	6966564	100,00%
StockAtual	Arred	29	0	6966564	6966564	100,00%
StockAtual	Devolucao	30	0	6966564	6966564	100,00%
StockAtual	PCMDevolucao	31	0	6966564	6966564	100,00%
StockAtual	DifPCMedio	32	0	6966564	6966564	100,00%
StockAtual	VPTTotal	33	0	6966564	6966564	100,00%
StockAtual	IdCabecOrig	34	0	6966564	6966564	100,00%
StockAtual	IdLinhaOrig	36	0	6966564	6966564	100,00%
StockAtual	IdLinhaOrdemFabrico	37	0	6966564	6966564	100,00%
StockAtual	StockNegativo	38	0	6966564	6966564	100,00%
StockAtual	QtdAcumuladoArtigo	39	0	6966564	6966564	100,00%
StockAtual	QtdAcumuladoArmLote	40	0	6966564	6966564	100,00%
StockAtual	CustoNaoImputado	41	0	6966564	6966564	100,00%
StockAtual	ActPCU	42	0	6966564	6966564	100,00%

Table C.3 continued from previous page

StockAtual	ActPCM	43	0	6966564	6966564	100,00%
StockAtual	ActUltEntrada	44	0	6966564	6966564	100,00%
StockAtual	ActUltSaida	45	0	6966564	6966564	100,00%
StockAtual	TipoDocumento	46	0	6966564	6966564	100,00%
StockAtual	PrecoUnitario	47	0	6966564	6966564	100,00%
StockAtual	Purchase	48	0	6966564	6966564	100,00%
StockAtual	Sale	49	0	6966564	6966564	100,00%
Suppliers	Fornecedor	1	0	63	63	100,00%
Suppliers	Nome	2	0	63	63	100,00%
Suppliers	DataCriacao	8	0	63	63	100,00%
Suppliers	DataUltimaActualizacao	10	0	63	63	100,00%
Suppliers	NomeFiscal	11	0	63	63	100,00%
Warehouses	Id	1	0	72	72	100,00%
Warehouses	Localizacao	2	0	72	72	100,00%
Warehouses	DataUltimaActualizacao	5	0	72	72	100,00%
Warehouses	Armazem	6	0	72	72	100,00%
Warehouses	Descricao	7	0	72	72	100,00%

C.4 Stores and Types of Business

Excel file example used at the DimDate load on Figure C.1



Key	Date	FullDate	Year	Month	MonthName	WeekDay	WeekNumber	Day	YearDay	Semester	SemesterName	Quarter	Quarter_Name	Week	Weekend	BusinessDay	Season	SeasonName
36525	01/01/2000	Saturday, January 01 2000	2000	1	January	Saturday	52	1	1	1	Semester 1	1	Quarter 1	Week 1	Yes	No	1	Winter
36526	02/01/2000	Sunday, January 02 2000	2000	1	January	Sunday	52	2	2	1	Semester 1	1	Quarter 1	Week 2	Yes	No	1	Winter
36527	03/01/2000	Monday, January 03 2000	2000	1	January	Monday	1	3	3	1	Semester 1	1	Quarter 1	Week 2	No	Yes	1	Winter
36528	04/01/2000	Tuesday, January 04 2000	2000	1	January	Tuesday	1	4	4	1	Semester 1	1	Quarter 1	Week 2	No	Yes	1	Winter
36529	05/01/2000	Wednesday, January 05 2000	2000	1	January	Wednesday	1	5	5	1	Semester 1	1	Quarter 1	Week 2	No	Yes	1	Winter
36530	06/01/2000	Thursday, January 06 2000	2000	1	January	Thursday	1	6	6	1	Semester 1	1	Quarter 1	Week 2	No	Yes	1	Winter
36531	07/01/2000	Friday, January 07 2000	2000	1	January	Friday	1	7	7	1	Semester 1	1	Quarter 1	Week 2	No	Yes	1	Winter
36532	08/01/2000	Saturday, January 08 2000	2000	1	January	Saturday	1	8	8	1	Semester 1	1	Quarter 1	Week 2	Yes	No	1	Winter
36533	09/01/2000	Sunday, January 09 2000	2000	1	January	Sunday	1	9	9	1	Semester 1	1	Quarter 1	Week 3	Yes	No	1	Winter
36534	10/01/2000	Monday, January 10 2000	2000	1	January	Monday	2	10	10	1	Semester 1	1	Quarter 1	Week 3	No	Yes	1	Winter
36535	11/01/2000	Tuesday, January 11 2000	2000	1	January	Tuesday	2	11	11	1	Semester 1	1	Quarter 1	Week 3	No	Yes	1	Winter
36536	12/01/2000	Wednesday, January 12 2000	2000	1	January	Wednesday	2	12	12	1	Semester 1	1	Quarter 1	Week 3	No	Yes	1	Winter
36537	13/01/2000	Thursday, January 13 2000	2000	1	January	Thursday	2	13	13	1	Semester 1	1	Quarter 1	Week 3	No	Yes	1	Winter
36538	14/01/2000	Friday, January 14 2000	2000	1	January	Friday	2	14	14	1	Semester 1	1	Quarter 1	Week 3	No	Yes	1	Winter
36539	15/01/2000	Saturday, January 15 2000	2000	1	January	Saturday	2	15	15	1	Semester 1	1	Quarter 1	Week 3	Yes	No	1	Winter
36540	16/01/2000	Sunday, January 16 2000	2000	1	January	Sunday	2	16	16	1	Semester 1	1	Quarter 1	Week 4	Yes	No	1	Winter
36541	17/01/2000	Monday, January 17 2000	2000	1	January	Monday	3	17	17	1	Semester 1	1	Quarter 1	Week 4	No	Yes	1	Winter
36542	18/01/2000	Tuesday, January 18 2000	2000	1	January	Tuesday	3	18	18	1	Semester 1	1	Quarter 1	Week 4	No	Yes	1	Winter
36543	19/01/2000	Wednesday, January 19 2000	2000	1	January	Wednesday	3	19	19	1	Semester 1	1	Quarter 1	Week 4	No	Yes	1	Winter
36544	20/01/2000	Thursday, January 20 2000	2000	1	January	Thursday	3	20	20	1	Semester 1	1	Quarter 1	Week 4	No	Yes	1	Winter
36545	21/01/2000	Friday, January 21 2000	2000	1	January	Friday	3	21	21	1	Semester 1	1	Quarter 1	Week 4	No	Yes	1	Winter
36546	22/01/2000	Saturday, January 22 2000	2000	1	January	Saturday	3	22	22	1	Semester 1	1	Quarter 1	Week 4	Yes	No	1	Winter
36547	23/01/2000	Sunday, January 23 2000	2000	1	January	Sunday	3	23	23	1	Semester 1	1	Quarter 1	Week 5	Yes	No	1	Winter
36548	24/01/2000	Monday, January 24 2000	2000	1	January	Monday	4	24	24	1	Semester 1	1	Quarter 1	Week 5	No	Yes	1	Winter
36549	25/01/2000	Tuesday, January 25 2000	2000	1	January	Tuesday	4	25	25	1	Semester 1	1	Quarter 1	Week 5	No	Yes	1	Winter
36550	26/01/2000	Wednesday, January 26 2000	2000	1	January	Wednesday	4	26	26	1	Semester 1	1	Quarter 1	Week 5	No	Yes	1	Winter
36551	27/01/2000	Thursday, January 27 2000	2000	1	January	Thursday	4	27	27	1	Semester 1	1	Quarter 1	Week 5	No	Yes	1	Winter

Figure C.1: DimDate csv file