

Industrial Reporting Using Power BI

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Abstract

With today's technological advancements, there has been an exponential growth in the amount of collected data. Because of this, in the corporate environment, the focus has shifted towards using this new data inflow as a way to generate valuable information and develop successful business strategies.

The present dissertation was developed at Amorim Cork SA and it has the objective of building a standardised performance report focused on the financial results of cork stoppers' production factories.

The goal of the created report is to provide the tools necessary to make quick and efficient business decisions, supported by real-time indicators (all the values of SAP systems are updated during the night), allowing the controllers to swiftly act upon unsatisfactory results, and providing a way to discover the main root causes for these results.

One important benefit of this report is the power to benchmark across all factories of the group. Previous to this project, the same performance indicators were being calculated in many different ways across the factories. That made the comparison between factories a near impossible task, since a factory that presented better indicators could actually be less productive than another who calculated their indicators under more strict filters.

To create the report, it was first necessary to understand its requirements. By working closely with the end-users to determine what information needed to be displayed, the standardised indicators were mapped and calculated. The complexity of the indicators required the use of both the Financial and Production OLAP cubes, and so for the first time at Amorim, a Data Mart with multiple OLAP cubes was created. These cubes, however, did not have all the necessary indicators, and so using DAX programming measures were created to add the remaining necessary indicators to the Data Mart.

After that, the report was designed taking into account the users' visualization preferences and Microsoft Power BI's capabilities, to make it as appealing and interactable as possible.

During the whole process, change management concepts were considered, and so, to ensure that the implementation of the report would be well-accepted in the organization the 8 Kotter steps of change management were applied.

By the end of the project, it was clear through an evaluation survey that the end-users were accepting the new report as the main tool for data visualization and reporting of the factories' financial values, with an average score of 6,1 out of 7 both on information displayed and overall evaluation of the report. Moreover, it was highlighted through the survey that the new report will allow users to perform better and more frequent control over the factories' financial data, while wasting significantly less time in data gathering and report creation.

Keywords: Benchmarking; Business Intelligence; Reporting; Power BI;

Resumo

Com os avanços tecnológicos atuais, tem havido um crescimento exponencial na quantidade de dados disponíveis. Por isso, no ambiente empresarial, o foco mudou para o uso desse novo fluxo de dados como forma de gerar informações valiosas e desenvolver estratégias de negócio bem-sucedidas.

A presente dissertação foi desenvolvida na Amorim Cork SA, e tem como objetivo a construção de um relatório de desempenho standardizado focado nos resultados financeiros de fábricas de produção de rolhas de cortiça.

O objetivo do relatório criado é fornecer as ferramentas necessárias para a tomada de decisões de negócios rápidas e eficientes, apoiadas em indicadores em tempo real (todos os valores dos sistemas SAP são atualizados durante a noite), permitindo que os controladores atuem rapidamente sobre resultados insatisfatórios e fornecendo uma maneira de descobrir as principais causas desses resultados.

Um benefício importante deste relatório é o poder de benchmark em todas as fábricas do grupo. Antes deste projeto, os mesmos indicadores de desempenho eram calculados de várias maneiras diferentes nas fábricas. Isso tornava a comparação entre fábricas uma tarefa quase impossível, já que uma fábrica que apresentava melhores indicadores poderia, na verdade, ser menos produtiva do que outra que calculava seus indicadores sob filtros mais rígidos.

Para criar o relatório foi, em primeiro lugar, necessário entender os seus requisitos. Ao trabalhar em colaboração com os utilizadores finais para determinar quais informações precisam de ser exibidas, os indicadores standard podem ser mapeados e calculados. A complexidade dos indicadores exigiu a utilização dos cubos OLAP Financeiro e de Produção, e pela primeira vez na Amorim foi criado um Data Mart com múltiplos cubos OLAP. Esses cubos, no entanto, não tinham todos os indicadores necessários e, portanto, usando a linguagem de programação DAX, foram criadas métricas para adicionar os restantes indicadores necessários ao Data Mart.

De seguida, o relatório foi construído levando-se em consideração as preferências de visualização dos utilizadores e as capacidades do Microsoft Power BI, para torná-lo o mais atraente e interativo possível.

Durante todo o processo, foram considerados os conceitos de gestão de mudança, e para garantir que a implementação do relatório na organização fosse bem aceite foram aplicados os 8 passos de Kotter para gestão de mudança.

No final do projeto, ficou claro através de um relatório de avaliação que os utilizadores finais aceitaram o novo relatório como a principal ferramenta para visualização e apresentação dos dados financeiros, com uma classificação média de 6,1 em 7 tanto na informação disponibilizada como na classificação geral do relatório. Além disso, o inquérito determinou que o novo relatório permitirá que os utilizadores tenham um controlo melhor e mais frequente sobre os dados financeiros das fábricas, além de perderem bastante menos tempo na recolha de dados e criação de relatórios.

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"Not everything that can be counted counts, and not everything that counts can be counted."

Albert Einstein

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Acronyms and Symbols

ABI - Analytics and Business Intelligence
AI - Artificial Intelligence
BI - Business Intelligence
DAX - Data Analysis Expressions
DW - Data Warehouse
DM - Data Mart
ERP - Enterprise Resource Planning
ETL - Extract, Transform and Load
IaaS - Infrastructure as a Service
ICM - Industrial Contribution Margin
KPI - Key Performance Indicator
MES - Manufacturing Execution System
MC - Maintenance Costs
OC - Operational Costs
OLAP - Online Analytical Processing
PaaS - Platform as a Service
PBI - Power BI
SaaS - Software as a Service
SAP - System Analysis Program Development
YTD - year-to-date

Chapter 1

Introduction

The cork stopper market is one that shows continuous growth over the past few years, with the steady increase of consumption of premium wine (Transparency Market Research, 2021), withstanding even the COVID crisis and increasing total sales during that period, with a market cap of 1980 million dollars in 2020 (Industry ARC, 2021). In the center of that market is the Portuguese and Spanish industry, which accounted for an astounding 79,8% of the entire market as of last year (Transparency Market Research, 2021).

As the leading producer and seller of cork stoppers in the world, Amorim Cork SA has been growing year over year by gathering more clients and increasing total sales values. However, even with the majority of the market share, the increasing competitiveness in the sector makes it so that innovation is a mandatory cornerstone of the company, to ensure the position it has earned as the leading cork stopper company in the world is sustained.

One of the ways in which the company is doing that is by engaging in a process of digital transformation, and investing in tools directed towards data gathering and visualization. With this, they expect to, more than ever, be able to quickly analyse and control all relevant data.

With the increase in the data inflow, and with the focus on digital transformation and continuous improvement, it seemed a natural next step for Amorim Cork SA to jump on these technologies and use them to reach the next step in data visualization and analysis.

1.1 Context and Motivation

This project was developed in Amorim Cork, SA, the world leading producer and seller of cork stoppers, as part of their digital transformation program, which started in late 2018 with the transfer to MES systems for data collection. One year later, in mid 2019, the first factories started using SAP systems, to improve the data processing and to standardise the information flow across the company. With this availability of data, there was a need to get the maximum possible value out of it. In order to do that, the next step in that digital transformation was the development of BI features, more specifically with Microsoft Power BI.



Figure 1.1: Division between Amorim's Business Units (Amorim Cork, 2021)

Before, there were various inefficiencies encountered when analysing and comparing factories during the companies' Executive Committees, as every factory unit calculated their KPIs in their own way, resulting in noncomparable results and sometimes even providing misleading information, as some worse performing units could show better results than a better performing factory simply because they calculated their indicators by less rigid formulas. By standardizing the analysis and making sure the data was presented in an accurate and dynamic fashion, there was the possibility to benchmark every factory unit.

Moreover, with Power BI, the industrial directors, who are not so comfortable analysing and working through the data in the data warehouse, start having most of the relevant data presented in an appealing way, with simple and effective ways of filtering and deep-diving.

1.2 Amorim Cork

Amorim Cork is the largest cork transformation group in the world. Founded in 1870, from a very early age the company focused on developing the potential of this natural raw material, applying it in various different sectors, from cork stoppers to footwear and even in some niche markets like sports floors (Amorim Cork, 2021). Because of these multiple points of focus, the group has divided itself into 5 main companies inside the Amorim Cork SGPS holding company. These five business units are: Amorim Cork SA (cork stoppers); Amorim Cork Flooring; Amorim Cork Insulation; Amorim Cork Composites; and Amorim Florestal (Figure 1.1).

Nowadays, the Amorim group is established in more than 100 countries, with over 27000 clients all over the world and still with a lot of potential for further growth.

In spite of this worldwide presence, of the 19 factory units of the company, 7 are located in Portugal, and with 5.5 million cork stoppers produced annually (Amorim Cork, 2021), there is a big need for efficient production management to ensure the quality in the quantity, a business value which Amorim prides itself on.

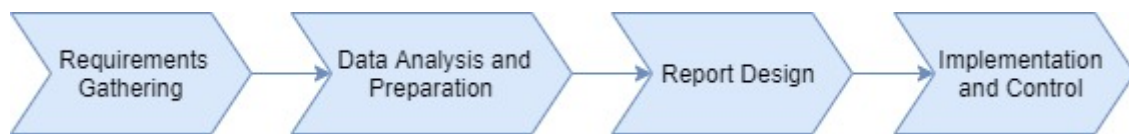


Figure 1.2: Project phases

1.3 Project Objectives

This project aims at developing the BI infrastructure for the second step of the digital transformation. More specifically, it will focus on the KPI's definition and dashboards creation using Power BI.

By the end of this project, it is envisioned that all the production factories within the group are evaluated under the same scope, with a clear vision of which industrial units are more efficient, as well as, in the case of the less efficient ones, where the main areas of improvement are.

This will be done by providing end-users with various financial and production related indicators, to allow them to quickly measure the performance of the factory and the trend of that performance.

Moreover, another goal of this project is to save the factory controllers' time, by providing them with a standard way to perform their analysis each month so that they do not have to update numerous Excel files, a repetitive and tedious process.

Finally, this project will delve in detail into the financial results of the company and provide specific and accurate explanations to the industrial contribution margin, which focuses mainly on the operational costs and the gross margin.

1.4 Methodology

In order to successfully achieve the objectives, the raw data of the company, stored in OLAP cubes with specific subsets of data, will need to be analysed and worked with to clearly express the information needed, in an appealing and effective way.

Firstly, there will be a phase of requirement gathering, where the main necessities of the report can be assessed, by working together with the end-users and analysis the current processes that take place.

After that, a preliminary report will be designed, and the additional necessary fields that are not currently in the database defined and implemented .

The report will then be made available to every end-user, and by providing one-on-one training and incentivizing feedback, the final adjustments will be added to the report as newer necessities arrive.

1.5 Structure of the Document

Besides this introductory chapter, this paper will have 5 more chapters. In the second chapter, a theoretical revision will be made regarding the important concepts relating to the theme of this thesis. Then, in chapter three, the project will be more thoroughly expanded upon. Next, there will be a chapter dedicated towards explaining the development process of the report. In a separate chapter, the implementation and its outcomes will be discussed. Finally, in the last chapter, the conclusions about the project will be presented and possible future work to be done regarding the final product suggested.

Chapter 2

Theoretical Background

A brief theoretical revision regarding all relevant topics for the development of the project is present in this chapter. Starting by explaining the concept of Business Intelligence (BI), and then diving into Data Warehouses and their characteristics. Performance measurement methods are also addressed, and finally an overview about Microsoft Power BI and its capabilities is made.

2.1 Business Intelligence

In a world dominated by data, it is more important than ever for businesses to understand how to extract value from the raft of digital insights available at their fingertips (Datapine, 2019). Furthermore, the growth of available data demanded increasing capabilities towards processing and analysing that data.

The concept of Business Intelligence (BI) is broad, but it can be generalized as the set of activities which transform raw data into useful information for business analysis, contributing to the growth of any company. It was introduced by IBM's computer scientist Hans Peter Luhn, in 1958 (Limp, 2021), as a tool to generate value by gathering, analysing and disseminating information to help make it more understandable, and thus help in the decision making process of critical problems. This new concept made it possible to take value from the data which was until then merely seen as waste, and turning it into one of the most valuable assets of any organisation (Luhn, 1958). In summary, through Power BI it is possible to gather insights and in-depth knowledge about an organization and its operations, by gathering and analysing its data. This analysis, in turn, can be used to give organizations the ability to make informed decisions that contribute to the achievement of its objectives (Valdez et al., 2017).

However, at that time, storage space was extremely costly, and so the progress in BI processes and capabilities was slowed down for decades to come.

In BI solutions, the data is stored inside Data Warehouses and divided into Data Marts, each specific to a different area of the companies' activities. That way, it is possible to work with rationalized data and achieve better performance.

2.1.1 History of BI

As business intelligence became a commonly known concept in the late 1990's, data warehousing costs began to decrease, due to the higher number of competitors entering the market (Better Buys, 2021). This increase in interest created what is now known as Business Intelligence 1.0.

This initial phase of BI was more focused on simple reporting, as the computing power at the time was not enough to support quick querying and filtering of the data (Intelligence Enterprise, 2021). To answer these needs, two new tools were developed, which are still considered vital today (Limp, 2021), with the intent of speeding the loading and querying process: Extract, Transform and Load (ETL), which helped map out the data flow into a data warehouse; and Online Analytical Processing (OLAP), which allowed for very efficient slice-and-dice querying of data, and provided different visualization options for the queried data.

With this developments, data could now not only be displayed, but also prepared to answer to business analyst's needs. However, these processes were challenging, and most users were not capable of executive BI tasks on their own, relying on IT departments or expert technical experts to build the reports they needed (Better Buys, 2021).

By the start of the 21st century, BI solutions were already considered a necessity in most enterprises (Limp, 2021), and the technological developments achieved by then allowed for the development of BI 2.0. In this stage, developments were mainly directed towards achieving real-time processing, by increasing the speed at which the information would become available, and to reduce the complexity of accessing it, thus making the tools more accessible for the average user.

Besides that, the Internet's exponential growth during that time and the increased connectivity between consumer and business meant that, in order to stay ahead of the competition and answer as quickly as possible to the clients' needs, there was a need for real-time information ready to be analysed.

Nowadays, BI applications are trending towards cloud systems, to answer to the increase in storage and processing power requirements (Limp, 2021). Moreover, the transfer towards the cloud also allowed for mobile access to the data, with users being able to check it at all times from their phones.

2.2 Data Warehouse

As mentioned in the Business Intelligence chapter, Data Warehouses (DW) are a fundamental subset part of BI. A Data Warehouse is a large collection of business data from multiple sources stored in a central database, which provides a reliable source of information for reporting and analysing all aspects of an organization, as well as supporting the decision making process. DWs were created to transition data towards fueling and justifying decision support systems, through Business Intelligence.

Since the data is updated frequently, data gathered by the system is more trustworthy, which helps ensuring that the decisions are being taken with relevant and accurate data. Furthermore, a DW is organised in such ways that allows faster decisions by sorting the data, so that it is ready to be analysed. It also objectifies the decision making process, as it removes the need for hunches or predictions. This complexity of capabilities means that a data warehouse cannot simply be purchased, it needs to be thoroughly designed in order to meet the company's requirements.

As can be seen in Figure 2.1, a Data Warehouse is kept separated from the organisation's operational data, to ensure that the data does not get corrupted and to add a layer of security to the raw data. Besides that, the data inside the DW is not updated as often as the operational data, as data will come in from multiple sources to unrelated tables and with the DW that data is schematized with modal relationships.

The operational data goes through three main stages before being ready for analysing: Extract, Transform and Load; Data Warehousing; and lastly OLAP querying. Finally, the end users (data analysts, data scientists, among others) can access the data warehouse whenever any information is needed, and all details of the data can be easily gathered.

Of course, when discussing DWs, one has to mention Ralph Kimball (known as the Father of Business Intelligence) and William H. Inmon (Father of Data Warehousing). They each created a vision to how Data Warehouses should be structured and requirements that needed to be met when designing them.

William Inmon believed in a top-down approach, where the Data Warehouse is a centralized repository for the entire organization, and Data Marts (DM) can be created only from the data already available inside the DW (Inmon, 2002).

On the other hand, Ralph Kimball defended a bottom-up approach, where the Data Marts are built first and their aggregation forms the Data Warehouse, which simply serves as a single repository for all the different DMs. He believed that, by building the DW this way, all requirements would must certainly be met (Kimball, 2013).

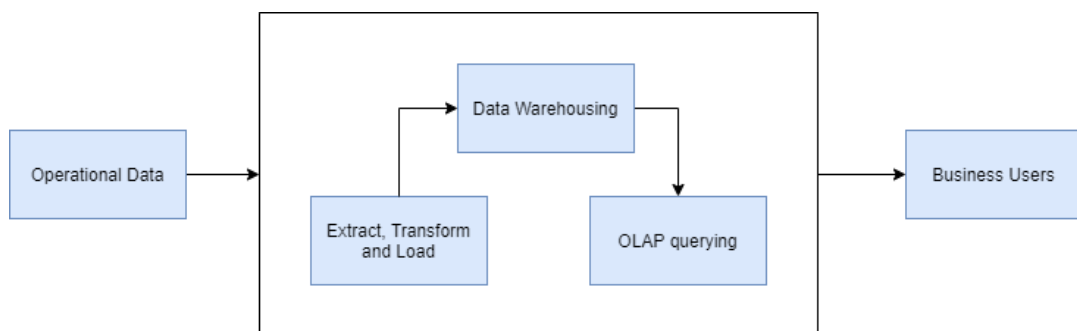


Figure 2.1: Data Warehousing Stages

2.2.1 Data Warehouse Requirements

William Inmon defined the term Data Warehouse in the early nineties as "a subject-oriented, integrated, time-variant, nonvolatile collection of data in support of management's decisions" (Inmon, 2002). According to him, these four characteristics are key in building a data warehouse.

1. **A DW must be subject-oriented**, which ensures that data is categorized and stored by business subject rather than by application;
2. **A DW must be integrated**. This is the most important characteristic of a Data Warehouse, as it must be capable of collecting data on a given subject from multiple sources and store it in a single place;
3. **A DW must be time-variant**, as data must be stored as a series of snapshots, each representing a period of time. That way, all data is accessible at all times, and historic data is easily searchable regardless of how long ago that data was stored;
4. **A DW must be non-volatile**, as typically data in the DW is not updated or deleted.

2.2.2 Data Warehouse Architecture

The Figure 2.2 represents the typical working scheme of a Data Warehouse. As mentioned previously, there can be multiple data sources feeding the same DW, be it through flat files (eg. Excel), operational systems, Enterprise Resource Planning (ERP) systems (eg. SAP), or multiple other sources.

After that, the data is extracted from the various sources to a staging area, where it is converted into a summarized and structured format more suitable for querying, and loaded into the Data Warehouse.

Once inside the DW, there are 3 main types of data: raw data, with which the users will work to perform analysis; aggregate data, data expressed as a summary, which Kimball (Kimball, 2013) referred to as "the single most dramatic way to affect performance in a large data warehouse"; and meta data, the data about data, that is used to classify, label and understand data, and thus help increase the connections between the data, as well as the speed of queries (Infogix, 2021).

In order to make the data easily accessible to a particular department of business, a DW can divide itself into multiple smaller subsets of data, Data Marts.

Finally, end-users can access those Data Marts and perform analysis and reporting of the prepared data with their analytics and business intelligence tools (Panoply, 2021).

2.2.3 Data Marts

Data Marts are smaller versions of data warehouses, and are focused on a single subject. In an organization's context, a DW is enterprise-wide data, while a DM contains only a department's relevant data. Since the size of a data mart is considerably lower than its respective data warehouse, the necessary time to build one is also much shorter than that pertaining a data warehouse.

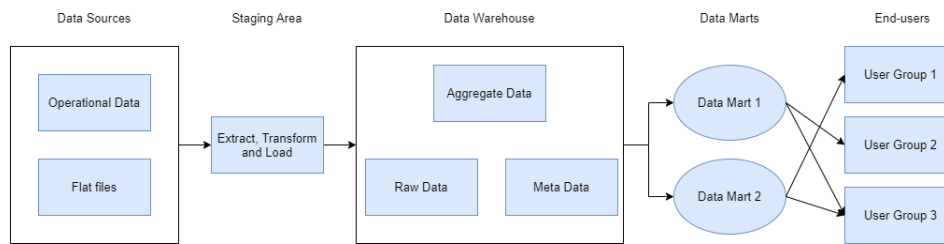


Figure 2.2: Data Warehouse Architecture

By using DMs and consequently smaller subsets of data, it is possible to achieve much better performance and execute more complex analysis over the data. Besides that, it allows for the segregation of data within the company, as not everybody needs to work with the same information, and by focusing only on what is important to them, users can achieve a greater proficiency in regards to their data and work better with it.

2.2.4 Dimension and Fact tables

Data in a DW is stored in tables, which can be separated into dimension and fact tables.

Dimension tables is where the different aspects of the DW are described, by dividing them into attributes, to provide structured information to the DW for analysis and reporting. This makes it simpler for end-users, who can design the queries with descriptive information. Because Of this singularity of the information displayed in dimension tables, they have to have a primary key, in order to restrict duplicate values.

This restriction, however, does not apply to fact tables. They consist of dimension tables' keys (as foreign keys) and facts, which are measures that can be summed, averaged, or otherwise manipulated. This organisation within the table is what provides the connections present in the database, and so every dimension table has to be linked to a fact table so that it is connected to the rest of the model. This obligation is also what gives users a lot of flexibility on queries, as they can easily determine the relationships within the model.

2.2.4.1 Schemas

A schema is the logical description of the entire database. They give details about tables' constraints, key values and how they are linked to each other.

For Data Warehouses, there are 3 main design solutions for schemas, which are the Star, the Snowflake and the Fact Constellation (or Galaxy) schema.

In the Star schema (Figure 2.3), each dimension is fully represented in a one-dimension table with a set of attributes. The fact table is at the center, combining all the dimension tables through foreign keys.

The Snowflake schema (Figure 2.4) is an extension of the star schema, where dimension tables are normalised and split into additional tables, every time the original dimension table has attributes that justify further separation.

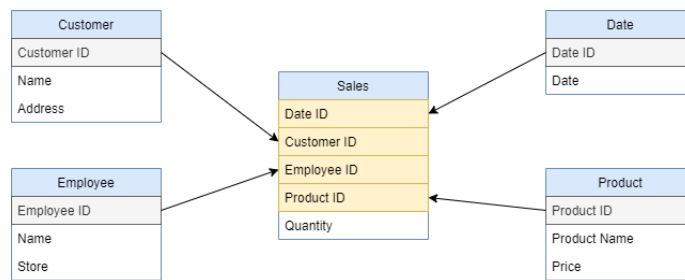


Figure 2.3: Star Schema example

Lastly, the defining characteristic of the Galaxy schema (Figure 2.5) is that it always has more than one fact table. This occurs because everytime there is an overlap between two dimensions (eg. products that belong to different markets/are available at different stores) there is a fact table to explain that relationship.

2.2.5 OLAP

Online Analytical Processing (OLAP) is a database technology that provides a flexible way to make complicated analysis of multidimensional data and provide rapid access to it. This sort of analysis is necessary because in a DW there are multiple views of the data (through links and relationships in it).

OLAP databases contain two basic types of data: measures and dimensions. Measures consist of numeric data, the values that are at the core of the business analysis process. The dimensions are complementary to the measures, as they are the categories used to organize them. They are usually organized by many levels of detail, through hierarchies of data that can easily be expanded or collapsed, with each level of it providing more information about the original data (Microsoft, 2021).

OLAP data is organized hierarchically and stored in cubes. An OLAP cube is a data structure that aggregates the measures by the levels and hierarchies of each of the dimensions that need to be analyzed, and allow for efficient operations for querying the data.

Any queries done inside a Data Warehouse are considered as an OLAP activity, as they are always analysis-based. On the other hand, analysis in traditional databases are done with Online Transactional Processing systems, as it only analyses data stored in two-dimensional tables, and are generally used to insert, update or delete small ammounts of data.

In that sense, OLAP queries support a better filtering and sorting of the data, because even if data is stored in multiple tables, these operations are quick in producing output. Besides that, data can be refined, as the main advantage of OLAP is to transform the data in the DW into not only data, but more importantly information.

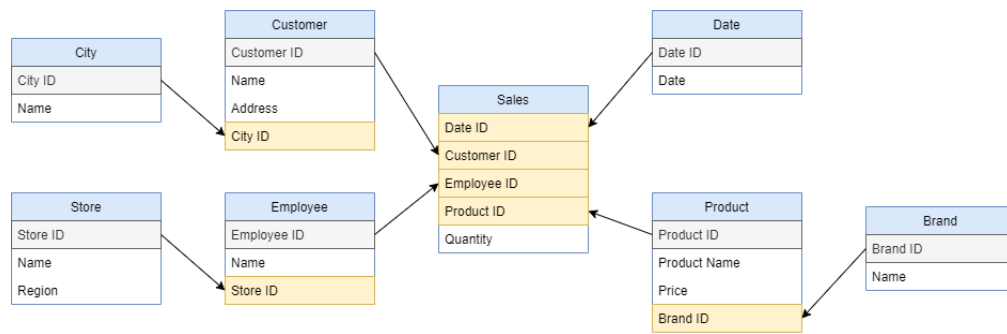


Figure 2.4: Snowflake Schema example

2.2.5.1 OLAP Operations

OLAP cubes allow users to perform 5 different kinds of operations, which help to quickly analyse and understand the data. These five operations are:

1. **Roll-up:** consists of climbing up a concept hierarchy for a dimension;
2. **Drill-down:** contrary to the roll-up, where you step down a level from a dimension hierarchy;
3. **Slice:** separation of data according to a particular dimension in a given cube;
4. **Dice:** an extension of slice, dice allows the creation of a new sub-cube from two or more dimensions of a given cube;
5. **Pivot:** the transposition of axis in order to present an alternative view of data.

2.3 Performance Measurement

Performance measurement is typically defined as the process of quantifying action by measurement of outcomes and results (Bureau of Educational and Cultural Affairs, 2021b). It plays a vital part in providing information over organizational performance, as well as, if applied correctly, increasing organizations' performance potential, through good control over critical areas and quick identification of poor performances (Mahmoud et al., 2020). Because of this, it is considered a fundamental principle of management, as management could hardly exist without performance measurement.

In today's age of information, it is more vital than ever to monitor performance and to take the maximum possible value out of the available information, to identify and fix the gaps between an organization's current situation and the desired performance.

Key Performance Indicators (KPI) can assist in achieving these goals, as measurable values that shows how well an organization, team, or individual is performing against a desired result (Mind Tools, 2021). KPIs are the heartbeat of the performance management process, as they are the ones that indicate whether progress is being made or not (OnStrategy, 2021).

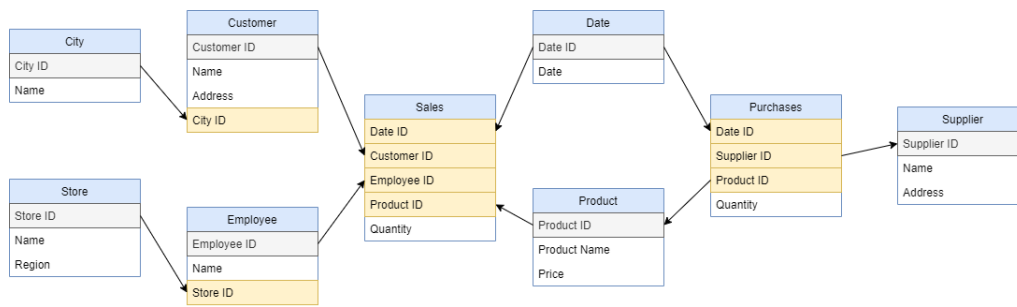


Figure 2.5: Galaxy Schema example

When defining KPIs, it is important to know the distinction between leading and lagging indicators. As the name suggests, leading indicators are aimed at the future, and represent an indicator of performance that might predict future success (Intrafocus, 2021). On the other hand, a lagging indicator measures only what has already been achieved to determine the quality of the performance (The Alternative Board, 2021). Having good leading KPI's means that corrective actions can be taken early to affect performance and, consequently, the lagging indicators.

To effectively develop KPIs, the most common approach is to use the SMART criteria (Bureau of Educational and Cultural Affairs, 2021a). This criteria sets specific rules in designing goals, and those rules are that KPIs have to be:

1. **Specific:** An indicator must be capable of being translated into operational terms, and focused on the topic at hand. When the subject of an indicator is not well defined, the results are not subject to proper evaluation and who tracks those indicators can arrive at wrong conclusions;
2. **Measurable:** An indicator needs to be able to be quantified, as if it is not possible to measure an indicator, progress cannot be tracked or evaluated;
3. **Achievable:** An indicator needs to aim towards realistic results. If not, it will not serve its purpose of creating change within the organization and it will merely demotivate the people responsible for meeting those impossible goals;
4. **Relevant:** An indicator must be directly correlated to the business and influence its success, as well as be a valid measure of organization's result;
5. **Timely:** Lastly, an indicator has to be evaluated within a given time frame, determined at the same time as the indicator with valid reasoning behind that choice.

When defining KPIs, it is desirable that they be more than just simple numbers on a spreadsheet, and that they are part of a story. With that in mind, change indicators (which express the value as a percentage of evolution compared to a previous period) are more effective when monitoring values than simply raw numbers and objectives, as they give a good starting point for the analysis.

Furthermore, once defined, it is imperative to ensure that the defined KPIs have these 4 attributes (OnStrategy, 2021):

1. **Measure:** the verbal expression of what is being accounted for, which needs to be as expressive as possible when defining it, to have clear goals and focus areas;
2. **Source:** where the data is coming from, as nowadays most enterprises have multiple data sources, and so it is important to record the source of information that is being used;
3. **Target:** the numeric end-goal for the measure, which needs to have the same dimension as it to be comparable. The due date and the target go together;
4. **Frequency:** how often the KPI is analysed, the minimum is the time-span between updating the information. The more volatile the business, the more stretched out should be the vision of the KPIs.

2.4 Microsoft Power BI

The line between analytics and business intelligence (ABI) platforms has blurred over the years and most enterprise options offer a certain amount of both (Venture Harbor, 2021).

Moreover, the modern ABI platform market has been steadily growing over the past few years, with a 19% increase in 2019 and 22% in 2018, which is even more impressive considering that the average price-per-user has fallen significantly over the same period. The focus and development of the market has transitioned into on-cloud functionalities, as well as machine learning and artificial intelligence features (such as predictive algorithms and models), to a point where it is predicted that soon both markets will merge and embody the same buyers and services (Richardson et al., 2021).

Microsoft Power BI is one of the leaders in this market (Richardson et al., 2021), and has been so for many years. With its massive market reach through Microsoft Office, and a great involvement with the community, on which it relies to identify areas of improvement to implement in their monthly updates, it is clear why it is one of the preferred platforms when it comes to data visualization and analysis solutions (Venture Harbor, 2021).

Microsoft Power BI services divide themselves in three different services: Power BI Desktop, Power BI Service and the Power BI Mobile App.

Power BI Desktop is used mainly for developing reports, whereas Power BI Service, a cloud-based service, is better suited for consultation of available reports. Some differences between these two services is that the web service does not allow the creation of calculated columns and measures, but makes it possible for users to create workspaces to better organize the reports. As for the mobile app, it serves exclusively as a consultation service.

One of Power BI's biggest advantages is its easy to use platform, both for development and consultation, which empowers users and makes them less reliant on IT departments and specialized personnel to prepare the reports and dashboards that they need. Thus, it once again enlarges

its market reach by being user-friendly for beginners, while also having some more advanced capabilities for the more experienced and knowledgeable users.

These capabilities include near real-time processing and reporting, as well as numerous data visualization tools that allow for the efficient analysis of all kinds of data. Besides that, Microsoft Power BI also offers the ability to seamlessly and effortlessly create new measures into the database, using Data Analysis Expressions (DAX) programming. DAX resembles Excel programming, with most of the functions being cross-platform. However, Power BI also offers different functions, more directed towards working with relational data.

Besides that, the platform is also evolving from merely performing descriptive analytics and has implemented some predictive functionalities, with the help of Microsoft's industry-leading artificial intelligence (AI) technology (Venture Harbor, 2021). This allows users to react sooner to trends that they might have otherwise missed without the use of these capabilities.

As for data visualization and its availability, Microsoft Power BI also offers subscriptions, a service in which a user can choose to receive entire reports, certain pages or even just selected visuals in their email, every day or in a time frame of their choosing. This way, data can be consulted at all times and is easily accessible, as the only requirement is having a device capable of accessing email services (Microsoft, 2021).

Another functionality present in Power BI to assist with data visualization are bookmarks, which capture the configured view of a report page and its filters, and saves it for easy access when opening the report at later dates. This saves user's time and the need to repeatedly select the same filters every time the report needs to be consulted.

However, it also has some limitations. While it can quickly perform simple operations with simple relationships, Power BI tends to struggle and rapidly decrease performance as complexity levels start to go up.

Moreover, Power BI tends to be rigid with its formulas, as the DAX language is not the most flexible and does not always allow for the desired fields to be used inside the functions. It encounters similar problems with the tables' relationships, where it does not allow for more than one way to join a pair of tables, and, in some cases, forces the creation of new fields solely with the purpose of linking tables together (Absent Data, 2021).

Chapter 3

Problem Description

In order to create the report in a way that will not only be hassle-free but also practical to the end-users, the entire report creation process must be mapped out and clearly determined. Firstly, the entire data structure within the organisation must be understood, as well as its limitations. Next, by engaging in a first contact with the end users and observing their work, the requirements to provide an effective analysis of the factory units can be assessed, and the initial challenges and restrictions for designing the report can also start to be taken into consideration.

3.1 Data Architecture at Amorim

The software used for this project, as part of the Amorim Cork SA path towards digital transformation, is Microsoft Power BI. This software has been used inside the organization since early 2021, and its areas of application continue to increase exponentially. Currently, there are reports built for sales, receivables, stock, real-time production, among many others, so naturally building one to control the whole industrial environment from a financial standpoint was an almost required step at some point in time.

After implementing a MES system, the company faced a new data inflow. With this system, it is now possible to access production data in near real-time (with updates occurring every 15 minutes) and it significantly improved the quality of the information, as it allows for control over every phase of the production process, as well as the ability to plan production ahead of time. With the new quantity and quality of data, the next step in the digital transformation process was naturally to improve the processing and organizing capability of the data and transitioning towards SAP systems.

After this change, Amorim Cork SA started to organize its data within OLAP cubes loaded in the cloud using SSAS Analysis Servers. In these cubes, data is separated in 5 different categories: Financial, Production, Order 2 Cash (Sales), Purchase 2 Pay (Purchases) and Transportation, and although these categories contain duplicate information across them (eg. center, profit center), this segregation of data is far more practical to the company. This way, employees can work only with smaller subsets of data relevant to them, which not only improves performance when

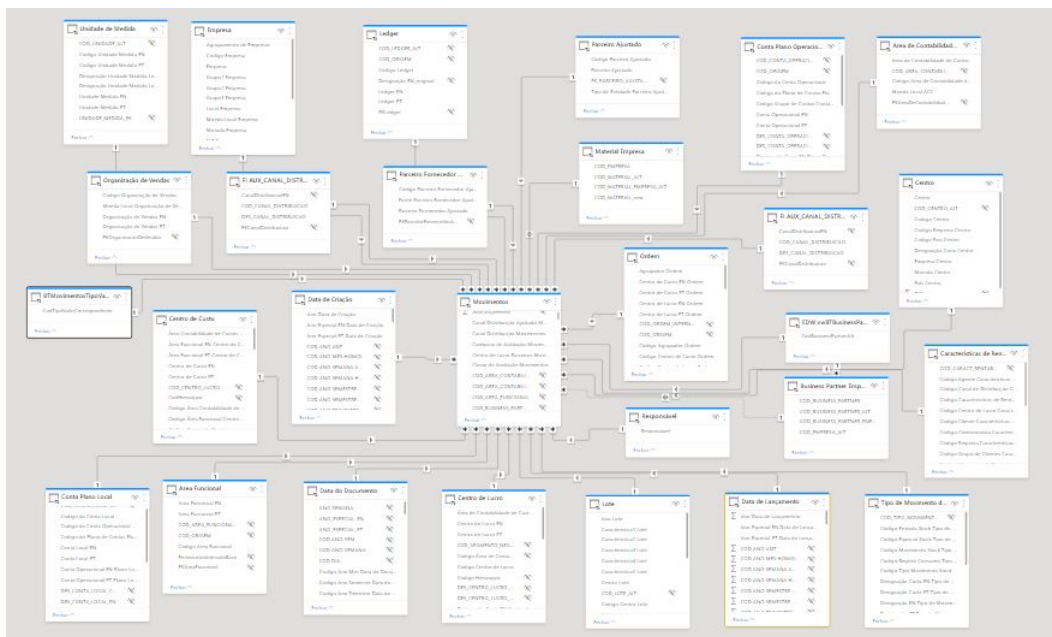


Figure 3.1: Distribution of the financial cube's tables

performing queries to the data, but also helps turning them more understandable and organized, easily outweighing the disadvantage of needing to store more data.

Within these OLAP cubes, the data is distributed in a Snowflake Schema with a movements table as the central fact one, describing what comes in and out from every single department/machine/factory. This structure makes sense in the Amorim universe as that is the only fact table needed to record the movements or transactions regarding everything that goes on in the company, be it production orders, transfers between factories and centers, sales, among many others. This distribution can be seen in Figure 3.1 (which is enlarged in Appendix C), where all the tables are connected to the central movements one, with either many-to-many or one-to-many connections.

3.2 Project Objectives

Before this project, factories' control was made via Excel reports, and every factory had its own set of reports with which they performed their own analysis without a standardized way to look at the data. Furthermore, every single one of those Excel reports required maintenance, which ultimately consumed a lot of time that could be better spent with other activities.

With that in mind, the end goal of this project is to be able to create a single industrial report that can serve as the basis towards measuring all the financial indicators within the factories environment by covering every relevant asset that can influence the final result. It is extremely important to ensure that the data is accurate by analysing all possible filters, so that there is confidence in the values displayed and that the end users can identify themselves with them.

Besides that, it also intends to help the end users by providing them with a quick and thorough interactable analysis of the industrial units, available to be consulted at all times. From this, it will

be possible to save time that is repeatedly wasted when constructing and updating the formerly used Excel reports, which will make it so that, in turn, the end users' productivity and availability are bound to increase.

3.3 End-users

Before starting to design the report, there are a few more things that will have to be considered.

Firstly, all end users (and consequently their preferences) must be accounted for. The main users will be controllers and industrial directors, and these two types of users have different preferences over how they like to read their data. Since controllers have to perform exact analysis, they prefer tables and matrixes displaying the true values of the fields, while industrial directors are more inclined towards analysis based on graphs, which are not only quicker to read but also allow for a faster comparison with previous time periods, and to verify the trends of the factory performance.

On top of that, Industrial Directors in Amorim are not used to having a tool that directly provides them with the information they want to see. Because of this, it is even more important to develop a report that is easy to read and interact with, and that has all the relevant information quickly available to them. This will allow them to be more independent in their work and to perform a more effective control of the factory, as they do not have to wait for the construction of reports with the specific data they require every time they need to look at the factories' data.

3.4 Requirements Gathering

One of the core phases of the project is gathering the main requirements for the report from the end users' perspective. By identifying the main elements needed to be displayed within the report, the visuals and the type of analysis can start to be determined.

This process was made by engaging in discussions with the factories' controllers and attending some of the companies' Executive Committees, where every facet of the corresponding factory was analysed. In the financial analysis, as can be seen in Table 3.1, there are three main aspects that seem most important overall: the Industrial Contribution Margin, the Competitiveness, and the Stock levels.

Table 3.1: Main report indicators

Indicators	Description
Industrial Contribution Margin	The overall profit generated by the factory unit, the difference between the gross profit and the operational costs.
Competitiveness	How much, on average, it costs to produce 1000 cork stoppers, by dividing the operational costs by the total number of cork stoppers produced.
Stock levels	The stock levels and their evolution, with the ability to filter out by material.

Furthermore, the need for standardization and benchmarking also arised, as it was quickly noted that different people performed different kinds of analysis of the same subject, and that the same factory evaluated by two different people would undoubtedly end up with different results. By doing this, it was guaranteed that every factory would be evaluated under the same scope (Table 3.2). This standardization of optics of analysis and calculation of indicators ensured that different industrial units could quickly and effectively be compared among each other, something that was not possible up until this point.

In order to provide better monitoring and controlling capabilities to the end-users, an overview page with relevant key performance indicators needed to be added to the report. This need was inspired from a Bowler already used within the organization to measure compliance towards the objectives in various sectors. However, since the Amorim Cork database does not have the objectives loaded into their OLAP cubes, only a temporal analysis can be performed.

Table 3.2: Performance analysis pages

Page	Description
Benchmarking	Visuals to measure performance between multiple factory units with dimensionless values.
Overview	A page that allows for a quick overall analysis of the entire factory unit through evaluation of multiple KPIs.

Another aspect to take into consideration are the time frames to be considered in the analysis. Results usually have a month over month comparison with former periods, to remove seasonal effects and give a quick indicator whether the results are on the rise or declining.

Besides that, there was also a big emphasis on easily displaying month-related values, as well as the accumulated value up until that point of the year, as those are the ones that actually give the end result of the factory unit at the end of the year. This helps not only to determine the months with bigger or smaller contributions to the overall value, but also gives the users the ability to deep-dive in on said months to explore what went right or wrong in those months that can explain those values.

A more detailed description and requirements for each of the three main indicators follows, as well as the pages that will help end-users to perform a quick and effective overall analysis of the factory.

3.4.1 Industrial Contribution Margin

The Industrial Contribution Margin (ICM) is the most important indicator from a factory, as it represents the difference between the gross margin from the sales of the factory (towards business partners or the commercial side of the company) and the operational costs during the same time period. Simply put, it is how much money the factory generated towards the company, and naturally, it is an absolute need to be able to consult this value at all times.

However, this is not the only value that is of interest in this analysis, and there is the requirement to further expand upon the subsets of this simple subtraction to fully understand how the factory is performing.

The Industrial Contribution Margin is determined as the net difference between the gross margin and the operational costs. The main causes of variation in these subsets is what will later explain the differences in the end margin result. By further exploring both of the margin's influencers, the main causes of variation can be determined and explained.

Before this project, the factories' ICM was still a developing topic, and every end user of the OLAP cube performed their own analysis with their own purposes. So, evidently, there was a need to standardize the optics of the analysis, as well as the restrictions and filters of certain fields, so that the information everyone will ever need to consult can be accessible in only one place.

3.4.2 Competitiveness

To Amorim Cork SA, the competitiveness of a factory is represented by how much it costs to produce 1000 cork stoppers, or mathematically, the division between the operational costs and how much cork stoppers were produced during the same time period (expressed in thousands). However, in more specific cases, like in the Amorim Top Series Unit, this metric is not the most accurate way to express this indicator, as being a factory that specializes in customised high-value items, there is a trend towards producing less and less cork stoppers, but the value of the production has been steadily increasing throughout the years. So, an additional element of the report will have to compare the operational costs with the value of the produced cork stoppers.

3.4.3 Stock level

Perhaps the most simple and straightforward aspect of the analysis is the factories' stock level. Even so, it is still needed to divide it into the different types of material, ranging from raw cork and cork stoppers to chemicals and packaging material. Besides that, it is also in this sector of the report that the production adjustments will be considered, as they cancel out any extra virtual production that may have occurred over the course of a month.

3.4.4 Benchmarking

Regarding the benchmarking between the different factory units, all the former indicators had to be expressed, however they need converted into dimensionless values, so that bigger factories do not automatically have better indicators and thus appear to be more efficient. To do that, indicators have to be calculated in a way that ignores the amount of activity performed within the factory, and simply look at the productivity of it.

By having these indicators, it will be possible to perform an accurate comparison across all factory units, and easily identify the best and worst performing factories inside the organization, as well as from where in the factories' values that differentiation comes from.

3.4.5 Overview Page

Naturally, the report will also benefit from having an overview page, an informing and interactive first page, where all the main performance KPIs developed when constructing the report will be displayed, along with a temporal analysis to detail the progress compared to that of last year.

With this page, end users will be able to quickly identify the areas with the more significant variations, and will be able to easily explore that indicator into all the detail necessary, all the way into the root of the deviation. That way, instead of scrolling aimlessly through the report pages looking for causes unsure where they are most likely to appear, the user experience will be much more personalised and directed towards quickly realizing what the most critical points of the factory are, and where actions need to be taken.

Chapter 4

Development

When creating a performance report or dashboard, the data has to be prepared to match the needs of its users, and organized in a way that is easy to read and understand. In this chapter, the steps taken towards meeting these goals are explained, by elaborating on what measures and tables were added to the database and the reasoning behind them, as well as the justification for the visuals used and their layout on each page.

4.1 Understanding the Data

To create this report, for the first time in the companies' 1027 Power BI reports, two datasets need to be merged to create a Data Mart, as both the financial and the production OLAP cubes are going to be used. These cubes have multiple similarities, which will create many duplicate tables. For example, the different factory units are divided into centers, that then segment themselves into profit centers, and a level below that, cost centers. As for materials, they follow a hierarchy capable of explaining every single material in full detail.

In both cubes there is a Movements table, where all the transactions inside a factory are detailed. Movements have a quantity and value associated with them, as well as a type of order which pointed towards what type of transaction it was. Besides that, some movements also have a "profit center partners movements", the destination profit center for the internal movements within the company.

To easily filter the data through different time scopes at any given time, the financial and production cubes also have, respectively, a "Type of value" and "Type of Temporal Analysis" field, which, despite the different name, provide the same utility. These fields allow data to quickly be set to distinct time frames to perform different analyses (eg. actual vs year-to-date).

In order to properly classify the types of internal movements, they are also separated by a classification of stock movements field. The most important ones for the creation of the report will be the 101 and 102, which represent production orders, and the 903 and 904, which represent stock adjustments.

In the financial cube, data is organized in a way that allows the quick creation of a full income statement, by having an account hierarchy where the levels of the hierarchy are equal to those of an income statement. There are several types of structure in the account hierarchy, destined for different end-goals: for example, the "EMCI" structure refers to the ICM, while the "EMCC" structure only looks at the values that contribute to the company's Commercial Contribution Margin. Besides that, there are also some pre-calculated measures that provide the values of some of the knots inside the income statement, in case they are needed for quick use.

An important field inside the production cube is the deposits in which the stock is stored. By storing the values and quantities within their own separate deposit, it is possible to divide the factories' stock levels into finished products, shipped stock, WIP, and even returns from unsatisfied customers.

4.2 Transforming the Data

As explained in chapter 2, Microsoft Power BI allows users to create measures using the DAX programming language. By using this language, new fields of data can be created in order to fulfill needs that cannot be achieved with the data available in the OLAP cubes. For this report, various measures had to be developed to further expand the capabilities of the data presented and to provide a more thorough and exact analysis.

Furthermore, with the merger of the two OLAP cubes (financial and production), filtering tables had to be added to ensure that, when applying filters to the data, those were taking effect on both cubes. That way, the same page could display information from both cubes regarding the same factory unit. Besides that, those filtering tables also made it possible to create measures that were calculated using data from tables of different sources without compromising the reliability and accuracy of the outcome.

4.2.1 Added Measures and Tables

This section presents the most relevant measures and tables that were created and added to the Data Warehouse, explaining the used data fields and DAX functions in detail.

4.2.1.1 Sales

One of the most clear areas where the data stored in the cubes would not suffice to explain the operations inside the organization to the level of detail expected was regarding the sales values. Due to the size of the organization, and the fact that its centers are divided into distinct profit centers with different types of operations, certain aspects had to be considered when creating a measure to calculate sales.

Firstly, only certain knots within the income statement were to be considered, as not all movements inside a company are sales. These fields were: "Sales", "Internal Sales" and "Return of

Sales". The junction of these three items accounted for the total raw sales of the analysis in question. Then, to remove artificial or duplicate values, the movements whose end profit center was one of those being analysed cannot be considered. To do this, the table with the list of the selected profit centers and the movements table needed to be cross-filtered, which was done with the TREATAS function. With this function, it is possible to filter information through unrelated tables, and so, by using it to treat the Profit Centers from the selected values of the slicers as filters for the Partner Profit Centers field in the Movements table, the transactions that needed to be expurgated were removed and the final values of net sales determined.

Internal sales, however, have an extra level of complexity when calculating them. Since not all centers are capable of performing all the processes for the treatment of cork stoppers (eg. washing, a process that gives colour to the cork stoppers), they can request that service from a different factory. Upon returning those finished cork stoppers, a new exit movement of materials between centers is created which at first glance count as sales. Those movements are not to be considered since they do not represent actual sales of that factory, and so, through filtering of the stock movement field, they were identified and removed from the total sales value. Only then is the net value of internal sales fully determined, and further analysis can start to be made.

Once all the final values are determined and there is a clear distinction between internal and external sales, another measure that is worth adding to the report is the "Average Price", that allows end-users to monitor the prices at which they are selling their cork stoppers to specific business partners or partner centers, by dividing the total value of sales by the number of cork stoppers sold.

4.2.1.2 Gross Margin

To thoroughly explain the factories' gross margin, every segment of the data and its deviations compared to last year have to be detailed upon. That was done by analysing the fields of the income statement and determining how they could be further divided to provide the best possible explanation to the values. For example, when analysing the internal sales' margins, the logical fields of separation are the partner profit centers and the materials, which are not the same when analysing WIP levels, where the type of order is a much more relevant field than a profit center.

Besides analysing that whole segmentation, there is also another sector that requires detailed clarification when it comes to explaining the gross margin, which is the production deviations, the benefits or extra costs associated with production orders when the process does not go exactly as originally planned (eg. deviations in consumed raw materials, quality of the end product, among other factors of variation).

4.2.1.3 Competitiveness

Competitiveness is the ratio between operational costs and amount of cork stoppers produced. Operational costs were already a direct metric from the system, but there was no direct way to obtain the exact amount of cork stoppers produced over a certain period of time. Thus, a measure that determined that was created, not only in quantity, but also in value.

By looking at specific stock movements that represent production, two metrics were created to be able to display how many cork stoppers were produced in a given time period (in quantity and value). Then, an additional and final metric was created dividing the total operational costs (a direct field of the financial OLAP cube) and the net amount of cork stoppers produced (the newly created metric).

4.2.1.4 Time-series analysis

Even though the database had the fields "Type of value" and "Type of Temporal Analysis", as stated previously, these were not very dynamic, since they did not allow the values from different time scopes to be used in some visuals. Because of that, using the DAX expression `SamePeriodLastYear`, the corresponding value for the previous year (N-1) was calculated for every metric where this kind of analysis was necessary.

4.2.1.5 Stock divisions

As mentioned before, the deposit codes can be used to separate the type of stock by taking into account where in the factory it is placed. However, there was also a need to separate stock values by materials, and whether they are finished product, work in progress, or even some other secondary material (not cork) involved in the production process (packaging materials, glues and oils, ...).

Thus, specific measures were created to represent these values and easily group them together, taking into account the names of the materials and the deposit in which they were stored. In this aggregation, however, it was not possible to add the quantity of stocks, as not all materials have the same unit of measurement.

4.2.1.6 Benchmarking

In order to effectively benchmark the factories and provide an accurate comparison among them, the KPIs used to perform this analysis have to be dimensionless. To do that, the selected indicators must be divided by a value that detaches themselves from the factory to which they belong.

In the indicators regarding the ICM, that value is total sales, and the indicators to track are the ICM and the gross margin. By dividing these by the total sales, the result represents the factories' profitability, and a good field of comparison among industrial units.

For the KPIs related to competitiveness, the value of the division is the net amount of cork stoppers produced. As for the indicators to track, the most logical ones are all the subdivisions of the operational costs. By using these values, the size of the factory is removed from the equation and they represent the costs related to the production of each cork stopper.

As for stock indicators, the most relevant one to track is the stock coverage, which tracks the stock levels divided by the demand from each factory. Besides that, another indicator that is valuable to track are the impairments, divided by the total stock value.

Once all the KPIs were determined, measures were created to determine each of these indicators, using the DIVIDE DAX function.

4.2.2 Filtering

With all the relevant measures created and the data ready to be used inside the report, the only thing that was still missing was how to filter the report to show only the relevant data for each analysis.

The method used to achieve this can be seen in Figure 4.1, and it is based on adding auxiliary tables with the optics of centers and profit centers that need to be analysed for each different industrial unit.

These tables, connected to the models and among each other, are led by the "Fábricas mestre" table, which has the main divisions for the report filtering, and contains the fields to use when it comes time to filter the report's pages, the "Fábrica" (factory) field. From there, there is a connection to two different tables, the "Fábrica CL Finanças", that assigns the profit centers to be linked with each factory in the financial cube, and "Fábrica Centro Stocks", which links the factories to their respective center inside the production cube.

As for the connection between the factories and the centers inside the financial cube ("Fábrica Centro Finanças"), these were done via a checker, where by the DAX function SELECTED-VALUE, the selected values from both tables are compared to check whether they are the same or not. This connection could not be done in the same way as the previous two since linking these two tables would create a direct double filter to the financial Movements table, which is simply not possible to do in Microsoft Power BI.

With these connecting tables, it was possible to easily reach all levels of data granularity and get detailed information regarding every subset of each factory, from the overall company to a specific profit center.

4.3 Report Design

The first, and possibly most crucial element of the report, are the slicers which will be put at the top of every page. These slicers, using the filtering tables explained above, will allow end-users to filter the entire report to only show the information they require, either from one or multiple factories. Moreover, there will be another slicer, on the bottom of each page, with date related fields (month and year), so that the optic of the analysis can be easily set and, if needed, changed. Both of these slicers are visible and synced in every page of the report, hence, users will only need to filter once over the course of their analysis.

The last element that will be present in every page is a slicer to easily alternate between the actual and the year-to-date values, using the "Type of Value" field mentioned before. While visible in every page, this slicer will not be synced across report pages, as the main way to analyse factories is through the year-to-date values, with the occasional need for verification of the monthly values.

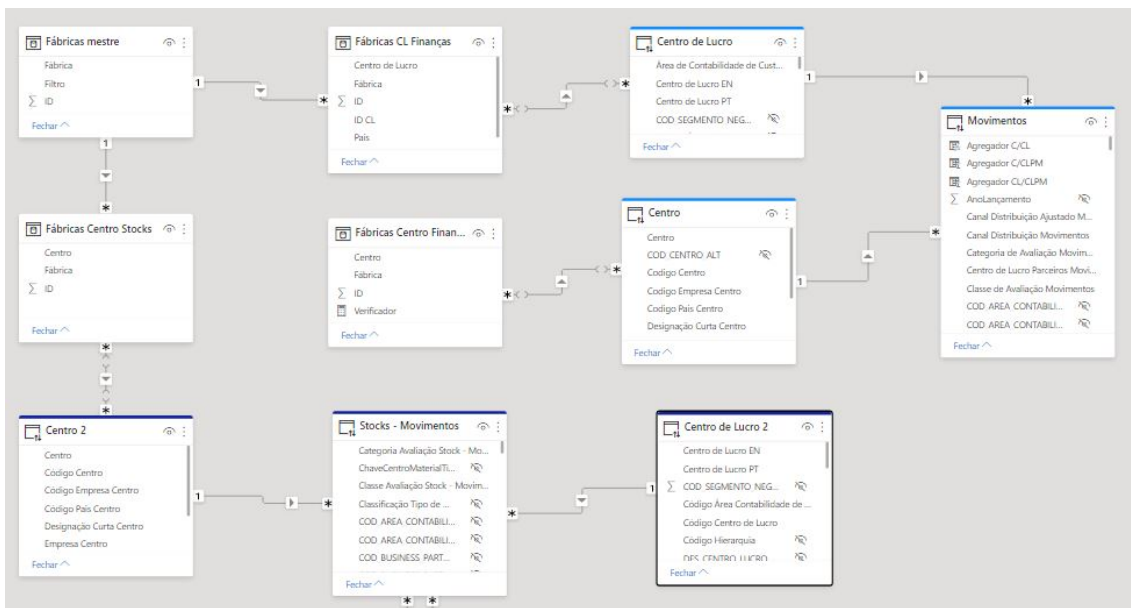


Figure 4.1: Added tables and their relationships

With these three elements, every user is now able to completely filter the report to match their needs. Moreover, Microsoft Power BI Service offers a bookmark capability that records the selections made inside each slicer and allows users to easily access those selections when opening the report with the simple click of a button.

To compare the performance of the factories between the current year and the last year, most tables will have both values present, as well as a third field which calculates the difference between the two and provides for a quicker analysis.

When it comes to laying out the report interfaces, there needs to be a focus regarding how the information of each page will be read and what are the most important fields information for each subsection of the report. To do that, each section of the report underwent a design process, to determine what the best visuals were for each page and which fields were the most relevant for analysis.

4.3.1 Overview

Noticeable in Figure 4.2, when designing the Overview page the goal was to provide end-users with the capability to quickly monitor and access every relevant facet of the industrial unit. Because of that, there was a prevalence to graphically displaying the values to provide a quick temporal analysis, as well as a comparison of the determined values with those of last year.

Of course, this being an initial monitoring page, there was not much detail regarding each KPI, and so a button directing users to the respective page with a more thorough analysis was added. This allowed users to not only quickly identify the areas inside the factory that were generating the biggest difference compared to last year, but also access the information regarding those areas and enable them to effectively determine the main root causes of variation.

Given the limited space of the dashboard, and the quantity of KPIs needed to be displayed, there was a need to add a second page to the overview, which was done with a bookmark. This bookmark switches the visuals in the page while maintaining the same original filters, and thus making it possible to combine information capable of filling two report pages in a single dynamic one.



Figure 4.2: Overview Report Page 1

4.3.2 Operational Costs

While constructing the detailed pages of the report, the readability of the information and the way it would be processed by users was taken into high consideration. Since typically, as Figure 4.3 shows, people instinctively attempt to extract information from an image by scanning it from the top-left to bottom-right of the page (Ambrose, 2007), there was an emphasis on placing the most important information on the top and then dividing it in further detail in the lower sections of the page. Besides that, the use of white space was also taken into consideration to show a clear separation between the visuals and establish a visual hierarchy within the information provided. Moreover, it was also used to not overwhelm the page with seemingly too much information, making the overall page more appealing to the end-users.

The overall design of the operational costs pages, which can be seen in Figure 4.4 for the maintenance costs, had its top row with the information directly from the income statement, as well as a temporal analysis, and the bottom section with a division over the most applicable fields from the Data Warehouse (cost center, material, business partner, among others). In the maintenance costs page, the bottom section focuses on Cost Centers and Business Partners. Besides maintenance costs, there are 4 more operational costs pages, namely:

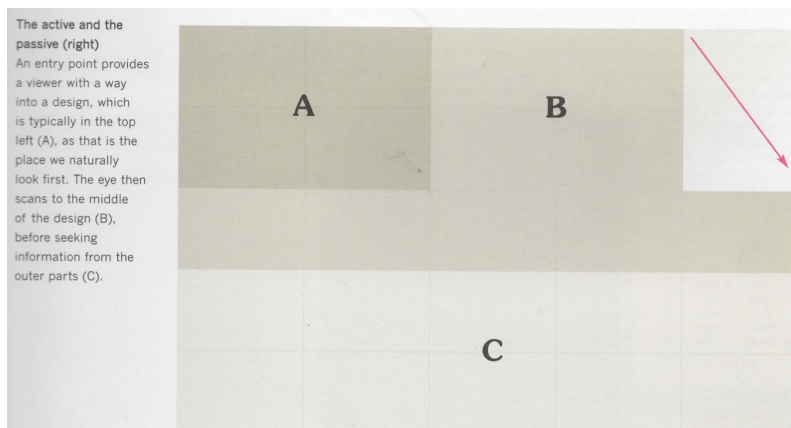


Figure 4.3: Focus points of readers (Ambrose, 2007)



Figure 4.4: Maintenance costs report page

- Staff costs, where the bottom section is divided into Functional Areas and Cost Centers. Moreover, there are two extra indicators that track how much was paid in overtime hours (gathered from a knot in the income statement) and the productivity of the factory (a measure created by dividing the total staff costs by the net amount of cork stoppers produced);
- Depreciations and amortizations, where the fields of subdivisions in the bottom sections are the Cost Centers and the Operational Accounts;
- External supplies and services, that are divided by Business Partners and Cost Centers, with a pointer to a separate page focused on the subcontracting of services, once again separated by Material and Business Partner;
- Energy, separated by Functional Areas and Cost Centers.

4.3.3 Gross Margin

The layout selected for the subsets of information inside the gross margin income statement is shown in Figure 4.5. In this page, the layout can be divided into two sections, a top and a bottom one. In the top area of the report page, information is separated by the two most relevant categories, while in the bottom a temporal analysis of the values is displayed. In the Internal Sales Margin page (Figure 4.5), the margin is presented while sorted by Partner Profit Center and Material. Besides this page, there are 5 additional pages to fully explain the gross margin, which are:

- Production Margin, separated by Operational Account and Material;
- Client Sales Margin, which is subdivided by Business Partner and Material;
- Commercial Sales Margin, that similarly to the Client Sales Margin is separated by Business Partner and Material
- WIP levels, divided by Production Order Type and Material;
- Product Deviations, where the values are sorted by Production Order Type and Operational Account.

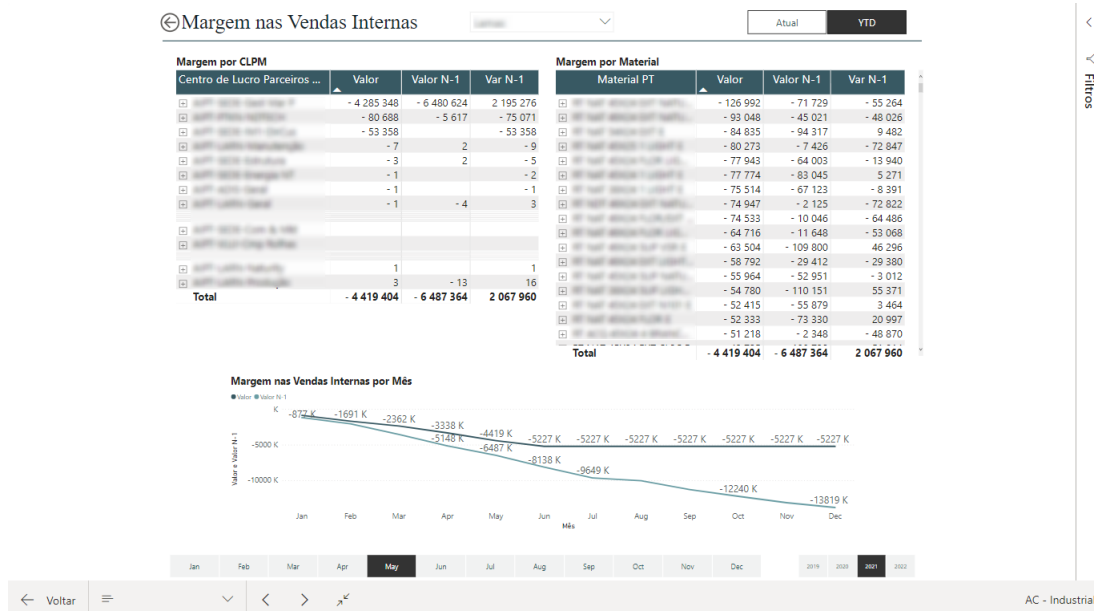


Figure 4.5: Internal Sales Margin report page

Additionally, in the product deviations' page, a tooltip (Figure 4.6) was also added to show the top 10 orders which contributed to the biggest deviations (in absolute value). A tooltip is a Power BI feature that displays separate pages of a report when hovering over the values of selected visuals, while keeping all filters of the original page and the hovered value. By applying it to the

page, it provides users with a quick way to identify the biggest outliers and contributors to each of the displayed values.

The selected design provides dynamic pages that can easily explain every facet involving the gross margin, giving thorough details about where the profits of the company come from and what operations are generating them.



Figure 4.6: Production deviations report page (with tooltip)

4.3.4 Sales

When categorizing sales, there needs to be a clear distinction between internal and external sales. For that, once again, the report page was separated into two sides, with the left one expanding upon the internal sales and the right upon the external ones, as seen in Figure 4.7.

For the internal sales, as explained previously, the services provided to other centers need to be expurgated from the total sales value. However, since they are still an operation made inside the factory, these movements are important to keep track of, and two different tables allow to fully elaborate on this topic, one showing net internal sales, and the other provided services.

Regarding the external sales, the analysis is more straightforward, and the only division that needs to be made for the values is separating them by destination country, and then by business partner.

In comparison to the other pages of this report, sales are examined under a different scope of analysis, as they are analysed based on centers instead of profit centers. Because of this, a second slicer had to be added to the page which got its values from the "Fábrica Centro Finanças" table, explained in Figure 4.1. By adding a checker to verify whether the selection in both slicers was the same, and removing the influence of the first slicer over the page, the page is, as intended, filtered by center instead of profit center.

As usual, a graph symbolizing the temporal evolution of the values is displayed in the bottom of the report page, to provide users with a visual tool that allows them to identify trends and compare this year values with last year's.

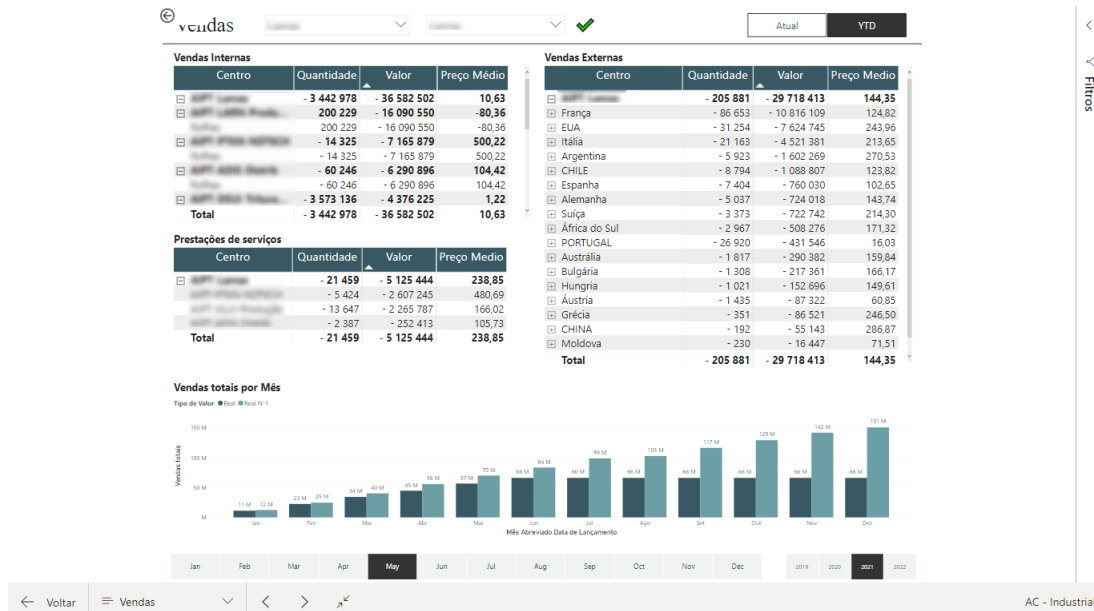


Figure 4.7: Sales report page

4.3.5 Stocks

In regards to analysing the stock levels in each factory, there are two optics of measurement that need to be taken into account: the stock values, and their evolution.

For the stock levels (Figure 4.8), it is important to quantify not only the value of each product in stock, but also the quantity of it, which, as explained before, has to first be split into units of measurement to not mix up values that cannot be grouped together. Besides that, another two indicators that are worth keeping close track are the impairments of products and the stock adjustments that are made manually to override any offset values that may have come from the system.

Furthermore, it is also important to provide users with a macro view of the stock value's temporal evolution, which will be further detailed in a separate page, visible in Figure 4.9. In this page, there are several groups of stock, made from the measures that were explained previously. With these metrics, an additional table with only one column with the names of the measures was created and inserted into a slicer. From that, a new measure using the DAX function SWITCH was created to update the evolution chart on the bottom of the report page so that it only shows the measure correspondent to the selected value of the slicer, and thus provide a easily accessible temporal analysis over all relevant stock related metrics.

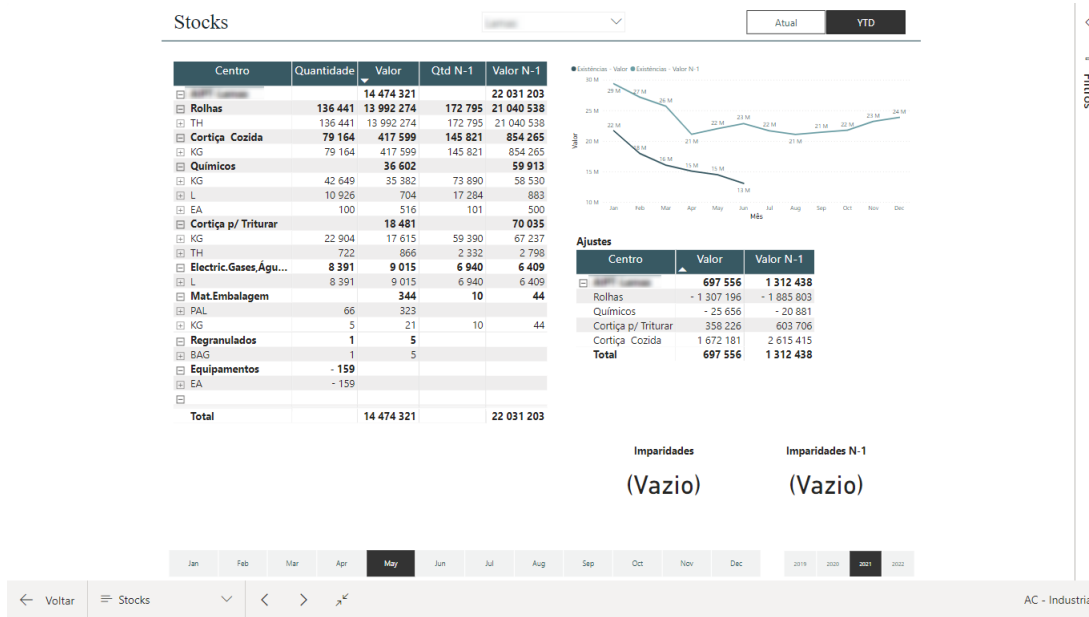


Figure 4.8: Stock analysis report page

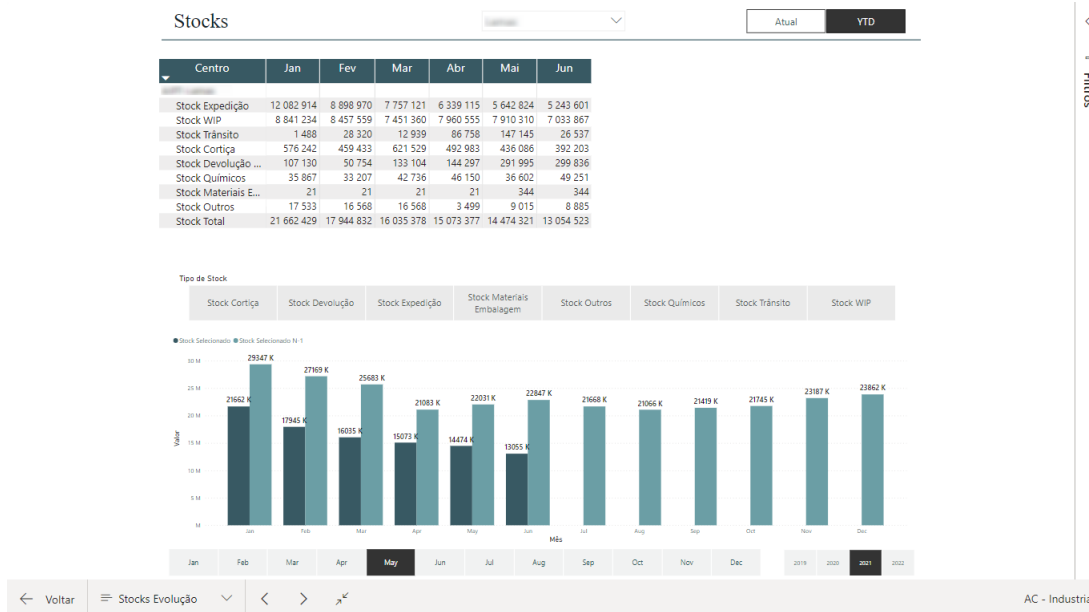


Figure 4.9: Stock evolution report page

4.3.6 Benchmarking

For the benchmarking page (Figure 4.10), a similar method to the one used in the stocks evolution page was used. By creating the measures and inserting them into a table, it was possible to filter the graph of the bottom of the page to successfully compare only the chosen measure across multiple factories.

As for the table, it provides not only a comparison with all the other selected factories, but also with itself, displaying the current and last year's values. This also allows the user to compare

the trend of the factories' performance, by analysing the variation from the previous year to the current one.

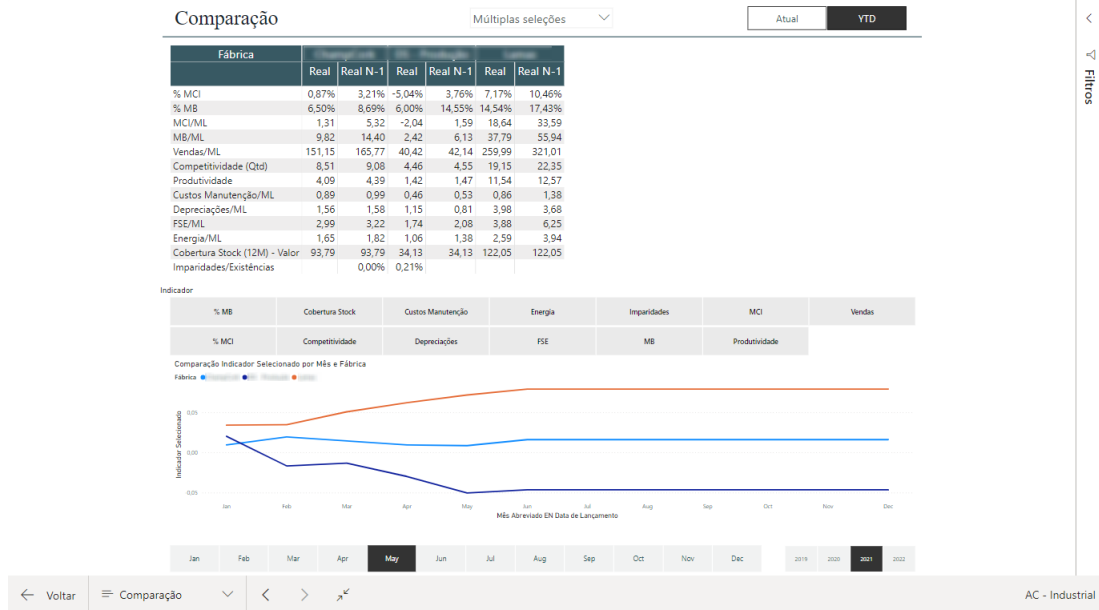


Figure 4.10: Benchmarking report page

Chapter 5

Implementation and Results

Once the report is fully developed, the implementation process can begin, to check whether it fulfills all required needs from the end-users and to gather feedback and results about the work produced. This chapter describes the implementation process and the results obtained with a survey that was provided to all end-users.

5.1 Implementation

The project was first implemented at a small scale in a testing phase with two controllers. After a quick familiarization and some minor adjustments to ensure the quality in the presentation of the data, the report was spread to the rest of the factory units and their optics of analysis were added to the report (through the filtering tables).

Even though Microsoft Power BI is already a tool used in many different areas of the company, this was the first report works with the factories' financial data, and so it was important to ensure that this transition of methodology was smooth and well accepted by all end-users.

To make sure that this happened, the 8 Kotter steps of change management were taken into account when implementing the new report (Kotter, 2021).

These 8 steps are:

1. **Create a sense of urgency** by finding reasons why change is necessary.
2. **Create a coalition** by forming a good team to create and implement the change.
3. **Develop a vision and strategy for change**, and create a clear vision of the differences between the previous method and the one that is hoped to be implemented.

The first three steps are directed towards creating a favorable climate for change. The reasons why change was necessary was obvious: there were various inefficiencies when analysing the factories' financial data, and a standardization of the values and analysis would certainly help in solving that problem. Moreover, users were guaranteed that the report would be created by the most suitable people for the job, since it was the responsibility of the company's Power BI team.

Lastly, they were explained how this new project would benefit their work, and give them more time to perform other value-added activities to the company.

4. **Communicate the vision**, and ensure that people support the innovation.
5. **Empower action** by removing barriers, such as organizational hierarchies, and allow people to assist the change.
6. **Create short-term wins**, as recognizing small wins motivates employees and makes them be more engaged with the process of change.

These following three steps are fundamental in making the change happen. By engaging with end-users and making them a part of the report designing process, they understood the final goals, and felt included and invested in the creation of the report, which made them more susceptible to accept it once it was completed. Moreover, since they were updated frequently on the status of the report, especially when new pages and functionalities were added, and even helped with some filters to reach some more complicated data, they saw first-hand the evolution of the report and were involved in that progress.

7. **Leverage wins to drive change**, and using the credibility gained from the first successes to motivate further improvement.
8. **Embed in culture**, by linking the improvements achieved to the implemented changes. That way, the new methods will become more enticing and eventually fully replace the old ones.

The last two Kotter steps have the goal to sustain change. This will be achieved by engaging in a continuous improvement process after the implementation of the report, to ensure that all needs of the end-users are met, either current ones or ones that might appear at a later time. That way, it is expected that, once the users are comfortable with the report and learn all its capabilities, they will embrace the new report as the main way of analysing the factories' financial data.

By applying these steps, the chances of the implementation's success vastly increased, and the end-users were more open to the change and use the new report.

To disseminate the report to all the end-users, a session was arranged where all the functionalities of the report were detailed. During this session, feedback was incentivized and all possible doubts were removed.

5.2 Results

To gather results concerning the usage of the report, a survey using Google Forms was created and distributed to all the end-users, to understand their satisfaction with the new report and to determine which areas of the report they felt that did not answer their requirements. This form, attached in Annex B, aimed at analysing every aspect of the report creation process, from the information available to the method of implementation. Besides that, there were also two extra

separate sections, one for controllers and the other for industrial directors, with more specific questions directed towards their use of the report. The report was answered by 11 (6 Controllers and 5 Industrial Directors) out of 14 end-users.

With this survey, it was clear that the overall feeling towards the report was positive, with an average satisfaction towards the information displayed in the report of 6,1 out of 7 (Figure 5.1), and with all end-users feeling comfortable enough to use the report independently and with trust in the presented data. This shows that the steps taken to facilitate the change were successful, and that the end-users are accepting the new report and are embracing it as part of their new day-to-day activities.

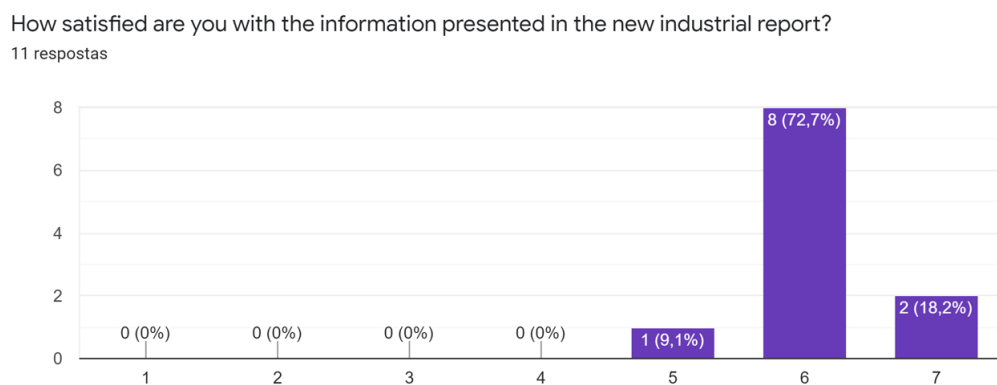


Figure 5.1: Satisfaction with displayed information

Besides that, there was a general increase in the desire to frequently perform control over the company’s financial values, as before the implementation of the report the most common practice was to analyse them once every fortnight or even month, done by over 70% of users (Figure 5.2a), and that plummeted to less than 10% after the implementation, with all but one user stating their desire to perform that analysis every week at the most (Figure 5.2b)

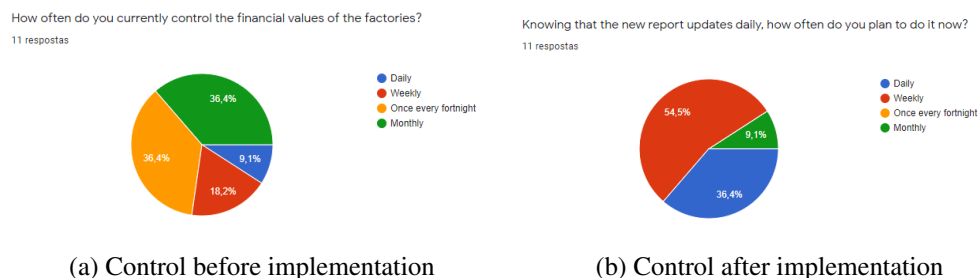
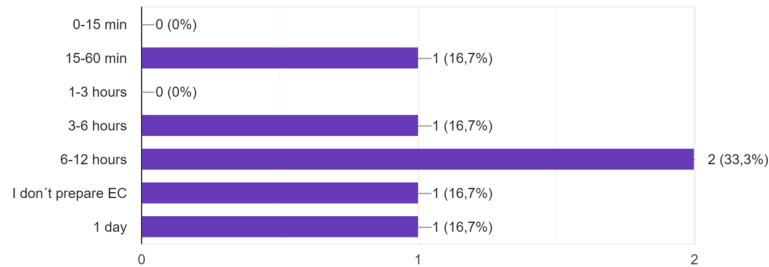


Figure 5.2: Data Control

Moreover, the main goal of the project, of creating a standardised report that would assist controllers and industrial directors in the preparation of the Executive Committees, was achieved,

On average, per week, how much time do you invest in preparing the executive committee and other necessary reports?

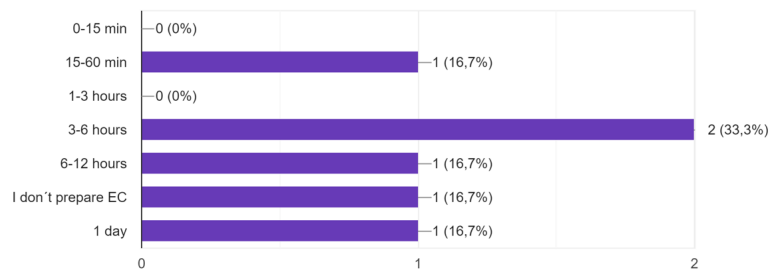
6 respostas



(a) Time spent in preparing reports

And how much of that time is invested in data collection?

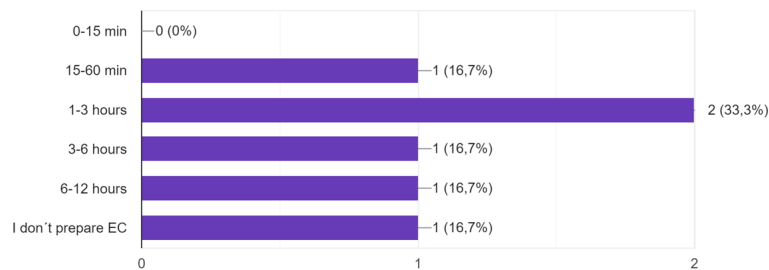
6 respostas



(b) Time spent in data gathering and preparation

How much time do you estimate that the new industrial report will save you each week in data collection and reporting?

6 respostas



(c) Time saved with new report

Figure 5.3: Controllers' time usage

with 100% of users claiming that the new report would assist them when preparing their presentations. Not only that, but the implemented report will also save a significant amount of the controller's time, formerly spent in data gathering and preparation. Figure 5.3 (taken from the controller specific section of the Google form) shows an estimated decrease of 40% in data collection and preparation time, that translates to, on average, 4 hours each week per controller. This

brings a significant benefit to the company and allows controllers to focus on their core job, that is to analyse the data and from there make their conclusions about what is happening in the factories. Summing up, it is clear from the answers that the new report provides users with the ability to perform more frequent control while spending less time, which translates itself into a big benefit for the company.

As for the Industrial Directors, the biggest advantage for them originated from the report is data accessibility, as seen in Figure 5.4, since they no longer have to depend on controllers to build the reports for them with the necessary data. This allows them to perform analysis in a more timely manner, and to act quicker on areas that they may notice are underperforming. Besides that, with the new report, they also benefit from the increased data quality, originated from the standardization process, both on how it is determined and how it is presented. By using the same report every time with fixed visuals, Industrial Directors now know where the data is stored and how to look and interact with it, something that they did not have prior to the implementation of the new report.

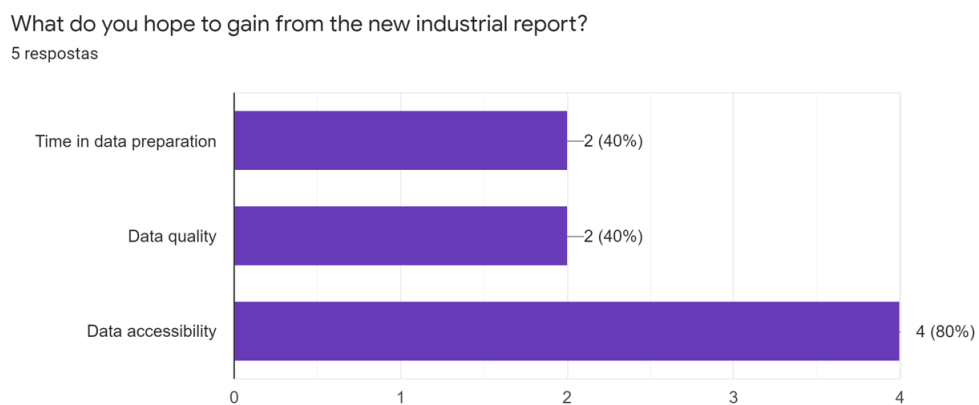


Figure 5.4: Industrial Directors Expected Gains

By analysing the ratings given to each section of the report individually (Figure 5.5), it is noticeable that the Overview page scored the best overall. As the introductory page to the report, this is very important, as it provides end-users with an engaging page upon opening the report, and it shows that the goal made for this page, of providing an interactable introductory page where users could quickly monitor every section of the factory unit and delve into the ones where they see the bigger discrepancies of the values, was met.

Alternatively, the report section with the most mediocre score is the Benchmarking one. Since this is a page made for comparisons between factory units and most end-users only have access to the data of one, this is justifiable, as for the single analysis of a industrial unit, this page alone does not bring much value.

After that, the sections that rated the most poorly overall were the Sales and Gross Margins portions of the report, with goes in hand with users' suggestions over which pages had the most

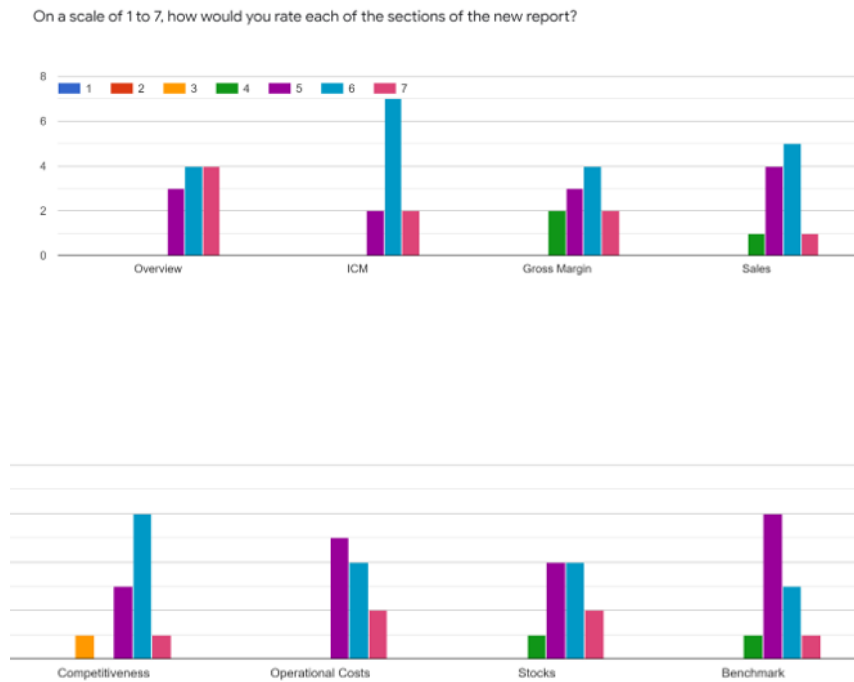


Figure 5.5: Report sections' ratings

room for improvement. These answers indicate that these sections should be the first to be looked at and worked on regarding future improvements, with a further need of enquiry to understand why these pages are not currently satisfying end-users needs and what additions have to be made.

An additional suggestion of improvement is the addition of budget and forecasting values to the report. This need is currently not achievable as these values do not yet exist in Amorim's Data Warehouse. Besides that one, another improvement suggested was the tracking of slow movers, which will be made possible once the impairment are associated with the materials, since as of now they only exist as a direct indicator.

Overall, the new industrial report answered the demands of the end-users, and provided them with a new tool with better visualization and reporting capabilities. This is shown in Figure 5.6, where the users rated the totality of the report and all its components as a 6.1 out of 7, a very positive score for a new report.

Globally, how would you rate the new report and the initiative to include in Power BI the dynamics of the company's financial analysis?

11 respostas

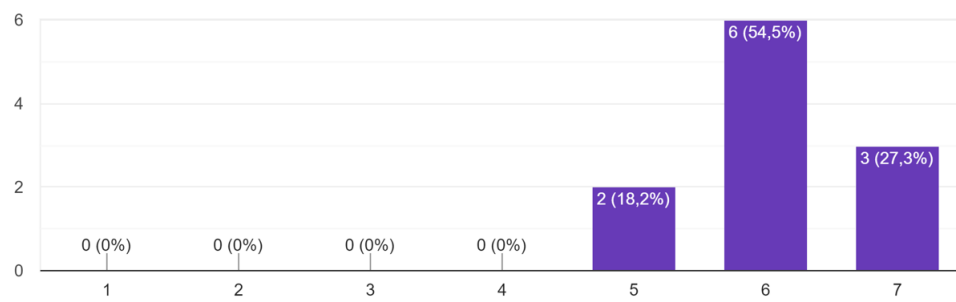


Figure 5.6: Global analysis of the report

Chapter 6

Conclusions and Future Work

Once all the results are gathered and analysed, it is time to reflect upon the project and make the adequate conclusions. Moreover, it is also relevant to infer on possible future improvements to the project, taking into account the feedback received and the capabilities of the service used.

6.1 Conclusions

The work developed in this Master's thesis had as a primary goal the creation of a standardised report in Microsoft Power BI to analyse the financial values of Amorim Cork SA's industrial units, by providing a detailed explanation of the Industrial Contribution Margin and all the subdivisions that came along with that concept.

With this explanation, it was also envisioned that the new report would be able to quickly detect the root causes of variation, providing users with effective analysis so that they know what are the areas of the factory that require intervention. Besides that, with the standardisation of the factories' analysis, a possibility for benchmarking arised, something that was not a reality in the company until this point.

This report was developed after an initial phase of requirements gathering, by working closely with the end-users of the information and assessing what data they need to visualize and which measures are critical to them.

To answer all of the end-users' needs, two OLAP cubes had to be combined into a single Data Mart, something unprecedented in the company until now, and additional measures were created through DAX programming to express the required indicators that were not fields in either of the cubes.

Besides that, the users' profiles also need to be taken into account when choosing how data is presented, as that is also a big factor in the efficiency of the information delivery process.

By understanding their requirements and arranging data in an appealing and interactive way, that data was transformed into valuable information, with which users can utilize to perform control and analysis over the factories' financial values.

Overall, the work developed in this project achieved the goals set out at its beginning, and users showed their pleasure with the report created and expressed their desire to use it as their main tool when analysing factories' performance in the future.

6.2 Future Work

Following the work performed during the current dissertation, there are a few suggestions of future improvements that can be made to improve the report and its capabilities.

Firstly, it is necessary to engage in a continuous improvement process to ensure that the needs of everyone who is in contact with the report are fulfilled, and that the usage of the report is as simple and direct as possible. This can be done by reinforcing the need for feedback, as well as by analysing the usage metrics provided by the Microsoft Power BI service, which reaches the granularity of every report page. That way, the better and the worse performing pages can be determined and actions can be taken according to those conclusions.

Moreover, the survey used to gather results already provided an indication over what pages of the report have the most room for improvement. That way, developments can start to be made on those pages (mainly Sales and Gross Margin) while usage data is being collected to provide another level of data to analyse and identify other areas of improvement.

Another capability that could be added to the report is to expand the model from only performing descriptive analysis and explore the more advanced predictive capabilities of Power BI. That way, it will be possible to better predict the short-term performance of factory units through, for example, trend and prevision lines.

Finally, since the Production cube was recently implemented in the company, it would be interesting to explore it more deeply and understand its capabilities, by studying if there are any other possible indicators that can be built on the basis of that cube that would provide additional visibility and control over the factories' performance.

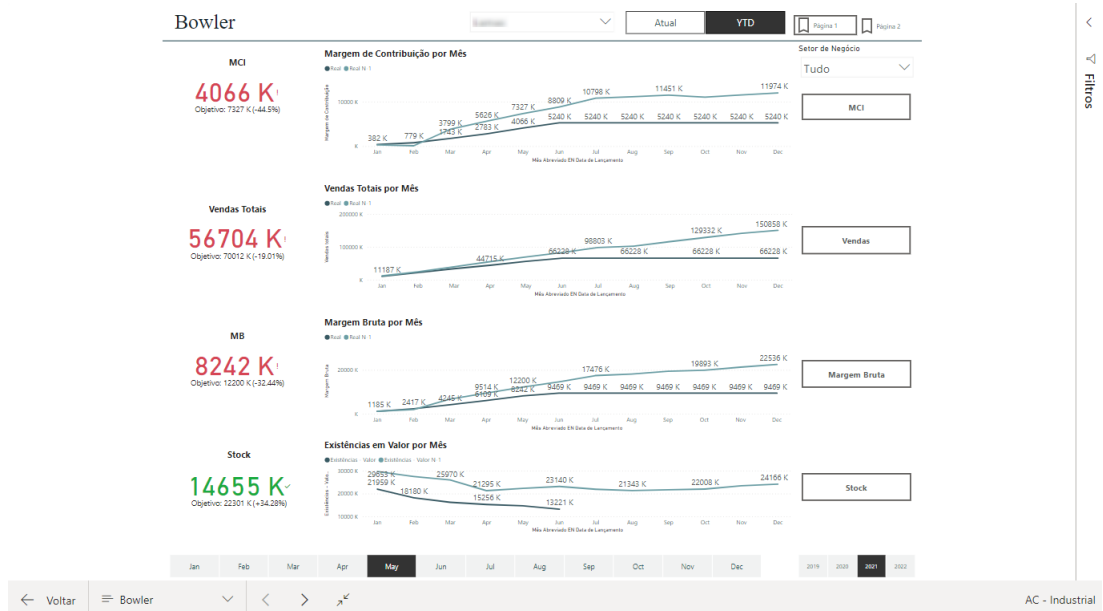
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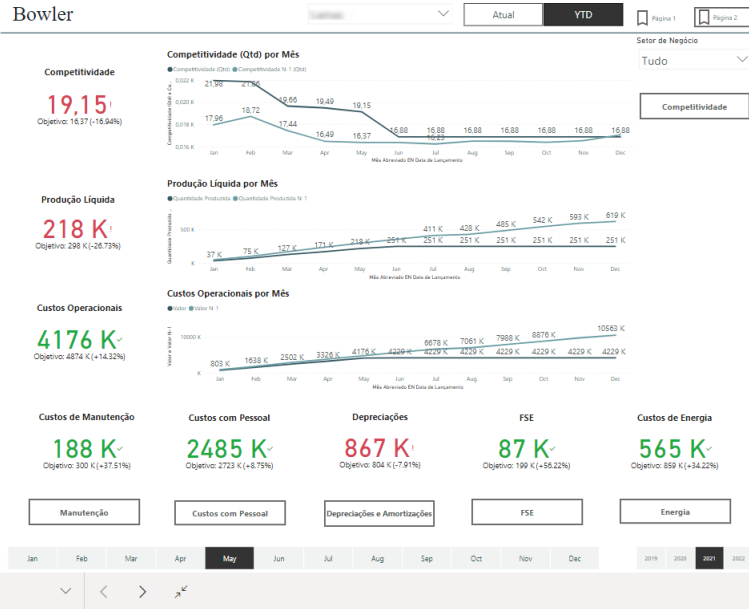
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Appendix A

Final Report





MCI

Atual YTD

	Real	Real N-1	Nível 4	Valor	Valor N-1	Var N-1
Vendas totais	56 704 061	70 012 123				
Margem Bruta	8 242 429	12 200 280	[-] Margem de Contribui...	- 4 066 406	- 7 326 585	3 260 178
% MB	14,54%	17,43%	[-] Margem Bruta	- 8 242 429	- 12 200 280	3 957 850
Custos Operacionais Totais	4 176 023	4 873 695	[-] Custo de Produç...	257 169 481	293 593 157	- 36 423 676
Margem de Contribuição	4 066 406	7 326 585	[-] Produção e Vend...	- 265 411 910	- 305 793 437	40 381 527
% MCI	7,17%	10,46%	[-] Custos e Provelto...	4 176 023	4 873 695	- 697 672
			[-] Energia	565 177	859 209	- 294 032
			[-] Combustíveis	130	130	0
			[-] Manutenção	187 613	300 239	- 112 626
			[-] Materiais de Proc...	6 116	5 576	540
			[-] Custos Com Pessoal	2 484 721	2 723 101	- 238 380
			[-] Outros Custos e P...	65 164	182 017	- 116 853
			[-] Depreciações e A...	867 101	803 552	63 549
			Total	- 4 066 406	- 7 326 585	3 260 178

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 2019 2020 2021 2022

Voltar MCI AC - Industrial

Margem Bruta

Atual YTD

Nível 6	Valor	Valor N-1	Var N-1
Margem Bruta	- 8 242 429	- 12 200 280	3 957 850
Produção e Vendas Industriais	- 265 411 910	- 305 793 437	40 381 527
Produção e Vendas Internas Industriais	- 261 753 370	- 298 654 007	36 900 637
Produção	- 261 753 370	- 298 654 007	36 900 637
Margem nas vendas Internas Industriais	- 4 419 404	- 6 487 364	2 067 960
Margem nas vendas para Comercial	262 431	- 281 510	543 941
Margem nas vendas para Área Comercial	- 164	- 164	- 164
Margem nas vendas para Cliente	262 615	- 281 510	544 125
Trabalhos em Curso - WIP	498 433	- 370 556	868 989
Trabalho em Curso - WIP	498 433	- 370 556	868 989
Custo de Produção	257 169 481	293 593 157	- 36 423 676
Consumo de Subprodutos	2 688 492	2 131 569	556 923
Contrapartida de Compras Internas Subprodutos	- 3 843	- 3 843	- 3 843
Reavaliação	225 527	140 888	84 639
Subprodutos	2 466 808	1 990 681	476 127
CMVMC	22 570 361	31 062 413	- 8 492 052
Contrapartida de Compras Internas CMVMC	- 1 935 251	- 1 435 725	- 499 526
Mercadorias e Matérias Primas	24 505 612	32 498 138	- 7 992 526
Consumo de Outras Áreas Industriais	24 571 717	26 561 710	- 1 989 994
Consumo de Outras Áreas Industriais	3 843	3 843	- 3 843
Consumo de Outras Áreas Industriais	120 061	112 849	7 212
Consumo de Outras Áreas Industriais	1 615 191	1 322 876	492 314
Consumo de Outras Áreas Industriais	22 632 622	25 125 985	- 2 493 363
Consumo de Intermediários e Acabados	207 338 912	233 837 465	- 26 498 553
Contrapartida de Compras Internas Inter e Aca	- 22 632 622	- 25 125 985	2 493 363
Desvios de Produção	- 9	291	- 300
Reavaliação	403 702	1 740 271	- 1 336 569
Intermediários e Acabados	229 567 841	257 222 988	- 27 655 047
Total	- 8 242 429	- 12 200 280	3 957 850

- Margem de Produção
- Vendas Internas
- Vendas para Cliente
- Vendas para Comercial
- WIP

Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec

← Voltar

≡ Margem Bruta

AC - Industrial

Margem de Produção

Atual YTD

Margem de Produção por Conta Operacional

Nível 6	Valor	Valor N-1	Var N-1
Margem Bruta	- 4 583 889	- 5 060 850	476 961
Produção e Vendas In...	- 261 753 370	- 298 654 007	36 900 637
Produção	- 261 753 370	- 298 654 007	36 900 637
Custo de Produção	257 169 481	293 593 157	- 36 423 676
Consumo de Subgr...	2 688 492	2 131 569	556 923
Contrapartida de C...	- 3 843	- 3 843	- 3 843
Reavaliação	225 527	140 888	84 639
Subprodutos	2 466 808	1 990 681	476 127
CMVMC	22 570 361	31 062 413	- 8 492 052
Contrapartida de C...	- 1 935 251	- 1 435 725	- 499 526
Mercadorias e Mat...	24 505 612	32 498 138	- 7 992 526
Consumo de Outra...	24 571 717	26 561 710	- 1 989 994
Consumo de Outra...	3 843	3 843	- 3 843
Consumo de Outra...	120 061	112 849	7 212
Consumo de Outra...	1 615 191	1 322 876	492 314
Consumo de Outra...	22 632 622	25 125 985	- 2 493 363
Consumo de Interm...	207 338 912	233 837 465	- 26 498 553
Contrapartida de C...	- 22 632 622	- 25 125 985	2 493 363
Total	- 4 583 889	- 5 060 850	476 961

Margem de Produção por Material

Material PT	Valor	Valor N-1	Var N-1
CT/TRIT VED - COZ ...	- 3 813 398	- 4 449 364	635 965
RT NAT 45X24 SUP ...	- 661 250	- 463 492	- 197 758
RT NAT 49X24 AA PVF	- 627 221	- 627 221	- 627 221
RT NAT 49X24 E/S (L...	- 554 626	- 685 648	131 022
RT NAT 49X24 EXT ...	- 519 452	- 189 913	- 332 540
RT NDT 49X24 FLOR...	- 511 441	- 563 903	52 462
RT NAT 45X24 1 LIG...	- 508 997	- 130 012	- 378 984
RT NAT 49X24 SUP ...	- 508 705	- 307 195	- 201 510
CT/TRIT VED - COZ ...	- 468 147	- 698 081	229 934
RT NAT 49X24 SUP ...	- 459 095	- 123 873	- 335 222
RT NAT 45X24 A BH ...	- 455 686	- 455 686	- 455 686
RT NAT 49X26 EXT ...	- 454 844	- 525 403	70 559
RT NAT 45X24 EXT ...	- 422 863	- 245 607	- 177 256
RT NAT 49X24 1 LIG...	- 410 405	- 59 866	- 350 539
RT NDT 49X26 EXT ...	- 402 483	- 362 338	- 20 145
RT NAT 49X25 AA PVF	- 401 243	- 401 243	- 401 243
RT NDT 49X24 EXT ...	- 391 653	- 750 107	358 453
RT NAT 45X26 SUP ...	- 383 463	- 441 908	58 444
RT NAT 49X24 FLOR E	- 378 844	- 817 196	438 352
Total	- 4 583 889	- 5 060 850	476 961

Margem de Produção por Mês



Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec

← Voltar

≡ Margem de Produção

AC - Industrial

≡ Filtros

≡ Filtros

⊖ Margem nas Vendas Internas

Atual YTD

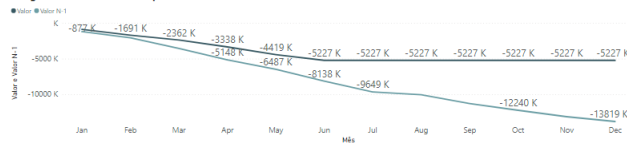
Margem por CLPM

Centro de Lucro Parceiros ...	Valor	Valor N-1	Var N-1
...	- 4 285 348	- 6 480 624	2 195 276
...	- 80 688	- 5 617	- 75 071
...	- 53 358		- 53 358
...	- 7	2	- 9
...	- 3	2	- 5
...	- 1		- 2
...	- 1		- 1
...	- 1	- 4	3
Total	- 4 419 404	- 6 487 364	2 067 960

Margem por Material

Material PT	Valor	Valor N-1	Var N-1
...	- 126 992	- 71 729	- 55 264
...	- 93 048	- 45 021	- 48 026
...	- 84 835	- 94 317	9 482
...	- 80 273	- 7 426	- 72 847
...	- 77 943	- 64 003	- 13 940
...	- 77 774	- 83 045	5 271
...	- 75 514	- 67 123	- 8 391
...	- 74 947	- 2 125	- 72 822
...	- 74 533	- 10 046	- 64 486
...	- 64 716	- 11 648	- 53 068
...	- 63 504	- 109 800	46 296
...	- 58 792	- 29 412	- 29 380
...	- 55 964	- 52 951	- 3 012
...	- 54 780	- 110 151	55 371
...	- 52 415	- 55 879	3 464
...	- 52 333	- 73 330	20 997
...	- 51 218	- 2 348	- 48 870
Total	- 4 419 404	- 6 487 364	2 067 960

Margem nas Vendas Internas por Mês



Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 2019 2020 2021 2022

Voltar

AC - Industrial

⊖ Margem nas Vendas para Cliente

Atual YTD

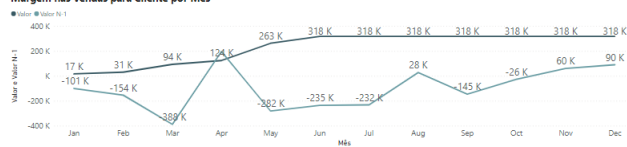
Margem por BP

Business Partner	Valor	Valor N-1	Var N-1
...	- 87 844	- 60 379	- 27 465
...	- 83 958	- 111 679	27 722
...	- 12 024	- 13 346	1 322
...	- 11 930	- 8 000	- 3 930
...		- 7 391	7 391
...		- 16 164	16 164
...		- 19 253	19 253
...		- 120	120
...		- 452	452
...	778	2 271	- 1 493
...	457 593	- 46 998	504 590
Total	262 615	- 281 510	544 125

Margem por Material

Material PT	Valor	Valor N-1	Var N-1
...	- 87 844	- 76 542	- 11 301
...	- 81 841		- 81 841
...	- 12 697	- 13 890	1 193
...	- 11 930	- 8 000	- 3 930
...	- 7 651	- 12 126	4 474
...	- 2 117	- 2 128	11
...		- 120	120
...	- 136 647	136 647	
...		- 1 577	1 577
...		- 3 125	3 125
...		- 10 095	10 095
...		- 5 197	5 197
...	672	544	128
...	778	2 271	- 1 493
...	17 272		17 272
Total	262 615	- 281 510	544 125

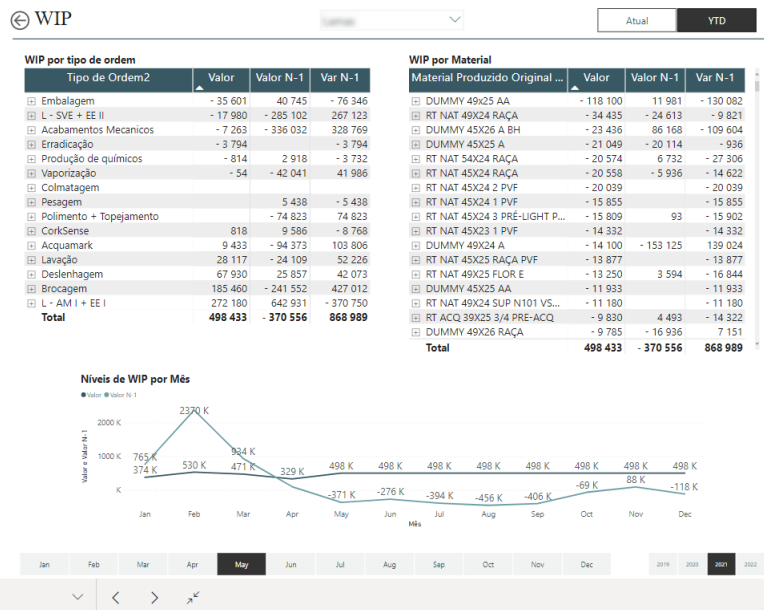
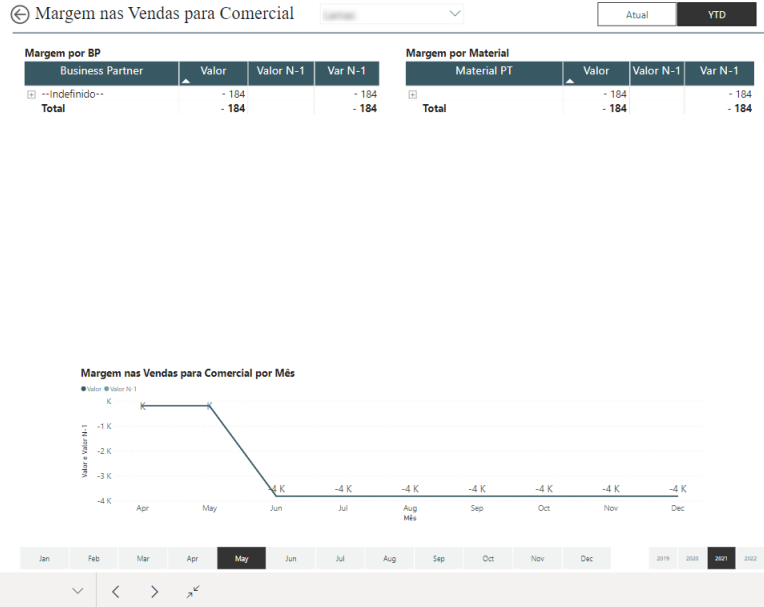
Margem nas Vendas para Cliente por Mês

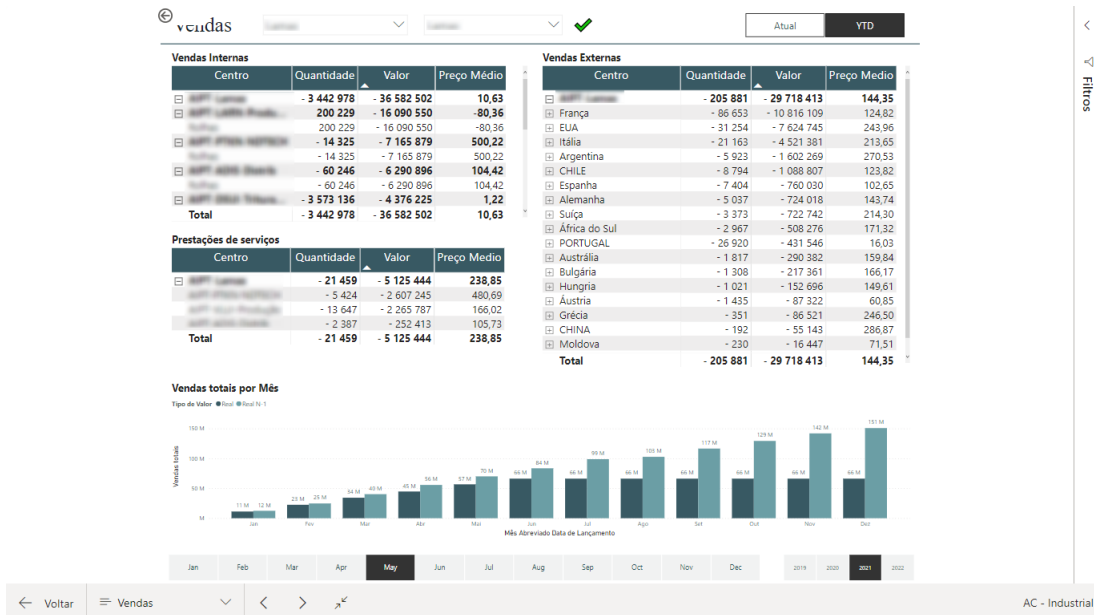
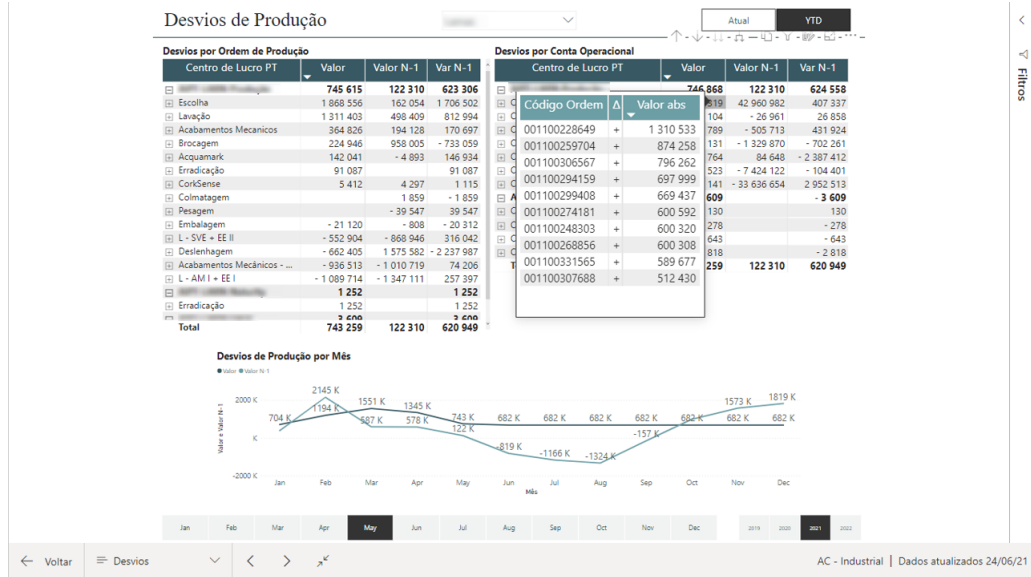


Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 2019 2020 2021 2022

Voltar

AC - Industrial



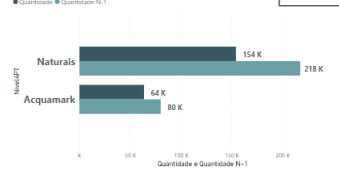


Competitividade (por quantidade)

Atual YTD

Nível 5	Valor	Valor N-1	Var N-1
Custos e Projeitos Ope...	4 176 023	4 873 695	- 697 672
Costos Com Pessoal	2 484 721	2 723 101	- 238 380
Depreciações e Amorti...	867 101	803 552	63 549
Energia	565 177	859 209	- 294 032
Manutenção	187 613	300 239	- 112 626
Outros Custos e Provei...	65 164	182 017	- 116 853
Materiais de Processo	6 116	5 576	540
Combustíveis	130		130
Total	4 176 023	4 873 695	- 697 672

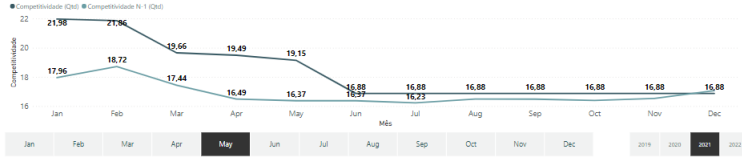
Quantidade produzida por material



Quantidade produzida

Centro	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rolhas												
Quantidade	36 522	74 904	127 145	170 416	217 882	250 385	250 385	250 385	250 385	250 385	250 385	250 385
Quantidade N-1	51 854	100 409	170 445	235 823	297 655	353 525	411 394	428 161	484 561	541 545	592 822	619 009
Quantidade						109	109	109	109	109	109	109
Quantidade N-1												

Competitividade por Mês

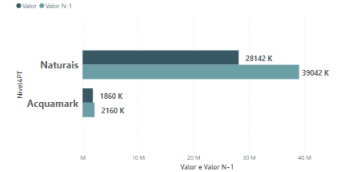


Competitividade (por valor)

Atual YTD

Nível 5	Valor	Valor N-1	Var N-1
Custos e Projeitos Ope...	4 176 023	4 873 695	- 697 672
Costos Com Pessoal	2 484 721	2 723 101	- 238 380
Depreciações e Amorti...	867 101	803 552	63 549
Energia	565 177	859 209	- 294 032
Manutenção	187 613	300 239	- 112 626
Outros Custos e Provei...	65 164	182 017	- 116 853
Materiais de Processo	6 116	5 576	540
Combustíveis	130		130
Total	4 176 023	4 873 695	- 697 672

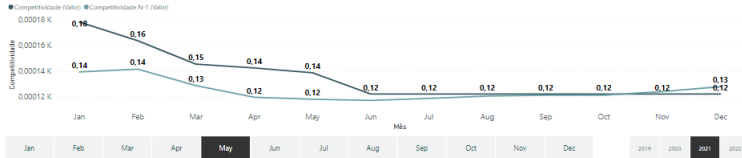
Valor produzido por material



Valor produzido

Centro	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rolhas												
Valor	4 467 163	9 964 123	17 123 883	23 260 667	30 002 442	34 485 531	34 485 531	34 485 531	34 485 531	34 485 531	34 485 531	34 485 531
Valor N-1	6 682 670	13 277 321	23 075 891	32 445 078	41 201 878	49 355 553	56 185 206	58 459 379	65 805 801	73 088 470	78 959 143	82 525 749
Valor						28 843	28 843	28 843	28 843	28 843	28 843	28 843
Valor N-1												

Competitividade por Mês

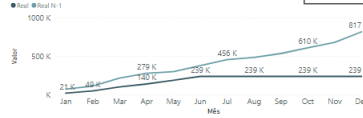


Custos de Manutenção

Atual YTD

Nível 6	Valor	Valor N-1	Var N-1
Manutenção	187 613	300 239	- 112 626
Serviços Externos de Manutenção	132 169	235 980	- 103 811
Materiais de Manutenção	73 025	76 166	- 3 141
Serviços Internos de Manutenção	- 17 581	- 11 906	- 5 675
Total	187 613	300 239	- 112 626

Custos de Manutenção por Mês



Manutenção por Centro de Custo

Centro de Custo PT	Valor	Valor N-1	Var N-1
CA - Diretos Industriais	81 908	89 570	- 7 662
CA - Suporte Industrial	39 443	33 560	5 882
CA - Manutenção	22 471	21 239	1 232
CA - Outros	21 355	21 108	246
CA - Serviços Externos	14 816	34 354	- 19 538
CA - Materiais de Manutenção	12 697	25 404	- 12 706
CA - Serviços Internos	10 972	40 843	- 29 871
CA - Outros	10 755	12 692	- 1 936
CA - Serviços Externos	6 354	20 679	- 14 324
CA - Materiais de Manutenção	5 828	4 187	1 641
CA - Serviços Internos	5 084	4 648	435
CA - Outros	4 762	3 576	1 187
CA - Serviços Externos	2 973	969	2 004
CA - Materiais de Manutenção	2 514	2 514	0
CA - Serviços Internos	2 107	1 039	1 068
CA - Outros	1 896	6 091	- 4 195
CA - Serviços Externos	1 547	864	703
Total	187 613	300 239	- 112 626

Manutenção por BP

Business Partner	Valor	Valor N-1	Var N-1
CA - Diretos Industriais	27 102	1 525	25 577
CA - Suporte Industrial	20 199	11 508	8 691
CA - Manutenção	19 481	17 643	1 838
CA - Outros	12 052	9 941	2 111
CA - Serviços Externos	11 618	391	11 226
CA - Materiais de Manutenção	11 616	20 038	- 8 422
CA - Serviços Internos	11 119	13 145	- 2 027
CA - Outros	9 051	10 203	- 1 152
CA - Serviços Externos	8 808	8 808	0
CA - Materiais de Manutenção	8 696	6 996	1 701
CA - Serviços Internos	8 644	18 672	- 10 028
CA - Outros	8 060	10 815	- 2 755
CA - Serviços Externos	7 745	7 756	- 10
CA - Materiais de Manutenção	7 536	7 536	0
CA - Serviços Internos	7 130	7 130	0
CA - Outros	6 681	6 227	454
CA - Serviços Externos	6 677	3 548	3 129
Total	187 613	300 239	- 112 626

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Custos com Pessoal

Atual YTD

Nível 6	Valor	Valor N-1	Var N-1
Custos Com Pessoal	2 484 721	2 723 101	- 238 380
Remunerações do Pessoal	2 037 000	2 251 476	- 214 475
Encargos sobre remunerações	408 612	437 165	- 28 552
Outros	26 636	22 925	3 711
Seguros Acidentes Trabalho Do...	21 260	21 463	- 203
Cantina	- 8 788	- 9 928	1 140
Total	2 484 721	2 723 101	- 238 379

Custos com Pessoal por Mês



Custos com Pessoal por Área Funcional

Área Funcional PT	Valor	Valor N-1	Var N-1
CA - Diretos Industriais	1 963 585	2 194 663	- 231 078
CA - Suporte Industrial	521 136	528 438	- 7 302
Total	2 484 721	2 723 101	- 238 379

Horas Extra **Horas Extra N-1**
45 K **29 K**

Produtividade **Produtividade N-1**
11,39 **9,15**

Custos com Pessoal por Centro de Custo

Centro de Custo PT	Valor	Valor N-1	Var N-1
CA - Diretos Industriais	452 776	498 325	- 45 548
CA - Suporte Industrial	384 847	411 157	- 26 310
CA - Manutenção	336 575	334 817	1 758
CA - Outros	216 723	272 343	- 55 620
CA - Serviços Externos	152 716	159 206	- 6 491
CA - Materiais de Manutenção	138 539	106 091	32 448
CA - Serviços Internos	127 624	137 579	- 9 955
CA - Outros	122 450	126 516	- 4 066
CA - Serviços Externos	115 734	124 501	- 8 767
CA - Materiais de Manutenção	101 793	86 501	15 292
CA - Serviços Internos	89 118	91 865	- 2 747
CA - Outros	87 699	75 449	12 240
CA - Serviços Externos	77 268	109 966	- 32 698
CA - Materiais de Manutenção	29 323	26 900	2 424
CA - Serviços Internos	22 232	106 959	- 84 727
CA - Outros	18 620	18 278	342
CA - Serviços Externos	9 359	8 385	975
CA - Materiais de Manutenção	3 022	423	2 599
CA - Serviços Internos	1 354	2 723	- 1 369
CA - Outros	- 27	- 27	0
Total	2 484 721	2 723 101	- 238 379

Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec 2019 2020 2021 2022

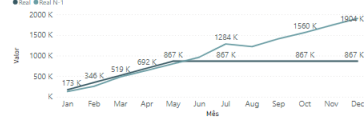
Depreciações e Amortizações

Legend

Atual YTD

Nível 6	Valor	Valor N-1	Var N-1
Depreciações e Amortizações	867 101	803 552	63 549
Ativos Tangíveis	836 883	801 292	35 591
Ativos Intangíveis	30 218	2 260	27 958
Total	867 101	803 552	63 549

Depreciações por Mês



Depreciações por Centro de Custo

Nível 8	Valor	Valor N-1	Var N-1
Ativos Tangíveis	836 883	801 292	35 591
At Fix Tang-Equip. Básico-Equipam...	185 456	200 321	- 14 865
At Fix Tang-Equip. Básico-Instalaçõ...	113 002	128 712	- 15 710
At Fix Tang-Equip. Básico-Ferrame...	83 817	61 027	22 790
At Fix Tang-Equip. Admin-Mobiliário	81 701	89 057	- 7 355
At Fix Tang-Equip. Básico-Outras L...	61 268	10 805	50 463
At Fix Tang-Equip. Admin-Equipam...	57 531	2 224	55 307
At Fix Tang-Equip. Básico-Instalaçõ...	53 188	53 508	- 320
At Fix Tang-Equip. Admin-Equipam...	48 383	85 728	- 37 345
At Fix Tang-Equip. Transporte	37 548	61	37 487
At Fix Tang-Equip. Básico-Equipam...	34 236	38 895	- 4 660
At Fix Tang-Equip. Básico-Instalaçõ...	24 313	21 089	3 224
At Fix Tang-Equip. Básico-Instalaçõ...	19 327	14 282	5 045
At Fix Tang-Equip. Básico-Instalaçõ...	15 244	18	15 225
At Fix Tang-Equip. Transporte	7 621	1 946	5 675
At Fix Tang-Equip. Admin-Equipam...	5 839	6 714	- 875
Total	867 101	803 552	63 549

Depreciações por Conta Operacional

Nível 8	Valor	Valor N-1	Var N-1
Ativos Tangíveis	836 883	801 292	35 591
At Fix Tang-Equip. Básico-Equipam...	641 812	630 667	11 145
At Fix Tang-Equip. Básico-Instalaçõ...	81 307	112 076	- 30 769
At Fix Tang-Equip. Básico-Instalaçõ...	60 313	39 616	20 697
At Fix Tang-Outros Ativos Fixos Ta...	37 237	28 455	8 782
At Fix Tang-Equip. Básico-Instalaçõ...	8 530	9 140	- 610
At Fix Tang-Equip. Admin-Equipam...	8 364	8 364	0
At Fix Tang-Equip. Básico-Ferrame...	7 082	5 249	1 833
At Fix Tang-Equip. Admin-Mobiliário	245	3 831	- 3 586
At Fix Tang-Equip. Transporte	- 8 006	- 27 742	19 736
Ativos Intangíveis	30 218	2 260	27 958
At Intangíveis-Programas de Com...	30 218	2 260	27 958
Total	867 101	803 552	63 549

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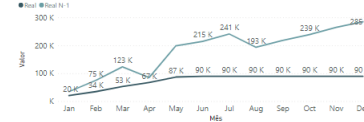
Fornecimentos e Serviços Externos

Legend

Atual YTD

Nível 7	Valor	Valor N-1	Var N-1
Fornecimentos e serviços exter...	86 912	198 532	- 111 620
FSE - Subcontratos	39 170	144 955	- 105 785
FSE - Serviços Prestados a Empre...	15 300	15 300	0
FSE - Serviços de Informação OSI	7 470	- 6 253	13 723
FSE - Materiais	7 049	9 473	- 2 423
FSE - Serviços Diversos	6 460	6 460	0
FSE - Rendas e Alugueres	4 413	3 370	1 043
FSE - Serviços Prestados Entidade...	3 542	463	3 078
FSE - Outros Trabalhos Especiais	3 491	43 103	- 39 612
FSE - Assurance	2 278	2 278	0
FSE - Deslocações, Estadias e Tra...	1 252	1 120	132
FSE - Seguros	378	271	106
FSE - Serviços Diversos Outros Se...	100	3 403	- 3 303
FSE - Vigilância e Segurança	76	139	- 63
FSE - Transportes	- 4 068	- 16 958	12 891
Total	86 912	198 532	- 111 620

Fornecimentos e Serviços Externos por Mês



FSE por Business Partner e Centro de Custo

Business Partner	Valor	Valor N-1	Var N-1
Subcontratação	160 818	151 656	9 162
...	6 460	6 460	0
...	3 742	3 742	0
...	785	42	743
...	621	621	0
...	430	430	0
...	406	609	- 203
...	400	200	200
...	353	588	- 235
...	304	304	0
...	295	1 914	- 1 619
...	287	287	0
...	215	215	0
...	214	46	169
...	170	106	64
...	126	80	46
Total	86 912	198 532	- 111 620

Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec 2019 2020 **2021** 2022

Subcontratação

Continuar

Atual YTD

Nível 8	Valor	Valor N-1	Var N-1
FSE - Subcontratos	39 170	144 955	- 105 785
Total	39 170	144 955	- 105 785

Subcontratação por Mês



Subcontratação por Material

Material PT	Valor	Valor N-1	Var N-1
SUBC RT BROCAR	34 808	81 384	- 46 576
SUBC RT LAVAR ROLHAS COLMATADO	4 362	56 237	- 51 875
	7 334		- 7 334
Total	39 170	144 955	- 105 785

Subcontratação por BP

Business Partner	Valor	Valor N-1	Var N-1
	34 807	83 301	- 48 494
	3 742		3 742
	621		621
		18 492	- 18 492
		269	- 269
		3 672	- 3 672
		39 221	- 39 221
Total	39 170	144 955	- 105 785

Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec 2018 2019 2020 2021 2022

Voltar

AC - Industrial

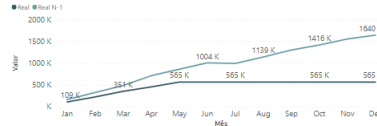
Energia

Continuar

Atual YTD

Nível 6	Valor	Valor N-1	Var N-1
Energia	565 177	859 209	- 294 032
Primárias	310 005	465 387	- 155 383
Electricidade	310 005	465 387	- 155 383
Secundários	255 173	393 822	- 138 650
Atividade - Energia	255 173	393 822	- 138 650
Total	565 177	859 209	- 294 032

Custos de Energia por Mês



Custos de Energia por Área Funcional

Área Funcional PT	Valor	Valor N-1	Var N-1
CA - Suporte Industrial	310 005	465 387	- 155 383
CA - Diretos Industriais	255 173	393 822	- 138 650
Total	565 177	859 209	- 294 032

Custos de Energia por Centro de Custo

Centro de Custo PT	Valor	Valor N-1	Var N-1
	215 458	359 136	- 143 678
	142 594	214 065	- 71 472
	51 096	75 551	- 24 455
	39 170	58 802	- 19 633
	34 728	28 356	6 372
	25 700	38 581	- 12 881
	18 309	27 487	- 9 177
	16 034	24 071	- 8 037
	13 410	20 131	- 6 721
	2 879	4 322	- 1 443
	2 767	4 155	- 1 387
	1 283	1 926	- 643
	1 227	1 842	- 615
	523	785	- 262
Total	565 177	859 209	- 294 032

Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec 2018 2019 2020 2021 2022

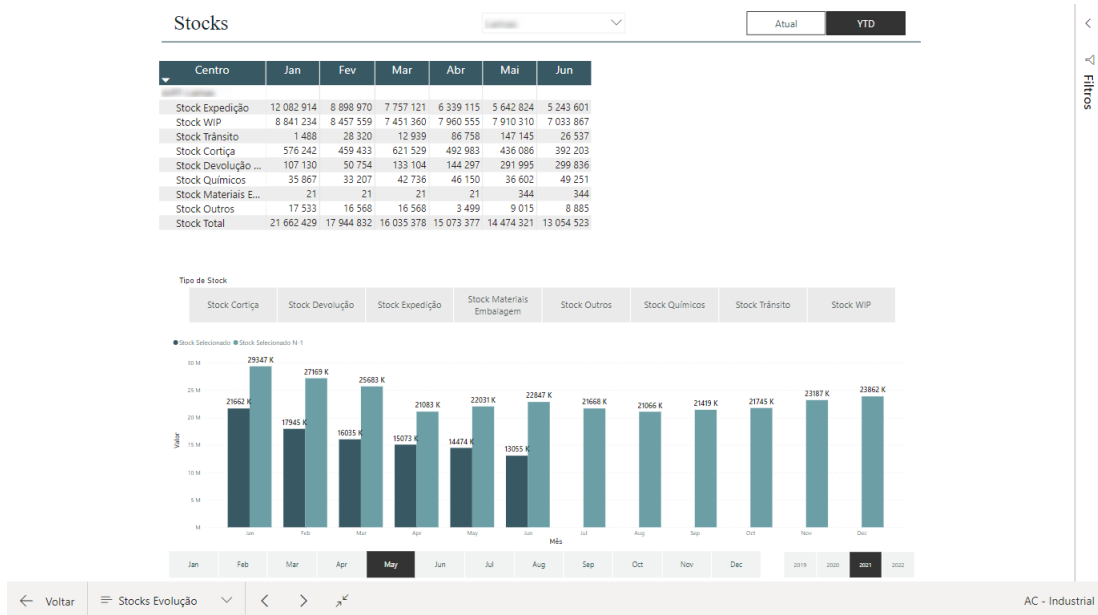
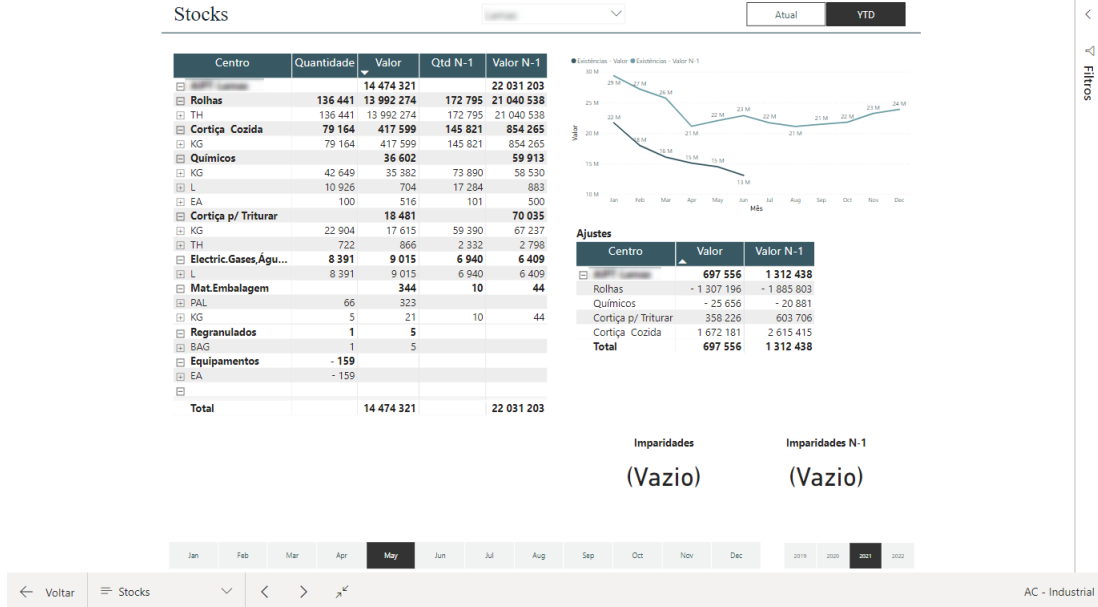
Voltar

Energia

AC - Industrial

Filtros

Filtros



Comparação

Múltiplas seleções

Atual YTD

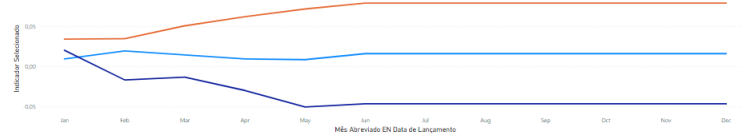
Fábrica	Real		Real N-1		Real N-1	
	Real	Real N-1	Real	Real N-1	Real	Real N-1
% MCI	0,87%	3,21%	-5,04%	3,76%	7,17%	10,46%
% MB	6,50%	8,69%	6,00%	14,55%	14,54%	17,43%
MCI/ML	1,31	5,32	-2,04	1,59	18,64	33,59
MB/ML	9,82	14,40	2,42	6,13	37,79	55,94
Vendas/ML	151,15	165,77	40,42	42,14	259,99	321,01
Competitividade (Qtd)	8,51	9,08	4,46	4,55	19,15	22,35
Produtividade	4,09	4,39	1,42	1,47	11,54	12,57
Custos Manutenção/ML	0,89	0,99	0,46	0,53	0,86	1,38
Depreciações/ML	1,56	1,58	1,15	0,81	3,98	3,66
FSE/ML	2,99	3,22	1,74	2,08	3,88	6,25
Energia/ML	1,65	1,82	1,06	1,38	2,59	3,94
Cobertura Stock (12M) - Valor	93,79	93,79	34,13	34,13	122,05	122,05
Imparidades/Existências		0,00%	0,21%			

Indicador

% MB	Cobertura Stock	Custos Manutenção	Energia	Imparidades	MCI	Vendas
% MCI	Competitividade	Depreciações	FSE	MB	Produtividade	

Comparação Indicador Selecionado por Mês e Fábrica

Fábrica



Jan Feb Mar Apr **May** Jun Jul Aug Sep Oct Nov Dec 2019 2020 **2021** 2022

← Voltar

≡ Comparação

< > ↻

AC - Industrial

← Filtros

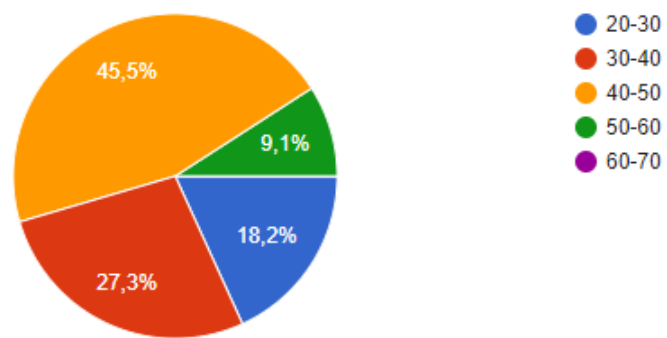
Appendix B

Google Form

B.1 Introduction

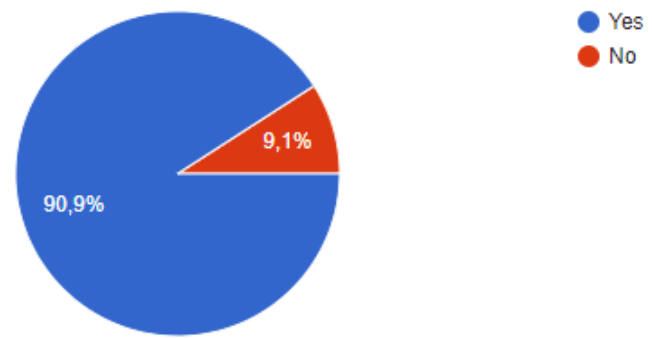
Age

11 respostas



Have you worked with Power BI before?

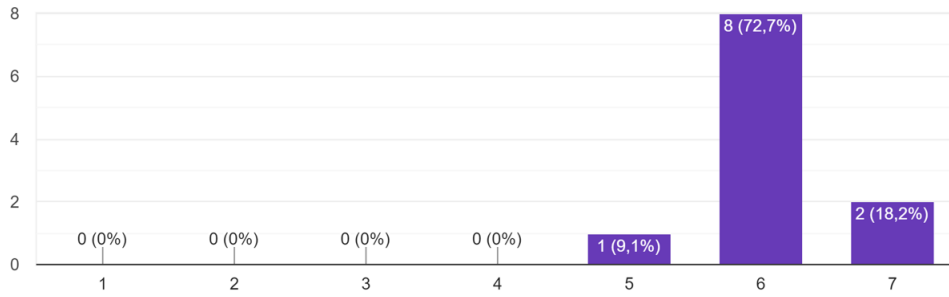
11 respostas



B.2 Available Information

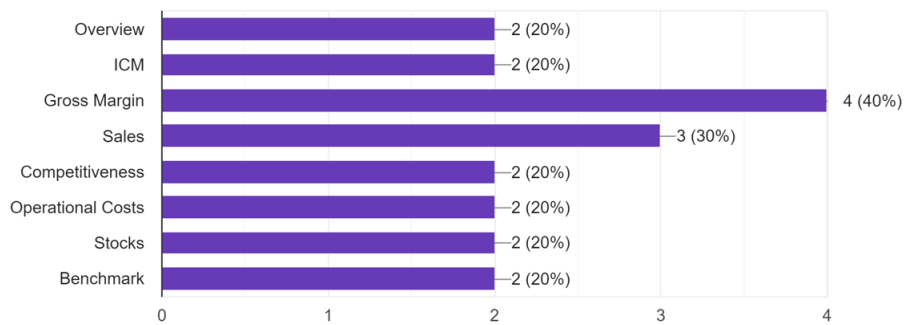
How satisfied are you with the information presented in the new industrial report?

11 respostas

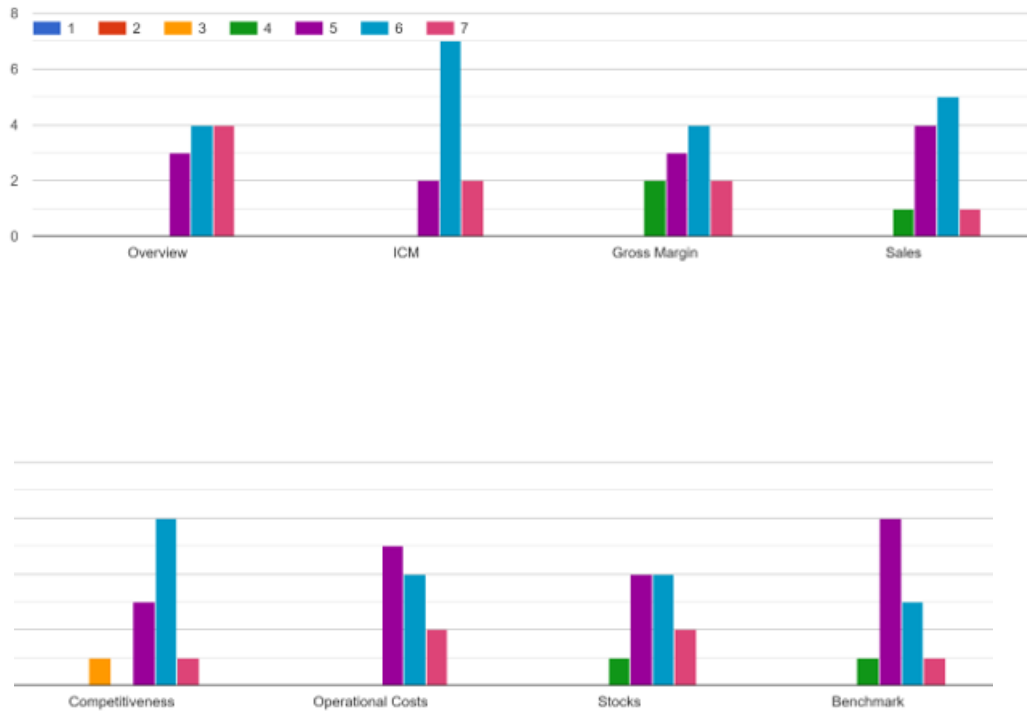


Which pages, in your opinion, have the most room for improvement?

10 respostas



On a scale of 1 to 7, how would you rate each of the sections of the new report?



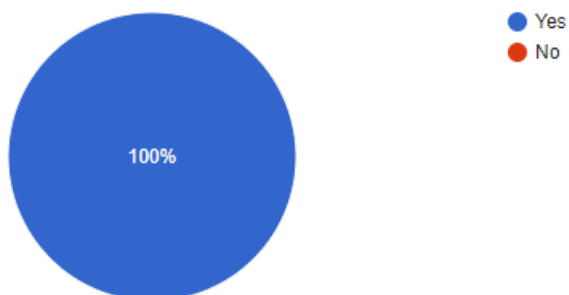
What features/metrics do you feel are missing from the Industrial Power BI that you need now?

4 respostas

- Slow Movers; Service Level Indicators
- Comparison with Budget/Forecast
- Deviation Analysis
- NA

Do you have confidence in the data presented in the developed report?

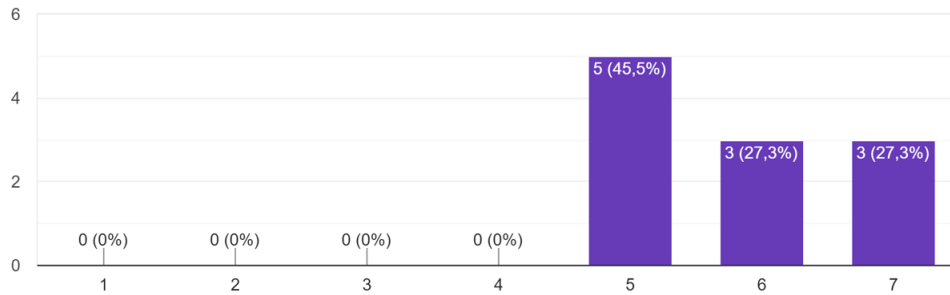
11 respostas



B.3 Usability

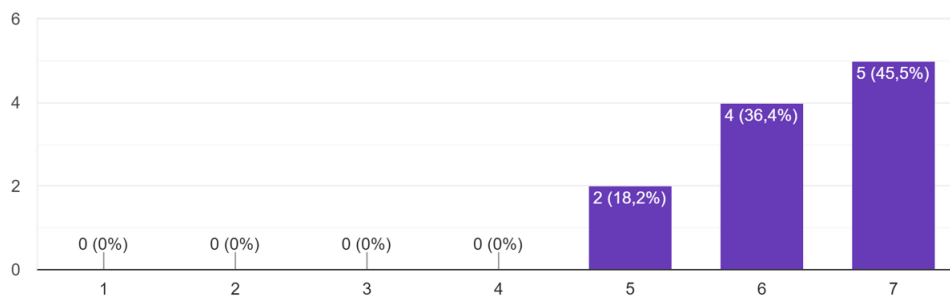
How comfortable do you feel with the new report for controlling the financial values of the factories?

11 respostas



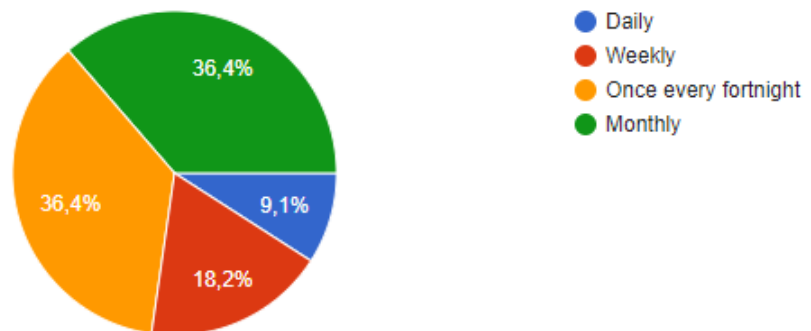
How do you rate the data presentation capability of the new Industrial Power BI compared to previous methods?

11 respostas



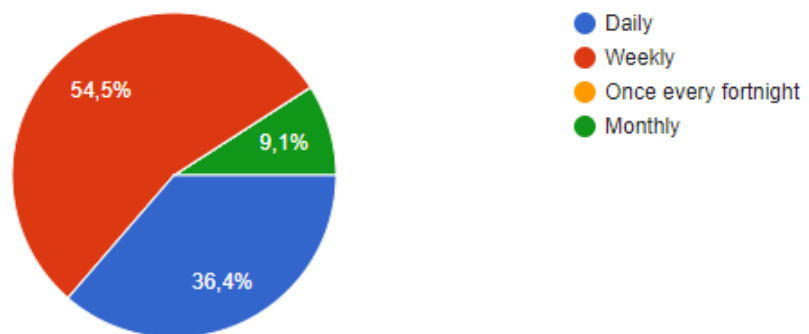
How often do you currently control the financial values of the factories?

11 respostas



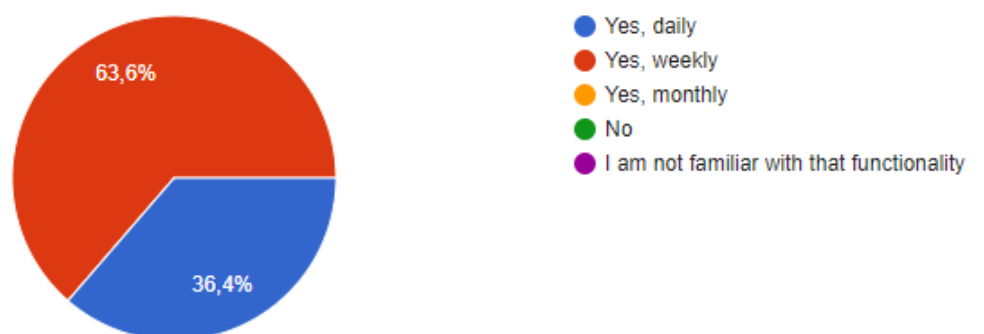
Knowing that the new report updates daily, how often do you plan to do it now?

11 respostas



If a subscription system is attached to the new report to receive it partially or completely in your email, do you plan to use it? How often?

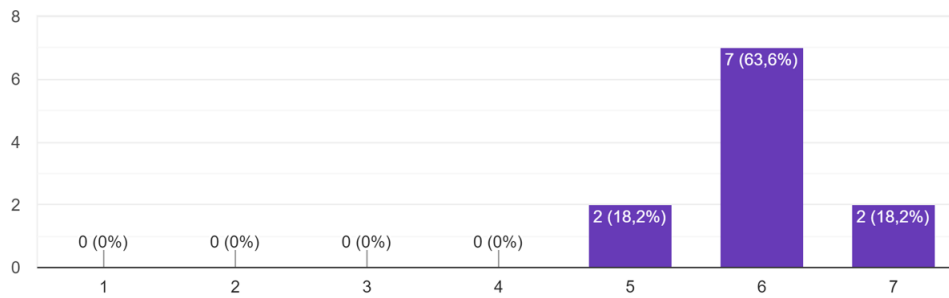
11 respostas



B.4 Implementation

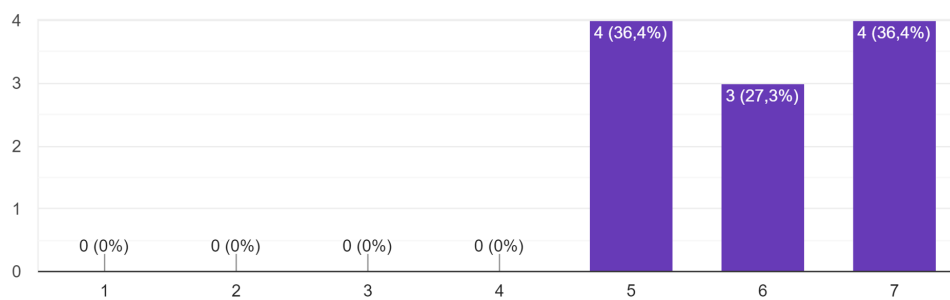
How would you rate the presentation of the new Power BI Industrial?

11 respostas



How would you rate the integration of industrial BI in the organization?

11 respostas



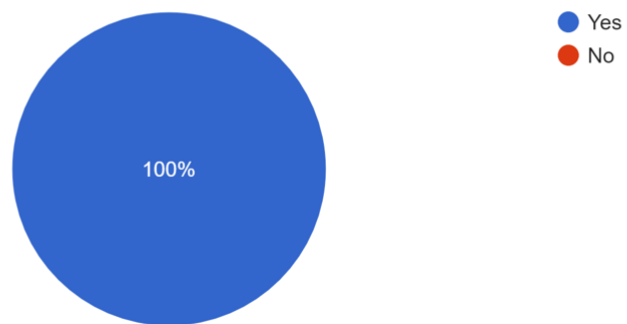
How do you think it could improve?

4 respostas

Sales
Enable export of full information
It's still too early to say. Honestly, it is necessary to explore in order to propose improvement.
NA

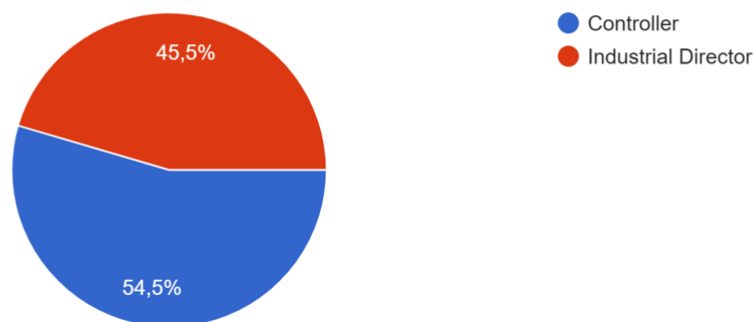
Do you feel that, in the way it is constructed, the report allows you to work with it independently?

11 respostas



What type of user are you?

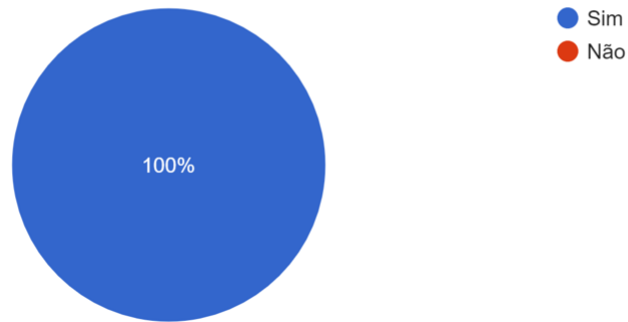
11 respostas



B.5 Controllers

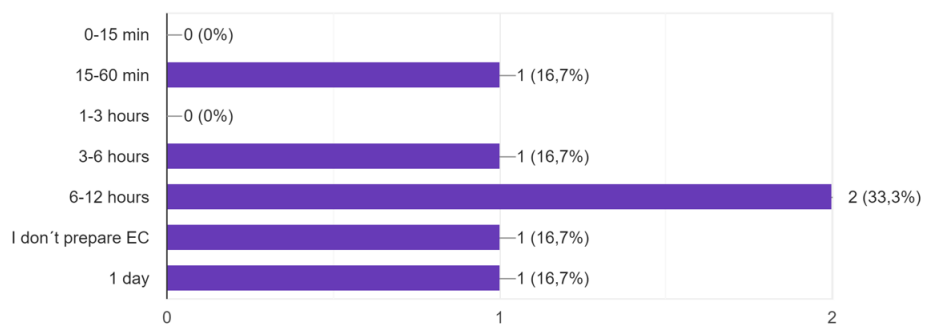
Do you think the new report will help in preparing the Executive Committees?

6 respostas



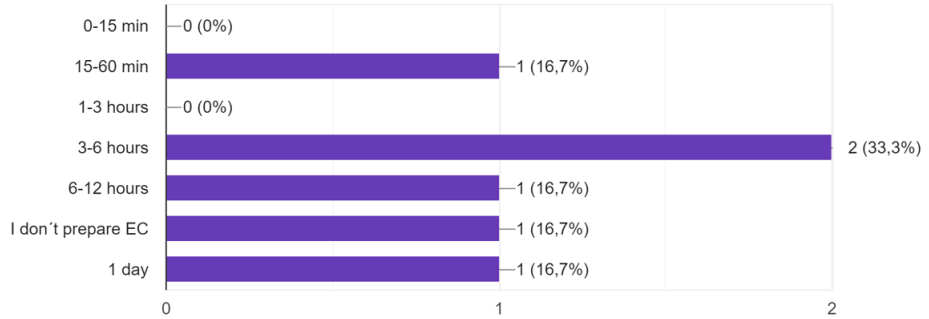
On average, per week, how much time do you invest in preparing the executive committee and other necessary reports?

6 respostas



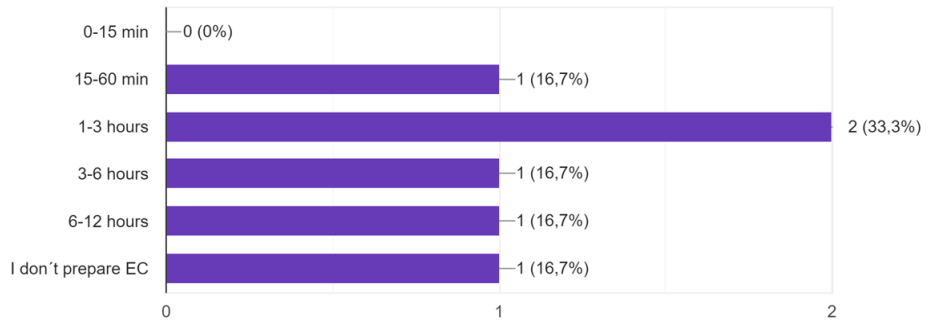
And how much of that time is invested in data collection?

6 respostas



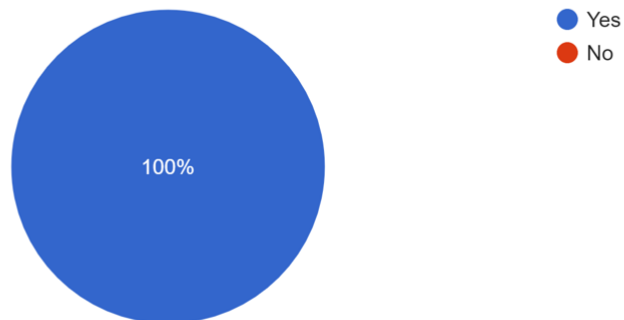
How much time do you estimate that the new industrial report will save you each week in data collection and reporting?

6 respostas



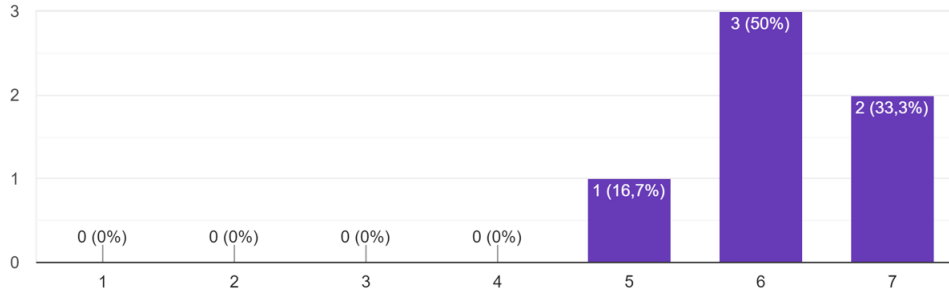
Do you expect to reduce the number of reports you have to build for industrial directors with the new Industrial Power BI?

6 respostas



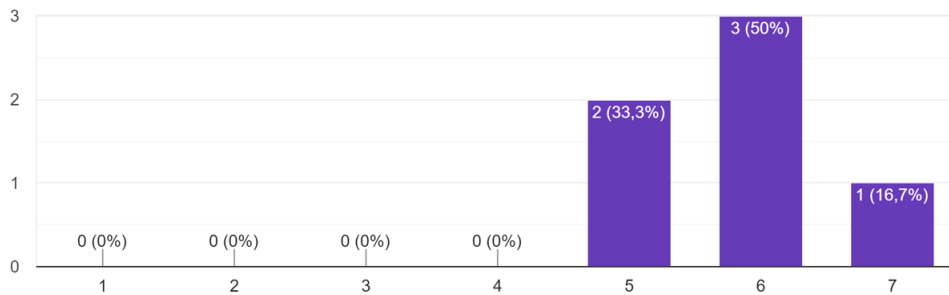
How do you rate the new industrial report in terms of data accessibility compared to the previous solution?

6 respostas



How much do you think the new Industrial Power BI will affect your performance in terms of data analysis and processing?

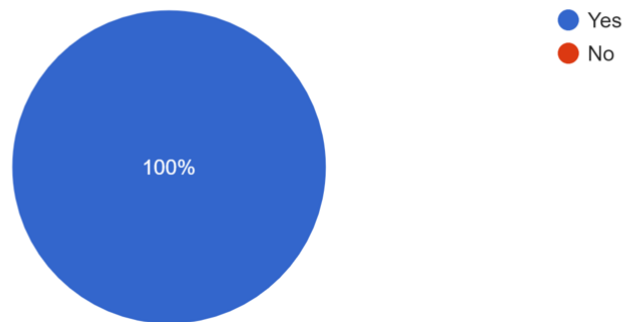
6 respostas



B.6 Industrial Directors

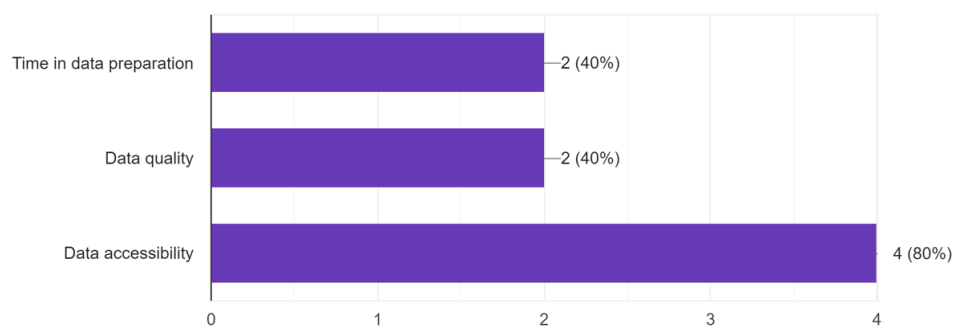
Do you think the new report will help in preparing the Executive Committees?

5 respostas



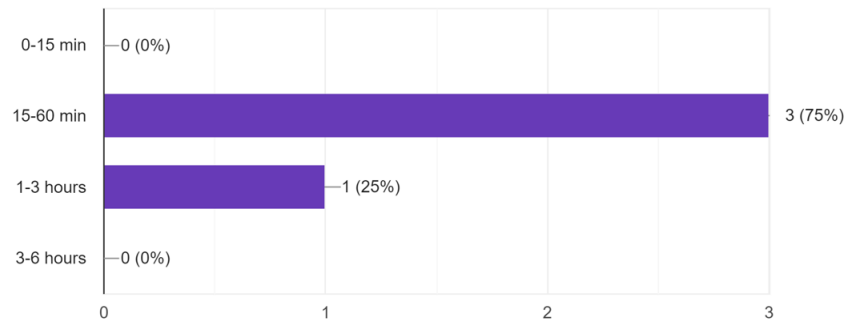
What do you hope to gain from the new industrial report?

5 respostas



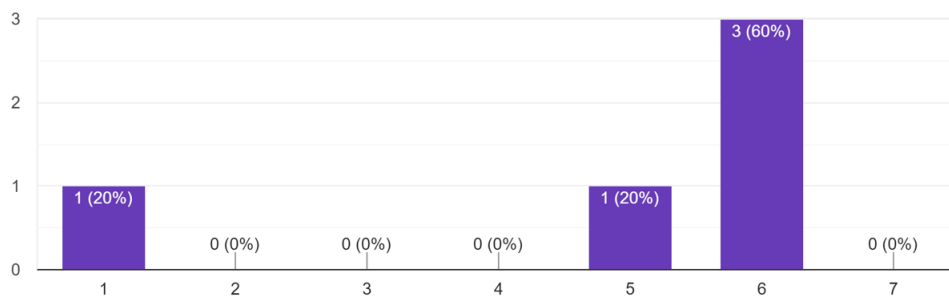
If you chose time, on average how much time do you expect to save?

4 respostas



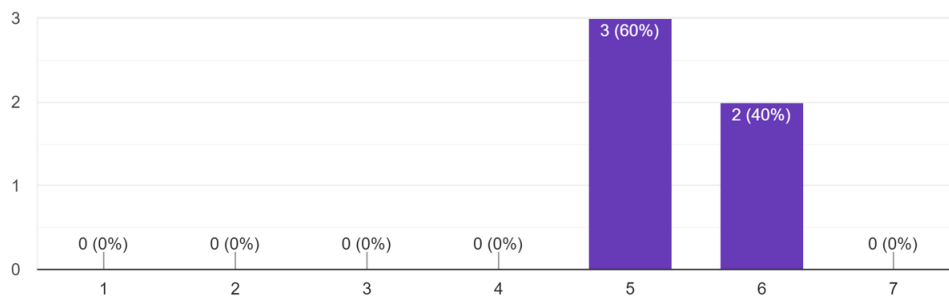
How much do you think the new industrial report helps you to effectively monitor factory values on a day-to-day basis?

5 respostas



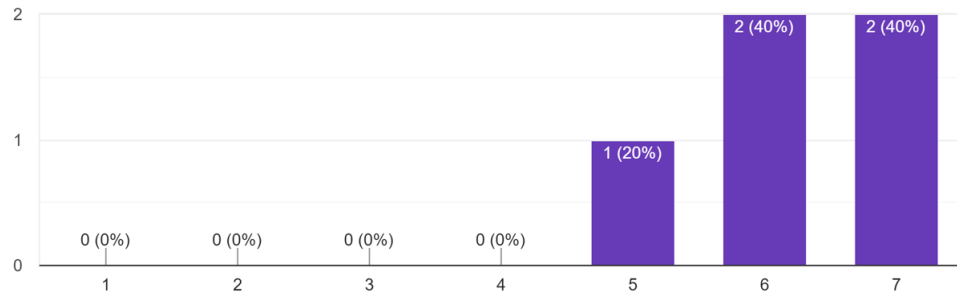
How much do you think the new Industrial Power BI will affect your performance in terms of data analysis and processing?

5 respostas



How do you rate the new industrial report in terms of data accessibility compared to the previous solution?

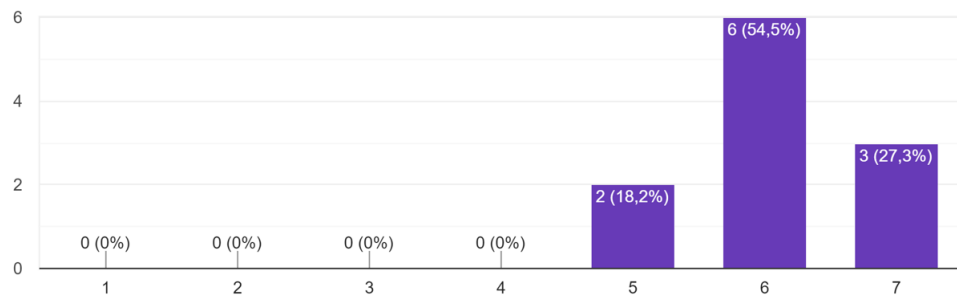
5 respostas



B.7 Global Evaluation

Globally, how would you rate the new report and the initiative to include in Power BI the dynamics of the company's financial analysis?

11 respostas



Appendix C

Distribution of the financial's cube tables

