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Empowering BI users: The impact of reporting automation

A case study in a retail company

Ana Rita Maia Caço

Project Work

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

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
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EMPOWERING BI USERS: THE IMPACT OF REPORTING AUTOMATION

By

Ana Rita Maia Caço

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

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STATEMENT OF INTEGRITY

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

Ana Rita Maia Caço

Lisboa, 10th July 2023

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ABSTRACT

Business Intelligence continues to be a trending topic, but organizations vary in their maturity levels when it comes to utilizing analytics and data for decision-making. One of the main components of Business Intelligence is reporting. Reporting automation can save time and resources and improve the quality of the outputs. However, one question arises. How does report automation, moving from a static report to a dynamic dashboard, change the Business Intelligence experience? By following the Design Science Research Methodology this research studies the impacts on the user experience of automatizing an obsolete PowerPoint report using Power BI. The results of this change on both technical and business users were tested using quantitative data gathered through a user satisfaction survey. Results show that Perceptibility, Completeness and Efficiency are the most impacted factors. The research was conducted in a retail company and its results contributed to improving the efficiency of the teams' work, and, at the same time, to raise awareness about the advantages and potential of using BI tools to support decision-making.

KEYWORDS

Business Intelligence; Data availability; Data visualization; Reporting automation

Sustainable Development Goals (SGD):

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LIST OF ABBREVIATIONS AND ACRONYMS

1P	First-Party Sales
3P	Third-Party Sales
ALT	Average Lead Time
ASP	Average Selling Price
BC	Bricks & Clicks
BI	Business Intelligence
BI&A	Business Intelligence and Analytics
CSF	Critical Success Factors
DS	Design Science
DSRM	Design Science Research Methodology
ETL	Extract Transform and Load
GMV	Gross Merchandise Value
IP	Price Index
IT	Information Technologies
KPI	Key Performance Indicator
L4M	Last Four Months
L4W	Last Four Weeks
MFO	Front Office Margin
PCR	Product Conversion Rate
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PP	Pure Players
RNS	Reported Net Sales
SKU	Stock Keeping Unit
SLR	Systematic Literature Review
SSBI	Self-Service Business Intelligence

KEY TERMS

Average Selling Price

"Refers to the price at which a certain class of good or service is typically sold. It is the average selling price of the product across multiple distribution channels." (*Average Selling Price (ASP)*, n.d.)

Average Order Value

"Tracks the average amount spent each time a customer places an order on a website." (*Average Order Value*, n.d.)

Bricks & Clicks

"The retailers that give their customers both an online and offline channel to do their shopping." (Carter, 2023)

Commission

A share that owners earn from each transaction processed in their Marketplace. (Javed, 2022)

First-Party Sales

The retailer buys the products from the suppliers he invites and sells them to customers. The retailer defines the prices, places the products on the market, and sells and ships them. (YEC, n.d.)

Front Office Margin

"It is sales value minus direct cost of sales." (*Front Margin Definition*, n.d.)

Gross Merchandise Value

"Refers to the value of goods sold via customer-to-customer platforms." (*Gross Merchandise Value (GMV)*, n.d.)

Lead Time

"Measures how long it takes to complete a process from beginning to end. In manufacturing, lead time often represents the time it takes to create and deliver a product to a consumer." (*Lead Time*, n.d.)

Marketplace

"A platform where vendors can come together to sell their products or services to a curated customer base. The role of a marketplace owner is to bring together the right vendors and the right customers to drive sales through an exceptional multi-vendor platform - sellers have a place to gain visibility and sell their products, and the marketplace owner earns a commission from each sale." (*What Is A Marketplace?*, n.d.)

Month to Date, Quarter to Date, Year to Date

"It's the period starting from the beginning of the current month/quarter/year up until now, but not including today's date, because it might not be complete yet." (*MTD, QTD and YTD Values Explained l Sisense*, 2017)

New Business

A department of the company that manages product categories that are out of the scope of the company's core business. In the case of the retail company in question, the core business is Electronics and New Business manages areas such as Sports, Home Decor, and Fashion. (This one is not a definition generalizable for the retail industry, it is just the nomenclature used in this company.)

Price Index

"Refers to a metric that e-commerce and retail businesses use to monitor and compare their prices to those of their competitors, for similar products." (*What Is Competitor Price Index?*, 2023)

Product Conversion Rate

"The number of conversions (in this case sales) divided by the total number of visitors" (*Conversion Rate*, n.d.)

Pure Players

"A company with products or services that are sold entirely online, without any physical storefronts." (*What Is a Pure Player?*, n.d.)

Reported Net Sales

"Net sales is what remains after all returns, allowances and sales discounts have been subtracted from gross sales." (*How to Calculate Net Sales?*, n.d.)

Stock Keeping Unit

"It is used by retailers to identify and track its inventory, or stock. An SKU is a unique code consisting of letters and numbers that identify characteristics about each product, such as manufacturer, brand, style, color, and size." (*What Is a Stock Keeping Unit (SKU)?*, 2022)

Third-Party Sales

Vendors sell their products directly to the customers, without the intervention of the retailer, which simply acts as a window to show vendors' products on its website. Vendors have full control over advertising, selling, and shipping their products. (YEC, n.d.)

1. INTRODUCTION

In this chapter, the context of the project is presented, and its scope, importance, objectives, and expected benefits are described.

The project on which the present report is based was developed in the scope of a twelve-month professional internship in a Portuguese retail company. The second year of the master's in Information Management was dedicated to applying some of the previously acquired knowledge, in practice, and this internship was the perfect scenario to do so.

During the internship, I worked as part of a Business Intelligence and Analytics team, that intended to give support to the Commercial Direction of the company. The team's responsibilities include regular reporting to suppliers, internal reporting about management indicators, and activities related to data integrity, data management, and data availability. These tasks are coordinated with Business Intelligence development projects that boost the company's data-driven mindset and improve processes' efficiency. Working closely with a Data Team, that addresses the more technical data-related tasks, the Business Intelligence team, on the other side, acts as a "right-hand" of the business, going along with commercial managers and their teams to help them achieve their objectives and consistently improve their work.

Regarding my main responsibilities in the company, the tasks I addressed can be segmented into two areas of activity. Firstly, I was responsible for producing, updating, and sharing weekly and monthly reports to the company's suppliers about their product's sales performance and stock evolution. Additionally, every week or by *ad hoc* requests, I produced internal reports to the company's managers regarding indicators such as market share, sales, and stocks. Along with these regular tasks, in the second area of activity, the one to which I allocated most of my time, I was focused on some Business Intelligence development projects, one of them the one that is described in this report.

1.1. BUSINESS CONTEXTUALIZATION

The company where the internship took place is a Portuguese retail company, working as a Brick & Click player in Portugal and Spain. Initially operating around technological retail, the company has recently become a Marketplace style company, acting as a window to products from external sellers, its products, and a catalogue of service offerings.

Evolving into this business model brings several advantages, internally and comparatively to the competition but it is also an immensurable challenge in terms of investment, resource management, and processes, and data is no exception. The company introduces itself as a digital company with a human touch, which involves being customer-centric, operating in an omnichannel manner to provide the best buying experience, and contributing to customer loyalty and satisfaction. The biggest challenge now is to boost the Marketplace, without losing the already conquered position in the market with the company's core areas.

Data-related challenges are constant, and several dedicated teams handle those challenges and work on the digitalization of the company, enabling growing competitive advantage and working efficiency.

Particularly, the online component of the business generates data at each second and, not to lose important information, this data must be handled and managed appropriately, to deliver decision makers the most accurate and updated data for them to base their decisions.

1.2. PROBLEM STATEMENT

Apart from the core business areas of the company, which are already mature from the point of view of data, associated with the appearance of the Marketplace, appeared as well different business areas (New Business) that, once they started to operate in the last few years, do not have their processes well-built yet, either their dedicated data visualization tools.

The New Business area is also being supported by the Business Intelligence and Analytics commercial team, which reported weekly to them several information about their sales, participation, budget, and online indicators. The process of updating the report to be shared, used to take between six and eight hours for the team, weekly. The report in question was produced in PowerPoint (*What Is PowerPoint? - Microsoft Support*, n.d.), having as data sources ten different Excel (*Microsoft Excel Spreadsheet Software | Microsoft 365*, n.d.) files and three already existing dashboards, and demanding a lot of manual work acquiring and preparing the information. Because of the recency and specific characteristics of the area, there were still no dedicated dashboards, which implied that the analysts that were responsible to share the information had to adapt the available data to suit the area's needs.

This process was identified as critical by the team and had to be automatized as soon as possible because the PowerPoint report not only took almost an entire day of work of one of the team members but was very susceptible to errors due to data incoherencies, mis updates or lack of information. Every time that New Business wanted to see a different angle in the data or to do any modification, the team had to spend time working on it and sharing the intended information. The same applies when an error is identified, the team had to redo the work spending even more time. Also, they only had access to new data once a week and could not do any further analysis, since the PowerPoint was static and did not enable them to change views or granularities, according to their needs.

Apart from the efficiency and data quality problem, the visualizations and ways of presenting data that were used were also not the most adequate and user-friendly, because of aesthetical aspects like colour schema together with more technical aspects like not giving the users the possibility to know what the exact values are in a graphic. Figure 1 is an example of one of the visualizations presented in the weekly report having those issues.

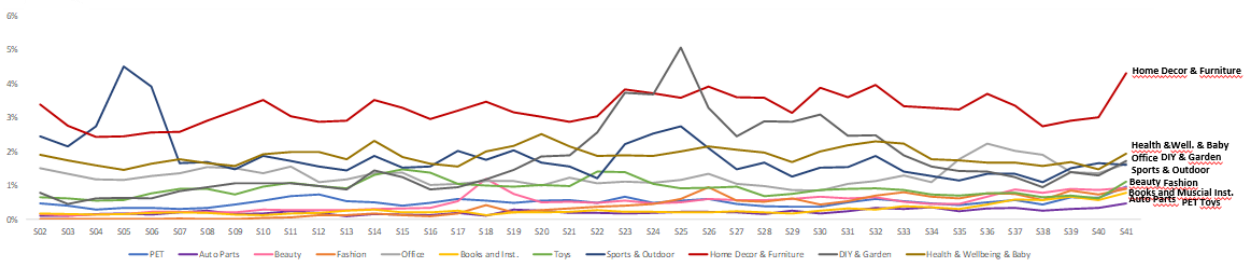

Figure 1 - Example of data visualization in PowerPoint report

1.3. OBJECTIVES

The objective was to automatize the previously described report, using Microsoft's Business Intelligence tool, Power BI (*Microsoft Power BI*, n.d.), to create a unique tool where all relevant information can be consulted to support decision-making.

This development was expected to solve the identified bottleneck, saving time and resources, and improving data accessibility and data quality. It was important and relevant not only to tackle these issues but also to introduce New Business people to the benefits of Business Intelligence reporting.

The evolution of the reporting process happened in two different phases, the first one moving from the PowerPoint-based report to a Power BI solution, recreating the same structure and metrics, and, posteriorly, adding additional features, visualizations, and metrics to the dashboard, according to users' needs. The division into two phases was motivated by the fact that, as the users initially were not Business Intelligence mature users, they would need time using the dashboard to figure out what additional functionalities would be useful. At the same time, the second phase would also work as fine-tuning of some errors that would be found during the utilization.

The development of the dashboard included Extract Transform and Load (ETL) work as a first step and, after that, the building of the report itself. All this process is covered in greater detail in the next sections of this report.

The research question associated with this project is: How does the Business Intelligence experience change with the implementation of the dashboard?

And, according to that, the research objectives were:

1. Understand the importance of data availability and data quality.
2. Describe the relationship between efficient data visualization and informed decision-making.
3. Build the required dashboard and the correspondent data architecture.
4. Evaluate the results and compare the new process with the previous one.

Research objectives one and two were meant to be achieved through a literature review. To research objective three, the methodology was Design Science Research Methodology (DSRM) which followed the six phases proposed by Peffers (2007) and, in this case, lead to a software artifact (a dashboard). Objective number four was achieved through quantitative data collection and analysis.

1.4. REPORT STRUCTURE

This report aims to describe the whole path from the identification of an efficiency Business Intelligence problem in the company, to the final artifact (dashboard) that intended to solve that issue, presenting the results and contributions of this process improvement. It also works as a learning tool, since some contents were already familiar from master courses, but needed to be explored in further detail to be able to arrive at the best solutions during the project development, as well as to adopt a proper project management methodology, in this case, DSRM.

The report is divided into six main chapters. The first one is the current one which gives context about the developed project, its importance, and details. The next chapter – Literature Review – presents the theoretical background of Business Intelligence and Analytics related topics, that work as a basis for the remaining work, raising awareness about what has been studied in the literature, from data quality issues to the best way to present information to decision-makers, passing through dashboard's actionability and changes to reporting processes. After that, in the Methodology chapter, the tools, and processes used to develop the project are described, following the DSRM approach, along with details about the organization's prior work and project structuring. In the Results and Discussion chapter, the work developed during the project will be evaluated and critical analysis performed, matching the final product developed to the initially defined research objectives. Finally, general conclusions about the project and the internship in which it is integrated are presented, together with recommendations for future work.

2. LITERATURE REVIEW

After presenting the context of the project, in this chapter, the theoretical background of Business Intelligence and Analytics related topics is presented, divided into four blocks, comprising the most relevant subjects for this project. The first block gives an overview of the basis of Business Intelligence and Analytics, with its definitions, benefits, difficulties, approaches, and specific applications in the retail industry. The second block relates to data quality, its importance, main issues, and ways to improve it. Thirdly, findings about data visualization and decision-making are presented, along with strategies to communicate findings effectively and efficiently. Lastly, reporting processes are addressed, together with ways to measure changes and improvements in those processes.

This Literature Review followed a Systematic Literature Review (SLR) approach, resorting to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram, which is part of the PRISMA Statement (Moher et al., 2009), to organize the document selection process. *Scopus*, *Web of Science*, and *b-on* were the three data repositories chosen to search for documents and this search was conducted using a query composed of Boolean expressions to select the documents that contained specific words in their title, abstract, and keywords. The topics searched were multidisciplinary, including data characteristics and Business Intelligence and reporting-related topics, as described in the query below.

("data quality" OR "data availability" OR "data accessibility" OR "data integrity" OR "information sharing") AND ("decision making" OR "decision support" OR "data visualization" OR "visual*" OR "dashboarding") AND ("business intelligence" OR "analytics" OR "self*service bi" OR "self*service reporting" OR "information management") AND ("automation" OR "reporting" OR "improvement*" OR "change*" OR "routine" OR "evaluation" OR "e*commerce")*

The search was performed in November 2022 and documents written between 1st January 2016 and 31st October 2022, in English, were included.

The remaining work was done using Zotero, an open-source reference manager (Murimboh & Hollingdale, 2012).

The documents' selection process is represented in the flow diagram (Figure 2). The initial data repository search returned 446 records (*Scopus*: 254; *Web of Science*: 113; *b-on*: 79), those were then filtered, removing duplicates (148 records excluded) and records with no abstract (1 record excluded). The records were then screened, firstly by title (200 records excluded), then by abstract (54 records excluded), and finally, only documents published in peer-reviewed journals in Q1 or Q2 were kept (13 records excluded). The remaining 30 documents, together with thirty-three extra ones that were added to the Literature Review process due to their relevance to the project were sought for retrieval. One of the 63 documents was not retrieved, and, because of that, 62 documents were integrally read and analyzed. Of those, 9 were excluded from the Literature Review due to their inadequacy, and the remaining 53 were considered eligible for further analysis.

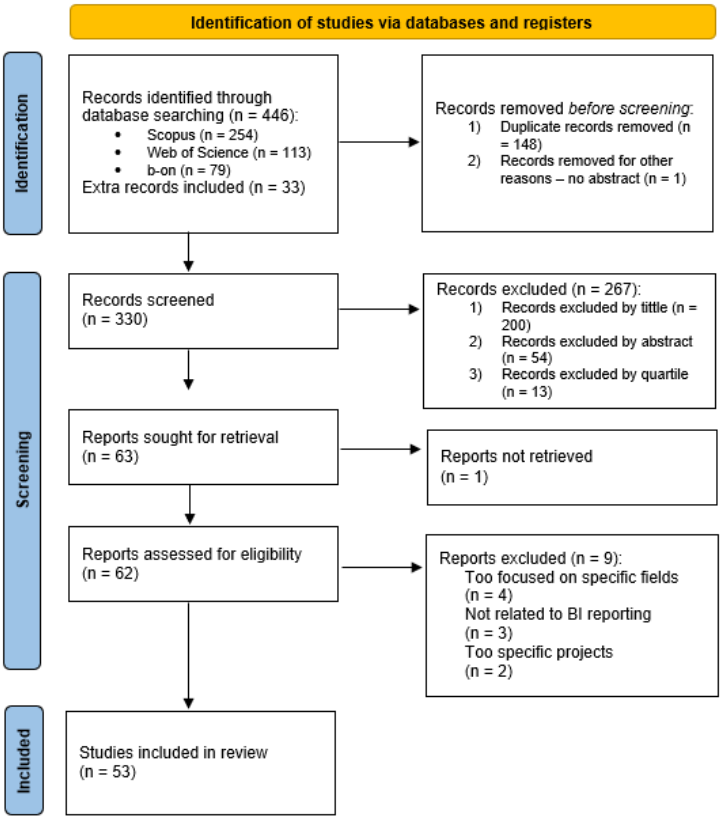

Figure 2 - PRISMA flow diagram

The result of the documents' critical analysis is described in the next subsections.

2.1. Business Intelligence & Analytics

The term Business Intelligence (BI) appeared for the first time in the literature by the year 1868 (Devens, 1868) and, since then, a long way has been made, and nowadays, what started as "a system to solve analytical tasks", is "considered to be a way of better decision-making, reducing costs and improving the quality of processes and performance" (Olexová, 2014).

There are several definitions in the literature for the concept of BI. It can be defined as a set of tools to gather, access and analyze data to help business users make better business decisions (Babu, 2012). Some of the BI functionalities include online analytical processing, forecasting, data mining, statistical analysis, and decision support, and some of its application areas are inventory analysis, market research, segmentation, product profitability, customer support, and multi-dimensional reports, as it provides a unified view of business activities.

Data Analytics on its side has the aim of extracting useful information from the data that is acquired, transformed, modelled and displayed by its processes (Geekiyanage et al., 2021). It helps identify trends and patterns in the data to support decision-making (Raut et al., 2021).

Business Intelligence and Analytics (BI&A) advanced techniques are used mainly to identify and investigate problems that would be difficult to understand only with transactional data and

conventional data and to predict future trends promptly. The decision-making culture that derives from it has a significant impact on creating a competitive advantage (Božič & Dimovski, 2019). According to Experian's Benchmark Report (2022), eighty-eight per cent of company managers say that being data-driven is essential to competitiveness since it helps to stay on top of market trends and customer needs.

BI&A contributes to improved organizational outcomes, by acting as an enabler of organizational transformations (Torres et al., 2018). According to the literature (Hannula & Pirttimaki, n.d.; Olexová, 2014), some of the most relevant benefits of adopting BI systems are:

1. Generates better quality of information for decision making - which becomes faster and improved.
2. Increases agility to anticipate opportunities and threats.
3. Enables faster and more accurate reporting.
4. Incentivizes information sharing.
5. Improves efficiency.
6. Provides an easier understanding of the meaning of information.

2.1.1. Critical Success Factors of BI

Many companies are adopting BI systems to learn from the past and forecast the future (Babu, 2012) and those projects can bring companies great benefits, but several challenges can lead to their failure (Farshadi et al., 2022).

According to Farshadi (2022), the most important Critical Success Factors (CSF) when implementing a BI project, are considered data quality and senior management support but these are not the only ones. Others include analytics quality, security standards, hardware quality, documentation, process identification, project team skills, scope management, and customer needs transformation. However, not all of those have the same importance regardless of the maturity level of organizational BI.

Apart from the ones defined above, the literature (Božič & Dimovski, 2019) points out transformation capability as an important factor, because having insights does not mean success. Those need to be related to the existing knowledge base and be delivered to the people that need them for decision-making. Also, acting as a basis of everything, the underlying technology must be trustworthy because long response times, high costs, poor performance and lack of scalability are obstacles that lead to BI&A underuse, limiting its potential.

Investment in cultural changes is also crucial, as said by Božič and Dimovski (2019), once findings reveal scepticism in what concerns the key positive influences of BI&A on higher management levels. The desired path leads to achieving a decision-making culture which will, ideally, blend the analytics' insight with managers' intuition, producing better and more effective results.

Knowledge sharing and human touch are also extremely important points. Human intervention is essential in data interpretation and complementing one another's knowledge and capabilities changes the scenario of having people that are mediocre at everything, to skilled teams with great knowledge.

Raut (2021) points out, on top of the CSF already mentioned, lack of skills, financial support and techniques or procedures as one of the most critical barriers against BI adoption.

2.1.2. Self-Service BI

With the growing need for data in all areas of a company, appears a need of developing skills related to data assessment and interpretation, among all users, enabling them to access data the moment they need it. As business areas and support areas usually are not as aware of these topics, it is important to present knowledge and information in a palatable and interactive format, so it can be easily comprehended by everyone and the interpretation effort can be reduced (Božič & Dimovski, 2019).

Traditionally, in BI systems, technical (or power) users serve less experienced casual users, being the first ones those who analyze and gather data that is requested by the second ones, producing reports and visualizations for them to base their decisions on (Lennerholt et al., n.d.). In line with what has been mentioned in the above paragraph, as data is needed in all departments, sometimes it gets difficult for BI&A teams to serve all the other users, fulfilling their data needs. At that point, some strategies must be adopted, to make the data users more independent and self-reliant.

Instead of the traditional request-response relationship between users (Alpar & Schulz, 2016), the so-called Self-Service Business Intelligence (SSBI) offers flexibility and operational efficiency increase, reducing the intermediates in the process of producing and updating the analysis, saving much time (Lennerholt et al., n.d.).

The implementation of SSBI systems has, however, some challenges, the main ones related to the access and use of data (e.g., data sources must be easy to access and use, correct data queries and data management and governance policies must be well-defined) and to self-reliant users (e.g., make BI tools easy to use, give the right tools to the users and educate them).

Apart from that, the main pointed out benefits of those systems include (Alpar & Schulz, 2016; Lennerholt et al., n.d.):

1. Empowered users.
2. Shift from reactive analysis to proactive analysis.
3. Relieved pressure on the IT department.
4. Saved resources.
5. Decreased number of decisions based on guessing.

2.1.3. BI in retail firms

"Data have become the most important intangible resource of a firm, especially in the retail industry" and its adoption not only amplifies organizational performance but also acts as a predictor of it, improving the marketing and business processes of retail firms. As Paulino (2022) states, the adequate use of BI provides a higher degree of market understanding that, ultimately, translates into an increase in sales and net profit.

Competition among companies is being intensified due to the increasingly dynamic market environments and its internal and external complexity (Schuh et al., 2019) and especially, the retail business is a very fast-moving industry, even more nowadays with the growing online participation that generates even more data so, it is crucial to not just get the business analysis done, but to act upon those analysis instantaneously (Babu, 2012; Kyeong & Nam, 2022). If the company does not understand customer preferences and does not take action in conformity with this, combined with market information, it will lag immediately behind the competition (Božič & Dimovski, 2019).

Among retail managers, the main BI benefits pointed out are improved decision-making (that becomes faster, better and based on better quality information), but also being able to acquire up-to-date information, better stock management capabilities, improved ability to anticipate market changes and better pricing tools (Olexová, 2014).

BI systems can influence the organization's well-being, since decision-making processes are part of several key business activities, including future strategies and goals that need the information to be based on (Marshall & de la Harpe, 2009). If decisions are made on time, and in a proactive manner, rather than in a reactive manner, it can contribute to some of the most important retail Key Performance Indicators (KPIs), increasing market shares, cutting costs, and aiding expansions (Lennerholt et al., n.d.).

2.2. Data Quality & Availability

We cannot talk about BI systems without talking about their foundations, Data. Without data there is no Analytics, there is no BI and there are no systems. And, even more important than data, we shall talk about quality data, because, despite having the most sophisticated data analysis techniques, if the underlying data is low-quality, biased or has a lot of noise, the results of the analysis will be meaningless (Kyeong & Nam, 2022).

On the other hand, trustworthy data drives innovation, customer experience and decision-making and replaces gut feeling. That is why companies are working on their data maturity levels – "investing in people, processes, and data technology, to have reliable data to make better business decisions". Mentioning the 2022 Experian's Benchmark Report (2022), almost three-quarters of the organizations say that, due to having too much data, it is difficult to prioritize where data management can add value, and seventy-five per cent of the respondents who consider that their data quality has improved in the previous year have exceeded their yearly goals and targets.

If the company does not trust the data being used as a basis for the analysis, it is more likely to stop the use of analytics and rely more on expert opinion or intuition (Ingram et al., 2022). As identified in the literature, there are three groups of factors that act as barriers or facilitators to the use of analytics for decision making and, one of them, is precisely the quality of data sought.

Over the years, the literature has pointed out several data quality characteristics, the most consensual ones completeness, accuracy, timeliness, consistency and accessibility and those can be divided into three categories, according to the type of information used to access the quality indicator. Are those: content-based-information, context-based-information and rating-based-information (Bizer & Cyganiak, 2009; Cichy & Rass, 2019; Marshall & de la Harpe, 2009; Yuan et al., 2021).

2.2.1. Data quality issues

Usually, in a real-world scenario, data is collected from different sources, which makes it heterogeneous, so it is important to have standardized processes of data collection, quality assessment and data cleaning to achieve and maintain a high standard of quality data, that will impact the business and the quality of decision-making (Cichy & Rass, 2019; Knowlton et al., 2017; Yuan et al., 2021). When those standards are not met, some of the consequences that may arise are deteriorated supplier relationships, reduced internal productivity and reduced business confidence in Information Technologies (IT), which can, consequently, affect the company's ability to stay competitive (Marshall & de la Harpe, 2009).

The main data quality issues are related to (Geekiyanage et al., 2021):

- Invalid data.
- Inaccurate data.
- Incomplete/missing data.
- Inconsistent data.
- Redundant data.

And it is important to evaluate all those topics in the data preparation stage of the projects, before moving on to building dashboards and generating reports. This process is usually automatized and based on pre-defined rules, however, it is important to differentiate actual quality problems from unusual, but valid values. This operation requires the human contribution of someone who is sensitive to the data values and has business knowledge (Gschwandtner & Erhart, 2018).

Experian's Benchmark Report (2022) concludes that the main areas affected by bad data quality are the ones presented in Figure 3.

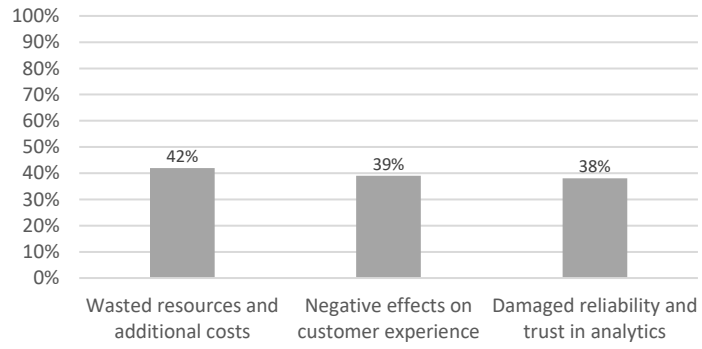

Figure 3 - Areas impacted by bad data
Adapted from Experian's Benchmark Report (2022)

More specifically in the retail industry, quality issues cause problems related to waste, availability, sales and supplier fulfilment (Marshall & de la Harpe, 2009).

The term data quality involves two main issues: data availability and data accuracy (Ingram et al., 2022). Concerning data availability, the information to be utilized has to be easily accessible, otherwise, decision-making processes will be extremely challenging (Marshall & de la Harpe, 2009). On the other hand, if users have the information ready to be utilized, they are much more likely to

work effectively and efficiently. Concerns around data accuracy can lead to significant efforts and resource consumption in figuring out and correcting the issues, causing delays in more advanced analytical works, as stated by Ingram (2022). The most common causes of inaccuracy in data are human error, lack of internal communication between departments, inadequate data strategy and inadequate management support (2018 Global Data Management Benchmark Report | Experian, 2018).

2.2.2. Improving data quality

High-quality data, the one that satisfies the intended need and does not create challenges that delay its utilization and, consequently, the decision-making process, is useful to effectively reach customers, and maintain business goals and profitability (Marshall & de la Harpe, 2009).

Following the conclusions of Experian's Report (2018), more than half of the organizations (52%) say that they want to achieve or maintain high-quality data to increase efficiency, and another forty per cent of respondents cite cost savings. Other reasons include protecting the brand's reputation, enabling more informed decisions, and reducing risk or fraud.

One of the main roles of data governance is coordinating and controlling data access, data availability and data quality, that is why it is important to establish data governance principles before the start of every project, to reduce the issues that may appear, for example, related to accessing and understanding data, creating trust and acceptance in the project outcomes and also ensuring that the information necessary for each project can be used with confidence (Brous & Janssen, 2020). "Throwing data at a problem", without worrying about its quality, governance, and data management, will not lead to good interpretation and outcomes acceptance.

2.3. Data Visualization & Decision-Making

Decision-making processes have evolved. They are not anymore just focused on historical data, but giving much more importance to real-time changes (Bhimani, 2015). To ensure those processes can be done in an accurate and timely manner, information has to be presented to decision-makers consistently and in context (Fatnani et al., 2017). The widely used tool to do so is the dashboard. Dashboards are a way of reporting data visually and dynamically, that intends to present its users with critical information to act upon. Those, differently from static reporting documents, have the potential to present (near) real-time data (Ghazisaeidi et al., 2015; Ivanković et al., 2021).

Companies are massively adopting these data visualization tools as a way of presenting data because they are easily configurable, can have alerting functionalities, enable process automation, and present easy-to-analyse visualizations, which has been proven to be valuable and contribute to upgraded decision-making (Fatnani et al., 2017).

Sometimes it is not easy to manage the performance of assets if there are no well-defined processes to do so, which leads to ineffective use of resources and missed opportunities. When a dashboard is built to tackle this issue, it usually integrates data from different sources and displays it in a user-friendly interface, that will guarantee its sustainability, expandability, cost-effectiveness, and easy

access. Furthermore, the literature states that BI applications at all types of managerial levels have a positive effect on measurable KPIs (Fatnani et al., 2017; Işik, 2021).

Improved decision-making is always pointed out as a major BI benefit, but how exactly can data visualization tools, like dashboards, contribute to this process? (Alqhatani et al., 2022; Awasthi et al., 2019; Jha & Jha, 2022)

- All-in-one without forgetting details: Dashboards aim to present all relevant metrics and important data to check the performance of the business at a glance. The information should be clear to interpret even without technical expertise. But, despite that, users can filter and drill down on the information to get as much detail as they need, according to the analysis they want to do or to their organizational level. Usually, when we go up the hierarchical organization of the company, users need less detailed information, while more operational managers need to know exactly what is going on. This characteristic of dashboards enables one unique tool to serve different purposes and user profiles.

- Ready to use data: A dashboard is constantly updated with the most recently available data without the need to update it manually if it is linked to the technology to do so automatically. Decision-makers can arrive every day to their dashboards and have those fed with new information, ready to be analyzed, to immediately check the performance, pinpoint if something is wrong, understand why that is happening and act upon it.

- Past and present: In cases where historical data is available, dashboards are a very useful way of presenting business results organized and in context with past data. This allows decision-makers to evaluate trends, which enables the perception of the relationship between actions and their effect on business results. Only looking at numbers is frequently not enough to get an idea of their meaning. Context is essential and historical context is crucial to know how the business is evolving, but also to anticipate events and prepare for them, based on what has already happened in the past.

- Unique source of data: Having a dashboard prepared with all the information that is needed, prevents decision-makers from having to use several different sources of information (several files or platforms) and looking through all of them to arrive at a conclusion. This saves time, reduces effort, and improves the accuracy of the information being used in decision-making. Apart from that, a dashboard enables everyone to base their decision on the same dataset, building trust and understanding between different teams or departments and avoiding distortions and misleading interpretations, which happens when each person uses their own data sources.

- Remove bias: Basing decisions on data and not on gut feeling or intuition removes personal bias from the equation, leading to more objective decisions and decisions that can be justified based on facts and numbers, which causes better and more trusted results. The success or failure of an initiative can be proved to support business growth and its consequences can be analyzed without being biased by one's personal opinion about it.

- What if: Dashboards can integrate functionalities that support simulations and what-if analysis, in this case, combining BI with Machine Learning features. This way, decision-makers can test different approaches to a situation, having a forecast of the outcomes without wasting resources testing it in practice. This, apart from saving resources and securing the company's stability, promotes creativity and encourages the testing of "out of the box" ideas.

Most business users share the same expectations and needs about data visualization tools. They require the dashboards to filter data instantly, enabling the visualizations of data from multiple complementary perspectives simultaneously. Users want the tools to enable them to easily make sense of data and present it to others, telling stories, and promoting collaboration. To allow this, better human-computer interfaces are required, combined with the user's knowledge of the fundamental skills of information visualization (Few, 2006a, 2008b).

2.3.1. Dashboard's actionability

In general, an actionable dashboard is capable of transforming data into information, information into opinions, and opinions into decision-making, as defined by Ivanković (2021). Consequently, a dashboard to be able to inform decision-making and support behavioural changes must be actionable.

What makes a dashboard actionable are the indicators that are presented in it. There are three different levels of decision-making (macro-level, meso-level and micro-level) that have different needs in terms of indicators, and the same applies to different departments and roles inside a company. Even if an indicator is statistically well defined, it may not have applicability or, in this case, actionability to every decision-maker. Having this in mind, it is important to define, in each context, the set of indicators to be presented, as well as identify the intended use of each indicator, to meet the information needs, with the input of the decision makers that are going to use them. Data quality is not just presenting accurate data, but also presenting adequate data for each problem (Barbazza, Klazinga, et al., 2021; Marshall & de la Harpe, 2009).

Taking into account the literature findings (Barbazza, Klazinga, et al., 2021), the life cycle of an indicator is presented in Figure 4.

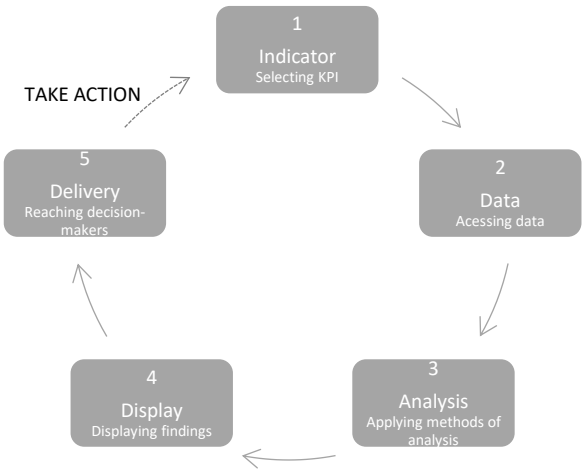

Figure 4 - Indicators' life cycle
Adapted from Exploring the actionability of healthcare performance indicators for quality of care (2021)

There is no single approach to building a dashboard, but certain characteristics can be introduced to improve its actionability. As defined by Ivanković (2021), there are seven essential actionable features a dashboard can have:

1. Know the audience and their information needs – if the audience and aim are clearly defined, it enables focus and continuity in the content.

2. Manage the type, volume, and flow of information – the selection of a concise number of indicators brings focus to the information and makes it possible to view all indicators briefly. Using a moderate number of indicators and presenting them from general to specific or divided by themes has proven to be especially effective.

3. Make data sources and methods clear – identifying the source of data and giving brief explanations about indicators' construction (e.g., limitations) transmits trust to the users.

4. Link time trends to policies – report data over time, together with key moments in time.

5. Provide data "close to home" – provide granular breakdowns when needed, since aggregated information is difficult to understand.

6. Break down the population into relevant subgroups – provide the possibility to explore characteristics of the different populations and differences among them.

7. Use storytelling and visual cues – do not leave the interpretation solely to the user, support it by combining brief explanations and visual techniques.

Objectively, an actionable indicator is defined in the literature as being both fit for purpose (serves a specific decision-making functionality) and fit for use (gets "the right information, in the right hand, at the right time") (Barbazza, Ivankovic, et al., 2021; Barbazza, Klazinga, et al., 2021). Considerations about an indicator's fit for use can be separated into three clusters, as defined by Barbazza and Klazinga (2021):

1. Methodological considerations – measure the indicator's perceived importance, engagement, potential, interpretability, standardization, and sensitivity to change.
   e.g., Whether the indicator measures what matters, its ease of interpretation, if it is clearly defined or if it is sufficiently sensitive to meaningful changes.

2. Contextual considerations – refer to critical factors regarding the setting in which the indicator will be used.
   e.g., Information infrastructure, system governance, workforce capacity and learning culture.

3. Managerial considerations – influence the indicator's use in practice.
   e.g., Data access, methods of analysis, way of displaying findings, and effectiveness of reaching decision makers.

2.3.2. Visualizations

Alongside the relevance and actionability of the indicators presented in a dashboard, it is as important to present them in a visually effective way, to be possible to find hints and formulate hypotheses about the data. To do so, there is some advice given in the literature (Barbazza, Ivankovic, et al., 2021; Božič & Dimovski, 2019; Few, 2004, 2006b, 2006c, 2008a; Gschwandtner & Erhart, 2018; Işik, 2021; Ivanković et al., 2021; Purevsuren et al., 2020):

- Combine visualization with raw data – visualizations are beneficial to understand big data sets, but raw data in a table format is important to understand if a peculiarity represents an actual problem or not.

- Enable visual exploration – provide different granularities and different viewpoints, starting with high-level summaries (what is happening) and enabling drill-down into details (why is happening).

- Connect past and present – relate actual data with historical data, to give the decision-makers feedback about their choices.

- Interactive visualizations – ease of use to less data-savvy personnel. Dashboards should be customized to tailor the specific necessities of the person or group it is being designed to.

- Use the right visuals - the most adequate visuals for each type of data must be chosen, to be clear, concise and intuitive. Color should be used in context, and meaningfully, using standard patterns of colors for specific purposes. Also, visual emphasis should be placed on the information that most requires the user's attention.

- Prioritize metrics – do not provide an excessive number of metrics, that will make strategic decisions difficult. Metrics prioritization is influenced by data availability and analysts should be careful not to build imbalanced dashboards.
- Include BI in mobile channels – this facilitates business, implementing digitalization, integration and strengthening the company's vision and communication network.
- Future-oriented tools – it is important to shift the dashboards paradigm from temporary monitoring and communication tools (routine reporting) into instruments that are integrated into the company's systems and act as warning mechanisms.

Also, there is a tradeoff being studied between the dashboard's flexibility and the user's learning costs. Conclusions show that, if the approach needs to serve well-defined tasks, the configurations should be built in. On the other hand, if the aim is to serve different departments or different tasks, the dashboard should allow flexibility of use, but not in a way that users have to make too much effort to learn how to use it (Gschwandtner & Erhart, 2018).

2.4. Reporting Automation & Changes Evaluation

Thompson (n.d.) defined as the major BI benefit the faster and more accurate reporting. With that being said, manual reporting brings several challenges related to data integrity, time consumption and overall costs involved in manual tasks, such as manual upload/transfer of reports and time taken to identify errors and problems with data validation, data capturing, data comparison and data analysis. The improvement and automation of these processes give the possibility of getting complete data in near real-time, improving timeliness, enhancing data quality, minimising errors, improving the efficiency of processes, and reducing costs, leading to more accurate and timely decision-making (Bagambiki, 2018; Fatnani et al., 2017).

To perform these process improvements, it is important to take into consideration all the CSF previously mentioned and, additionally to that, to customise the reports according to the requirements of the users. This requirement engineering is the most crucial stage of the development life cycle, because, if that does not happen, the adoption of the new processes will be prolongated, bringing extra maintenance costs and the end-users will find the systems difficult to use (Olexová, 2014).

2.4.1. Evaluation tools and methods

When there is an update in a system, application or process, the results of such a change must be evaluated and, if possible, compared to the expected outcomes defined *a priori*, since most of the time these improvements require time and resources investment, and its impacts must be presented to stakeholders. Satisfaction measures can be defined, and their evolution monitored, comparing the satisfaction before the update and after the update.

In the revised paper from Dedić and Stanier (2016), it is proposed an approach for measuring changes in reporting processes. It states that a reporting process improvement "is successful only if the changes provide or improve a positive experience for users" and defines two clusters of measures to take into account: (1) business/end-users satisfaction - positively increment user satisfaction by facilitating

decision making or improving productivity or, on the other side, negatively influencing user satisfaction -, and (2) technical functionality.

Regarding the identification of the end-users, Davis and Olson (1985) defined two user groups: the ones that make decisions based on the output of the reports - business users; and the ones that enter information and prepare the reports - technical users.

Following this approach, all users answer a survey twice, at two distinct phases: with the original BI process, before changes, and after the modifications occur, in the new BI environment. Through the comparison of the values, the evaluation of the results will mirror the success of changes to the BI reporting system (Dedić & Stanier, 2016).

The survey questions are divided into two groups, one about user satisfaction and another one about technical functionalities of the reporting process. The questions in each section are presented in Table 1.

Table 1 - Survey questions (Dedić & Stanier, 2016)

Cluster of measures	
User Satisfaction	
1	"Does information content meet your needs?"
2	"The information provided in the report is adequate?"
3	"Output is presented in a format that you find useful?"
4	"The system and associated reports are easy for you to use?"
5	"Information in the report is up to date?"
6	"Do reports have the functionality that you require?"
7	"The BI system is flexible enough to support easy change of "descriptive content"?"
8	"Is the change of "descriptive content" fast enough to fulfil business needs?"
9	"Does exporting and sharing content functionalities meet your needs?"
Technical functionality	
1	"Speed of execution time for initial BI report or dashboard"
2	"Speed of execution time for SQL query"
3	"Speed of re-execution time when changing report language, currency or unit"
4	"Speed of execution time when drilling-down conditioning, removing or adding columns in reports"
5	"Amount of time required to change erroneous descriptions or descriptive attributes and hierarchies"
6	"Database memory consumption"
7	"CPU memory usage during the execution of SQL query"
8	"CPU memory usage during the execution of initial BI report or dashboard"
9	"CPU usage during re-execution of the report when changing language, currency or unit"
10	"Technical scalability of the proposed solution in the existing environment"
11	"Support for a possible extension of the system in the future"

A free text question in the survey allowed the users to suggest additional factors that could be considered, and the suggestions are presented in Table 2.

Table 2 - Extra factors to be evaluated (Dedić & Stanier, 2016)

Cluster of measures	
User Satisfaction	
1	"Description of the key figures is available, sufficient, and easily accessible via BI reports?"
2	"Functionalities to allow consolidation of presented information are available in BI reports?"
Technical functionality	
1	"How platform-independent are BI reports (able to run on any PC, Laptop or mobile device)?"

In both stages of evaluation, all users are asked to complete the survey according to their expertise, meaning that questions about technical functionalities are only mandatory for technical users.

The questions are Likert-type items, falling into an ordinal measurement scale, thus, to measure central tendency, it is recommended to use median and mode.

Following the literature findings, median and mode are different and complementary central tendency measures, and, because of that, their changes can also be interpreted differently. While the median of a dataset divides it into two halves and its positive or negative shift represents that the higher or lower values have become more dominant, the mode is the value that appears more frequently in a dataset and its changes reflect a change in the dominant value (Gonzales & Ottenbacher, 2001; Kotronoulas et al., 2023; Vetter, 2017).

After the development of a complete framework for evaluating changes and measuring the success of improvements to BI reporting processes, Dedić and Stanier (2016) pointed out as future work the use of the presented evaluation tool in the context of a real project. This one is a research gap found in the literature that is going to be used in this project. Additionally, the tool can be customised, and extra factors added, according to the specific needs of each project.

Another point of view on the evaluation of changes is suggested by Olexová (2014) in her paper. She states, based on the literature (Moore & Benbasat, 1991), that there are eight factors worth evaluating, the factors that influence the speed to which BI users will adopt the new system.

1. Relative advantage – "the degree to which a certain innovation represents an upgrade when compared to the current technology".
2. Compatibility – "the degree of an innovation matching the existing values, needs and experience of potential adopters".
3. Trialability – "the degree to which an innovation can be experimented with before using it".
4. Image – "the degree to which the use of an innovation is perceived to represent an improvement in one's image or status in one's social system".
5. Voluntariness – "the degree to which the innovation adoption is voluntary or is of free will".

6. Ease of use – "the degree to which one perceives that adoption of an innovation would be without physical and mental effort". This factor, together with compatibility should be addressed at the requirement engineering phase, with the involvement of the end users.

7. Visibility – "the degree to of the idea of the innovation itself can be visible".

8. Result demonstrability – "tangibility of using the innovation, including their observability and communicability".

Also, Few (2017) has written about important criteria to measure data visualization effectiveness. For him, it is important to have into account the seven following characteristics. Those divide into two subgroups, one that aims to measure the degree to which a visualization is informative and the second one that aims to measure the degree to which a visualization is emotive.

Informative

- Usefulness – is determined according to the audience's needs since it is pointless to communicate something effectively if it is not relevant information to the objective of the users.
- Completeness – assures that a data visualization includes all the information that is needed to understand the context behind it.
- Perceptibility – information should be presented in a way that the human brain can perceive the main insights immediately and with minimal effort.
- Truthfulness – data visualizations should be accurate and valid.
- Intuitiveness – visualization chosen should be familiar and easy to understand.

Emotive

- Aesthetics – to be "pleasing to the eye" is usually enough. However, if the audience needs extra motivation, the analyst should invest in "beautiful" data visualizations.
- Engagement – should not be applied in a way that distracts users from data but should draw one's attention to it.

To all these criteria it is, however, important to look through the light of the creator's intentions and the audience's needs.

2.5. LITERATURE REVIEW'S RESULTS DISCUSSION

It is important to define the research gap in which this project is framed and to do this, not exclusively, but also based on the existing literature, in this case, the documents reviewed and presented in this chapter. As this is a project developed in the scope of a company's need and intends to solve a problem that is a bottleneck in the BI&A team's work efficiency, the research gap to be fulfilled is the inexistence of an efficient data architecture and data visualization tool to support the decision making of the New Business team. Apart from that, the theoretical gap found was in the limitations and suggestions for future work of the paper from Dedić and Stanier (2016). This study intended to build a tool that measures the success of changes made to BI processes, particularly reporting processes, although it is

not tested in practice. The tool was built theoretically and there is a gap in applying it in a real project, which will be done in this project. The evaluation tool suggested, together with the necessary adaptations, will be used to answer the proposed research question, measuring how much the BI experience changed when moving from the PowerPoint-based report to the Power BI report. Also, Few's (2017) paper will be used to define the most important factors to be measured in this process.

Concerning the previously established research objectives, both number one (understand the importance of data availability and data quality) and number two (describe the relationship between efficient data visualization and informed decision-making) were addressed in the SLR, when, among other relevant information, the main data quality issues were pointed out, as well as ways to improve data quality, data visualization hints are explored and also how the use of BI to decision making can be potentiated. This literature review contributed also to research objective number three - building the required dashboard and the correspondent data architecture, in the sense that helped to define some important factors to take into account when building a dashboard, like actionability, and also pointed out some data quality issues that must be addressed in the ETL phase of the developments, as well as consequences that may arise if those issues are not taken into account. Finally, and as already mentioned in the research gap definition, research objective number four - evaluate the results and compare the new process with the previous one, will be achieved using a tool (or combination of tools) discovered in this literature review.

3. CONCEPTUAL MODEL

After reviewing the relevant literature on BI and its related topics, based on that, and on the project's requirements, in this chapter, the concept model is defined, a draft of the dashboard that was built.

The dashboard follows the same structure as the previously shared PowerPoint report, with four main sections:

1. Sales – actual and historical data about sales evolution, together with profit, margins, and other relevant indicators.
2. Participation – actual and historical data to check how New Business sales are being represented in the total company's sales, as well as the participation of each business unit and its evolution through time.
3. Budget – information to compare the previously established budget and forecasted sales with the actual sales values, to keep track of financial indicators.
4. Digital KPIs – online indicators, such as conversion rates, page views, and Average Selling Prices, to track the business's online performance.

All the sections enable drill-down in the commercial dimension (business areas, business units, and categories), in the operational dimension (country and regions), communication channels (online and different store typologies), and different time levels (day, last 7 days, last month, month to date, quarter to date and year to date), to allow flexibility in the analysis and suit different users.

The dashboard was developed in Power BI Desktop and then published on the company's Power BI App so that it can be automatically refreshed every day and be accessible to all users.

4. METHODOLOGY

In this chapter, the journey of moving from the previously defined concept model to the final product is explained in detail, following the guidelines of the chosen methodology.

4.1. PRIOR ORGANIZATION'S WORK

The New Business area of the company started to operate in 2018 and, since then, they need to know how exactly the business is performing. Since they do not have their dedicated data team and data infrastructures yet, to address this necessity, the BI team created a report, to be updated and shared weekly with a set of information. The first solution found was to build a PowerPoint structure that would be fed with data from different sources about the topics that needed to be addressed: sales, participation, budget and online indicators, and shared weekly with the required users.

The process of updating and sharing the report involved the following steps:

1. Open nine Excel files with around twenty Pivot Tables[1] each and update them one by one.
2. Update charts and tables to appear in the PowerPoint, in a final Excel file that reads the data from the other nine.
3. Open and filter a Data Studio[2] dashboard, take print screens of three different sheets, and paste them on the PowerPoint.
4. Open an Excel file linked to a Power BI dashboard and update the Pivot Tables in it.
5. Open a Power BI dashboard, filter it, take around thirty-six print screens and paste them on the PowerPoint.

This whole process ended up taking around six hours to be completed, due to the number of different sources and their slow running times. This was not efficient at all, since one of the team members dedicated almost an entire working day weekly to do this. All of this added up to several other disadvantages from the point of view of data quality and data availability that will be explored in further detail in section 4.3.1.

4.2. DESIGN SCIENCE RESEARCH METHODOLOGY

For all the previously mentioned reasons, the process was not efficient and did not guarantee accurate data delivery. Because of that, it needed to be automatized and hugely improved.

The chosen methodology to do so was DSRM, following the principles, practices and procedures defined by Hevner and Peffers (2004; 2007). Opposite to the traditional behavioral science research

[1] "A PivotTable is a powerful tool to calculate, summarize, and analyze data that lets you see comparisons, patterns, and trends in data." (Microsoft Support, n.d.)

[2] "Google Data Studio is a web-based data visualization tool that helps users build customized dashboards and easy-to-understand reports." (*What Is Google Data Studio and How to Create Report On It?*, n.d.)

paradigm that intends to develop and verify theories, the DSRM paradigm is a problem-solving approach, that seeks to create and evaluate new and innovative artifacts that solve previously identified organizational problems (Hevner et al., 2004). The utility is the final goal of DSRM and that is the main reason why this was the chosen methodology.

Apart from that, this methodology is consistent with prior literature, it provides a nominal process model for doing Design Science (DS) research, and it provides a mental model for presenting and evaluating DS research in Information Systems (Peffers et al., 2007).

Also, as this was a project developed in the scope of a professional internship, the goal was not only to solve the company's identified problem, but also to learn as much as possible from the process and, in the DS paradigm, as stated by Hevner (2004), "knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact". It is not required extensive knowledge about the topic *a priori*, and it enables learning by doing approach, which was ideal.

DSRM is adequate for this project since one of its strands is to address solved problems more effectively or efficiently, which was the case in this weekly report. There was already a solution but needed to be performed more efficiently. Also, the *as-is* of the presented problem had a critical dependence on human cognitive and social abilities to produce an effective solution and those cases are the indicated ones to be approached by DSRM (Hevner et al., 2004).

In this case, the application of DSRM included both design processes defined by March and Smith (1995) - build and evaluate - and led to an artifact in the form of an instantiation - an implemented system.

> *"A methodology is a system of principles, practices and procedures applied to a specific branch of knowledge" (Peffers et al., 2007)*

So, in the case of DS research, the methodology includes these three elements: conceptual principles that define DS research, practice rules and the processes to carry out and present the research - the procedures.

The process presented by Peffers (2007) is a sequential order of activities: 1) Problem identification and motivation, 2) Defining the objectives for a solution, 3) Design and development, 4) Demonstration, 5) Evaluation and 6) Communication. He makes clear the idea that "there is no expectation that researchers would always proceed in sequential order from Activity 1 through Activity 6". In the specific case of this project, as it is a problem-centered approach – the research resulted from the observation of the problem and suggested future research in a paper -, it is the basis of the nominal sequence and should start in Activity 1.
Regarding Activity 4 and Activity 5, the literature varies between joining both activities in just one or keeping them separate.

4.3. REPORT AUTOMATION

In this subchapter, the process applied during the project development is explained, following the DSRM phases and detailing what was done in each of them.

4.3.1. Problem identification and motivation

Time is one of the most desired assets nowadays, as we live in a very fast-paced world and business environment. More time is needed to do more and do it better. This company is not outside of this paradigm. As it operates in the retail area, everything happens fast, and decisions must be made even faster, to stay ahead of the competition and keep the business sustainably growing.

Another problem every company is struggling with these days is data quality. People are relying more and more on data to base their decision-making processes on, and, because of that, the data that is consumed by the company must be the most accurate and trustworthy possible, and at the same time it should be available and updated when needed.

Those two big issues combined translate the main concerns of the company around this weekly report that was shared by the BI team with the users of the New Business team. While it consumed around six to eight hours weekly to be updated and shared, there was not any guarantee that the data produced was viable and consistent.

To be able to define the exact pain points that both the analysts and the business users were facing with this report, inputs were collected from them and systematized. Also, to be able to define the problem in the most complete way possible, I did the whole process of updating and sharing the report from start to end to get the real feeling and difficulties faced by the analysts, and my considerations are also mirrored here.

- The PowerPoint format does not allow flexibility, users can only look at the slides that are presented, not being able to interact with the data, drill down or filter.

- Every time an error is found, the users of the report have to communicate it to the analyst, who investigates and corrects the mistake. Sometimes, this can take almost the same amount of time as preparing the report from scratch, as the different sources are linked to one another and changing one implies having to correct the others.

- New data is only available once a week and users do not have the autonomy to update it if they need it more frequently.

- Data visualizations are not built according to user experience rules and data visualization best practices. Users cannot check what exact values are and what variable corresponds to each line, in a line chart, as an example.

- As there is the need to do a big amount of table refreshes, formula updates and chart designs, there is a high chance that some of the data being shared is not accurate and does not correspond to real values.

- It is not possible to check specific time intervals, geographies, and further detail in general, apart from the ones that are presented.

- Every time the users need to see a different vision, for example, an entire month's vision to present in a meeting, they must do a special request to the analyst that spends more time preparing it.

Regarding the motivation to develop this project, there are many reasons why this process needed to be automatized and, apart from helping the BI team in saving time, this project has a big impact on the daily work of a group of people that are not so used to base their decisions on proper data – the New Business team. They usually consume data that is not exactly produced for them but rather adapted to suit their necessities. But, since this is an area with several specificities, their work is much more facilitated and efficient when they have access to a dedicated data visualization tool.
Apart from business reasons and talking about personal motivation, the development of this project and the time spent working on it provided me with huge knowledge about the company, its structuring, goals, and mindset, but also about the data, and how it is stored, managed, and interpreted. It gave me very important hints for my future work at the company and helped me feel much more prepared to do it. Also, every little step taken in the direction of the adoption of a data-driven culture in the organization is a small contribution to a higher valorization of data analysis and the positive impact that it can have on a business.

4.3.2. Objectives definition

Having as a basis the general problem and correspondent implications defined above, the main objective was to build a dashboard that replaces the previous PowerPoint report, with, at least, the same metrics and data and improved visuals, data quality and data accessibility characteristics.

More specifically, the objective was to arrive, at the end of the first development phase – the one that aimed to replicate the PowerPoint report – at a published Power BI dashboard, with the underlying data model, and at the end of the second phase, the result should be the dashboard from the first phase improved taking into account the feedback from users and extra functionalities that prove to be relevant in the meanwhile.

Quantitative objectives included:

1. Build a data model including sales, budget and online indicators data, and the correspondent metrics.
2. Build a dashboard that is updated daily and automatically, and available to every user.
3. Save around six hours weekly to the BI team.
4. Reduce the number of corrections necessary due to errors found.
5. Provide precise information, with no discrepancies from other official data sources used in the company.

Qualitative objectives were related to:

1. Build a dashboard with visuals that are easy to interpret and, at the same time, provide useful information immediately.
2. Raise awareness of data analytics, BI, and their importance and potential in a business.
3. Improve the autonomy of users.
4. Give the possibility to look at data from different angles, enabling new analysis and ideas.

These objectives were defined at the beginning of the project with the help of the BI team and were confronted at the end with the real results of the solution.

4.3.3. Design and Development

In this section, the whole process of developing the dashboard, from the first requirements definition to the final product will be described. An important note to leave is that some decisions made, and procedures adopted were based on the company's best practices or influenced by the company's constraints.

Requirements definition

The first step of the design and development phase was the requirements definition. To plan the whole project journey, the BI team and the New Business team defined what was going to be done, in what steps and what deadlines. It was agreed to produce a Power BI dashboard, including metrics of sales, margin, and online indicators, mainly. This report was going to be developed in two phases, the first one aiming to replicate the PowerPoint report and then the second one which development would be dependent on the feedback from users on the first deliverable and extra necessities that might appear. The result of this requirements definition was a list of metrics divided by topics, the data sources from where each of them came, access permissions needed, as well as a detailed plan of priorities and deadlines for the deliverables.

The structure of the report is the one defined in Chapter 3 – Concept Model. Next are described the main Business Needs of the team, together with specific questions whose answers will help to keep track of the main indicators and the respective metrics created to answer each of the questions. All the metrics are presented in comparison to historical data, to facilitate its interpretation and raise visual alarms easily, every time there are critical deviations.

Sales

As the company operates in the retail industry, sales values mirror the performance of the company and it is crucial to always keep track of sales, margin values and quantities sold. In the case of the New Business area, as the major percentage of sales are third-party sales – coming from the marketplace, some particularities have to be taken into consideration.

Table 3 - Dashboard metrics: Sales

Business Need	Business Question	Metric
Manage the sales evolution, the actual revenue obtained and where it comes from. The metrics to be used are different to First-Party Sales (1P) and Third-Party Sales (3P).	What is the actual sales value?	Reported Net Sales (*RNS*) – 1P
		Gross Merchandise Value (*GMV*) – 3P
	How much are we getting, after costs are subtracted?	Front Office Margin (*MFO*) – 1P
		% MFO
		Commission – 3P
		% Commission
	What is the split between 1P and 3P sales?	*1P %*
		3P %
	How are the sales evolving, through time?	Last four Weeks (*L4W*)
		Last four Months (*L4M*)
Manage the Price Index (IP), in comparison to the competitors.	How competitive are we in terms of pricing?	*IP Bricks & Clicks* (BC)
		IP Pure Players (PP)
Identify the top sellers, brands, stores, business units, categories, subcategories, and products, selling in the Marketplace.	How many products are being sold?	*Quantity Sold*
	What is the average price our customers are paying for a product?	Average Selling Price (*ASP*)
	What is the lead time the sellers are offering our customers?	Average Lead Time (*ALT*)
Manage the sellers' and offers catalogue.	How many active sellers do we have?	*Number of sellers with sales*
	What is the percentage of active sellers?	*% Of sellers with sales*

Participation

New Business is a recent area in the company and its growth has been substantial, but it is important to be aware of the percentage of the total company's sales it represents, to get an idea about whether the growth is motivated by the overall company's growth or represents individual evolution of New Business department.

Table 4 - Dashboard metrics: Participation

Business Need	Business Question	Metric
Manage the weight of New Business in the total company and the weight of each business unit in the total New Business.	How much of the company's sales are New Business sales?	*Online Participation*
		Offline Participation
		Omnichannel Participation
	What are the most and the least significant business units?	*Online Mix*
		Offline Mix
Check how New Business offline sales are performing compared to the total Marketplace offline sales.	How much of the offline Marketplace sales are New Business sales?	*Participation of offline New Business in Total offline 3P*

Budget

At the beginning of each year the monthly budget is defined for each business unit and a sales forecast is done throughout the year, and updated periodically, based on new inputs that may appear. These values are then used to do several planning, such as promotions.

Table 5 - Dashboard metrics: Budget

Business Need	Business Question	Metric
Identify and act upon substantial deviations from the pre-established values.	How are we performing compared to the established budget?	*Actual/Budget*
	Does the sales forecast predict an increase or decrease in sales?	*Forecast/Last Year*
	Based on the Month to Date sales, how much do we expect to sell until the end of the month?	*Sales Estimation*

Digital KPIs

Every business that has an online presence should give importance to online indicators and, in the case of New Business, which happens nearly 100% online, this is even more important.

Table 6 - Dashboard metrics: Digital KPIs

Business Need	Business Question	Metric
Understand the customers' online behaviour.	What is the average value our customers are spending on an order?	Average Order Value (*AOV*)
Keep up with the online performance of each business unit.	What are the most and least visited product pages?	*Product Views*

Table 6 - Dashboard metrics: Digital KPIs

	What products are bought more and less in comparison to the number of times their page is visited?	*Product Conversion Rate (PCR)*
	How many people added at least one product to the cart in a website visit?	*% Add to cart*

Data architecture and ETL

Before starting to build metrics and visuals in Power BI, data had to be collected and a data model built. As there was the need to include metrics from different business areas and it is a big company, data is not all stored in the same databases, structured in the same ways, and coming from the same sources. Those different sources must be integrated into one and the process to do so is ETL.

Following the company's best practices, the ETL process was divided between two platforms: SQL Server Management Studio[3] and Power BI. SQL Server Management Studio was used initially to create views, with some aggregations and filters, that will then be imported into Power BI, without the need to write a complex query in the "Get Data" section. All the remaining ETL was done in Power BI, using Power Query[4] – its ETL engine. Having into account Microsoft's definition, "Power BI is a collection of software services, apps, and connectors that work together to turn unrelated sources of data into coherent, visually immersive, and interactive insights" (Microsoft, 2023). Here in the ETL phase, it was taken advantage of the part that refers to turning unrelated sources of data into a coherent one. Apart from being able to connect to various data sources and extract data from them, Power Query provides a visual editor that allows several data transformations, such as column splitting, grouping, sorting, and more.

In a real project, processes are rarely straightforward when it comes to gathering data and building a data model, and this case was no exception. The initial plan was to build the entire data model in Import dataset mode, which is the most used method to build datasets in Power BI. This way, all necessary tables would be imported into Power BI, then metrics would be built and finally, the visuals. However, there was a challenge related to the online indicators which come from the Online Department data sources and are transformed and filtered in ways that are not easy to understand and replicate in a way that values would be consistent and trustworthy. Because of that, the solution that appeared to best suit the requirements, was to build the Digital KPI's page (the one that reflects online indicators) using DirectQuery dataset mode – the one that can be used to connect Power BI to other published Power BI datasets - and connect the file directly to the online dataset published on the company's Power BI workspace.

[3] "SQL Server Management Studio is an integrated environment for managing any SQL infrastructure that is used to deploy, monitor, and upgrade the data-tier components used by your applications and build queries and scripts." (*What Is Microsoft SQL Server Management Studio (SSMS)?*, n.d.)

[4] "Microsoft's Data Connectivity and Data Preparation technology that lets seamlessly access data stored in hundreds of sources and reshape it to fit the needs."(n.d.)

To adapt to this new solution, and because of constraints related to the automatic refresh of the dashboard, it was decided to create a dataset with data about sales, participation and budget and publish it in the Power BI workspace and then create the definite Power BI report, connecting it to this previously created dataset, as well as to the Online dataset, ending up working entirely with DirectQuery dataset mode.

Having this into account, the ETL process described next corresponds to the one done to build the dataset, which is the main model and integrates data for the sections of Sales, Participation and Budget.

Extract

The first step was to, based on the list of metrics resulting from the requirements definition phase, import the needed tables and files to Power BI. The sources were SQL Server tables, one Hadoop (*Apache Hadoop*, n.d.) table and an Excel file. Table 7 and Table 8, present a description of the several imported tables, the source of each of them and a small description of the data they contain and their purpose.

Dimension Tables

A dimension table stores attributes that describe and filter the objects in the fact tables, in a way that supports meaningful answers to business questions.

Table 7 - Data Model: Dimension Tables

Table Name	Source	Description
DIM Time	SQL Server table	Includes the time frame to be considered decomposing each date into Year, Quarter, Month, Week and Day.
DIM Operational	SQL Server table	Represents the operational structure of the company, both online and offline and includes store details such as store codes, typology, country, and regional aggregations.
DIM Commercial	SQL Server table	Represents the commercial structure of the company, decomposing each business area into smaller levels of aggregation.
DIM Commercial_Intermediate	SQL Server table	Marketplace products can appear fast and are always changing and, because of that, it is still a challenge for the company to have every product from every vendor associated with a base unit, subcategory, category, and business unit. This table helps to establish the relationship between Marketplace product categories and the company's actual categories, to be able to map the Marketplace orders.

Table 7 - Data Model: Dimension Tables

DIM Competitor	SQL Server table	Details about the main competitors (both PP and BC) and respective stores.
DIM Sku_Marketplace	Hadoop table	Stock Keeping Unit (SKU) is the unique identifier of a product. For the same reason as *DIM Commercial_Intermediate*, this table establishes a relationship between Marketplace SKUs and a valid category.
TimeLevels	SQL Server table	Table with temporal aggregations to be used in slicers that provide views of the day, last 7 days, last month, month to date, quarter to date and year to date, depending on the selected date.
Day	SQL Server table	Table with only one row and column representing the most recent day to which there is sales data.
SalesFlag	SQL Server table	Indicates the date and time of the last update of sales data and its status - if it succeeded or failed. Data to populate this table comes from a step in the company's engine that processes daily sales and is used in every sales dashboard to indicate what was the last time the values being shown were updated.
Top	Power BI (insert data)	Table created in Power BI with numbers 5, 10, 15, 20, 25 and 50, to be used in filters and slicers.

Fact Tables

A fact table presents quantitative information, the numerical data of a business. Those are the main tables in a schema.

Table 8 - Data Model: Fact Tables

Table Name	Source	Description
FACT Sales	SQL Server table	The table contains all sales data with detail to the category level, stating to each day, store and category what was the value of RNS, Gross Sales, quantities sold, and commissions, including historical data.
FACT Sales_Marketplace	SQL Server table	Data about Marketplace orders, with details about order status, dates, quantities and prices, shipping costs and commissions, as well as details about the ordered products and respective sellers.

Table 8 - Data Model: Fact Tables

FACT Prices	SQL Server table	Data about competitors' prices, and the company's prices to the same categories to the products that match, to calculate the IPs, that sign if the company is competitive or not in terms of pricing.
FACT Forecast_Budget	Excel File	Table imported from an Excel File published in SharePoint[5] where all New Business managers upload the data about budget and forecast to their categories.

Transform

After importing all the needed tables, M language[6] was utilized in PowerQuery to do the necessary transformations. Those include renaming columns, creating calculated and derived columns, replacing values, and splitting or merging columns. Those transformations left tables ready to be loaded into Power BI and create the necessary metrics on top of them.

Load

After all the needed transformations were applied, tables were loaded into the Power BI report and could be consulted in the Model View. The connections among fact and dimension tables were created and the data model was then built, as can be consulted in Appendix B.

The complete ETL process is systematized in Figure 5.

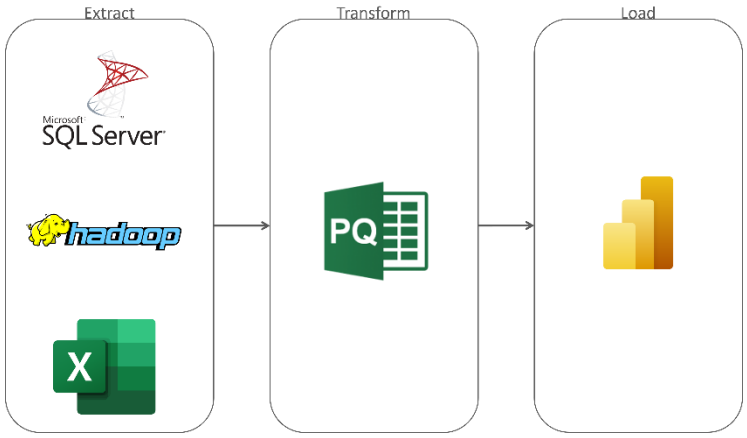

Figure 5 - ETL process diagram

[5] "A cloud-based service, hosted by Microsoft, for businesses of all sizes where employees can create sites to share documents and information with colleagues, partners, and customers." (Microsoft Support, n.d.)

[6] "It is a functional, case sensitive language, used in Power Query." (Microsoft, n.d.-b)

Power BI dashboard

After the data model was built and ready to be worked on, the previously defined metrics were built, using the DAX language[7]. This was done using the available functions and standard procedures, it is only relevant to leave a special note to the metrics containing historical data. It is very important to always look at the values in comparison to something else and, it is a company's best practice to compare the values to data from the same period in the previous year. Then, every metric built has an equivalent one to historical data and, depending on the time filter applied to the visuals the metrics differ. As an example, if users select to see the data in a day or last 7 days' vision, values are compared to the same weekday last year, otherwise, if users wish to see last month, month to date, quarter to date or year to date vision, values are compared to the same month day last year. This differentiation is made to allow a more precise comparison, since, for example, a Saturday is not expected to have comparable values of sales to a Tuesday, in the case of ordinary weeks and, when looking at smaller time intervals, this is significant.

Once metrics got ready to be used, each page of the report was built, having into account the business users' perspective and the data visualization's best practices. After the ETL, this was the time to use Power BI tools to transform data into "visually immersive and interactive insights" (Microsoft, 2023).

Power BI was the chosen software to develop this dashboard since it is the widely used one in the company. This way, everything ends up being coherent and there is a guideline in every report built. Users are aware of the main functionalities, and it is also an easy tool to work with, with lots of documentation online, monthly updates and available on every device. On top of that, the company has a platform where all Power BI reports are centralized and published so that users can find what they need, organized by topics, and always updated.

Something common to almost every section of the report is the filters at the top of the page, allowing different time level aggregations, geography and channel selections and the color schema used, which is consistent along all the report and uses red to sign negative evolutions compared to historical data, and green to signify the opposite. On the side menu, users can navigate through pages, click on the company's logo to go to the previously visited page, and visit the Glossary page, which was built to guide the users in the initial times of utilization, understanding the metrics presented in the dashboard. On the date slicer, users select the dates they want to consult.

Some of the visuals already existed in the company in spread dashboards and were adapted to best suit New Business needs and included in this report, so that users can have a unified view of all the main indicators, without the need of moving from one dashboard to another.

It is important to state that the data is altered for data privacy reasons and some minor changes were done in the report pages, to protect the identity of the company.

[7] "Data Analysis Expressions (DAX) is a library of functions and operators that can be combined to build formulas and expressions in Power BI, Analysis Services, and Power Pivot in Excel data models." (Microsoft, n.d.-a)

Sales

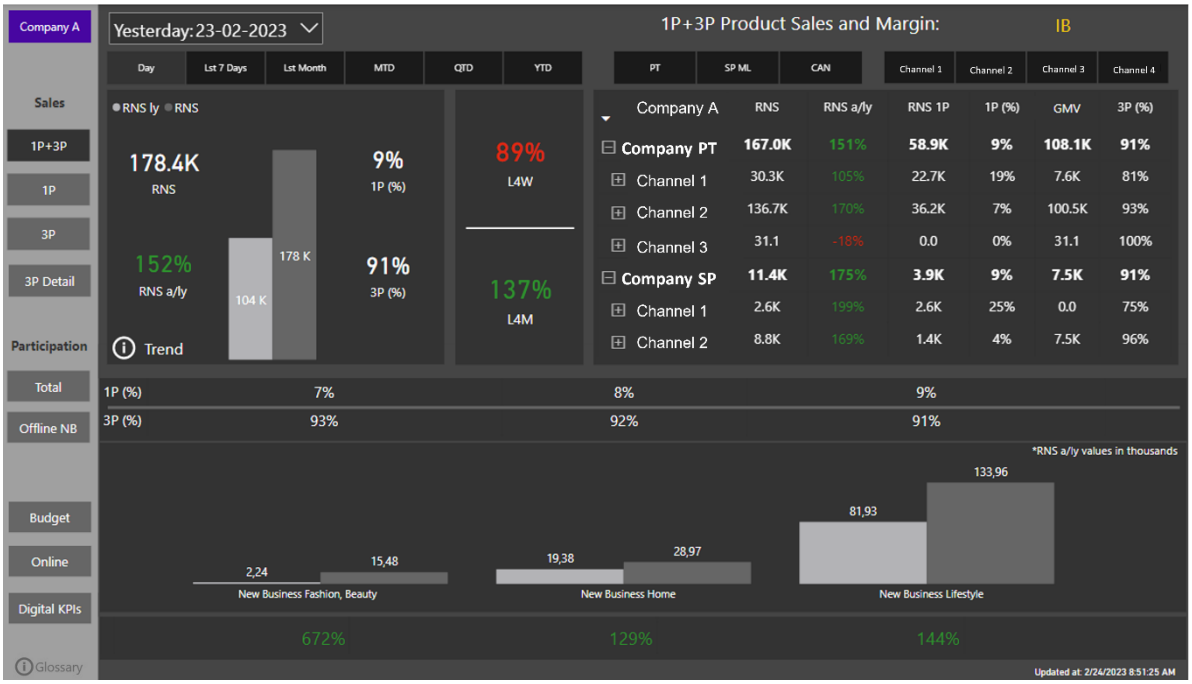

Figure 6 - Dashboard: Sales 1P+3P

The home page is the one with sales indicators, where business users can get the first image of their performance. There are indicators of RNS, with actual values, evolutions, and distribution between 1P and 3P and also a comparison of current sales with L4W and L4M sales. The bellow panel enables drilling down to lower levels of aggregation and the remaining visuals are also interactive.

This screen is the one users consult first to get an idea of the previous day's sales and can also use it to do a more detailed analysis. For example, in case of sales are significantly decreasing, some strategies have to be adopted to revert the tendency and, using this report, users will be easily alerted to that.

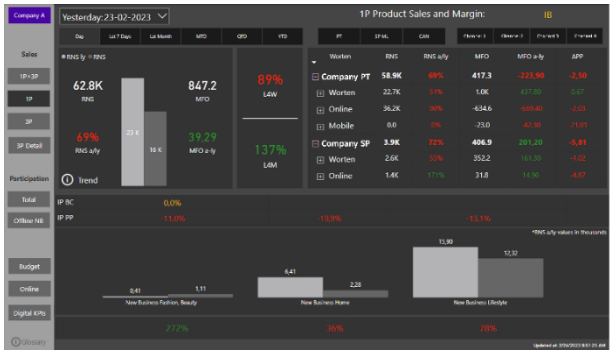

Figure 7 - Dashboard: Sales 1P

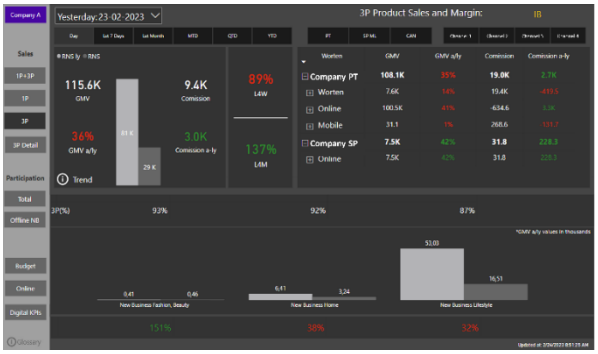

Figure 8 - Dashboard: Sales 3P

Apart from the homepage, if users want to dive into further detail, there are two other complementary pages, that divide sales between 1P and 3P. Both design and content of the three pages are similar, differing only on the metrics presented, once 1P sales present RNS and MFO values and 3P sales

present its equivalent metrics, which are GMV and Commission. Here, and differently from the main page, users can have an idea of the actual profit the company is making.

Still in the sales section, there are some additional pages. In one of them, users can consult a vision of sales values, but from an evolutive perspective, which can be particularly useful if there are special days or epochs, that must be monitored in greater detail.

On the other one, there is a more operational vision that is focused on Marketplace administration. Here, users can consult the top categories, brands, and sellers, and their performance regarding the main indicators (quantities sold, ASP and ALT). This one is an important view, since one of the problems the Marketplace represents to the company is the fact that, because sellers are independently serving the customers, there is no control over service levels, and, with this tool, Marketplace managers can be alerted to critical situations and contact the sellers in question, to assure a more consistent service level among all Marketplace, which will lead to better customer satisfaction.

From that page, users can explore further and enter the seller view, to consult active sellers, which is an important indicator not only to check broadly if the size of the Marketplace is increasing but also to raise alarms in case there is a significant drop in the number or percentage of active sellers. This can happen if there is any system problem and offers cannot be published or accessed, if sellers lost interest in selling in the Marketplace for any reason or if the customers are not adhering as much as previously.

Participation

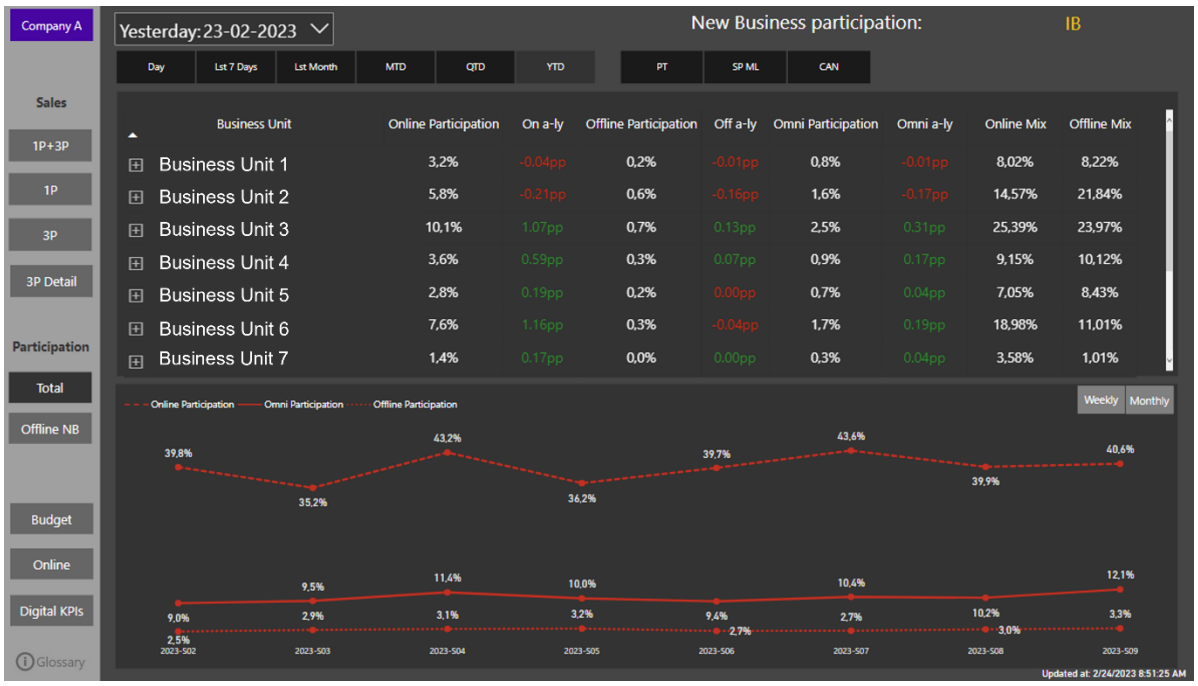

Figure 9 - Dashboard: Participation

In the Participation section, the first page is focused on overall New Business participation in total company sales. Users can see how each business unit and category is performing, currently, and in

comparison with historical data, in total company's sales (participation) and inside New Business (mix). The visual on the bottom of the page represents the participation divided and compared by channel and enables weekly and monthly vision. This visual reacts to the selection of a specific business unit or category in the table above. The buttons that switch between weekly and monthly vision were done using bookmarks. Although there is a proper drill-down tool, users are not always aware of this so, to facilitate user experience and make sure users take advantage of this functionality, this was the solution found.

This vision is particularly useful to decide what business units need more investment because they are losing performance and to check if there are any of them whose performance is exceeding expectations. Also, it gives an idea if the increase or decrease of New Business is being influenced by this phenomenon also in the company in general, or if they reflect New Business strategies.

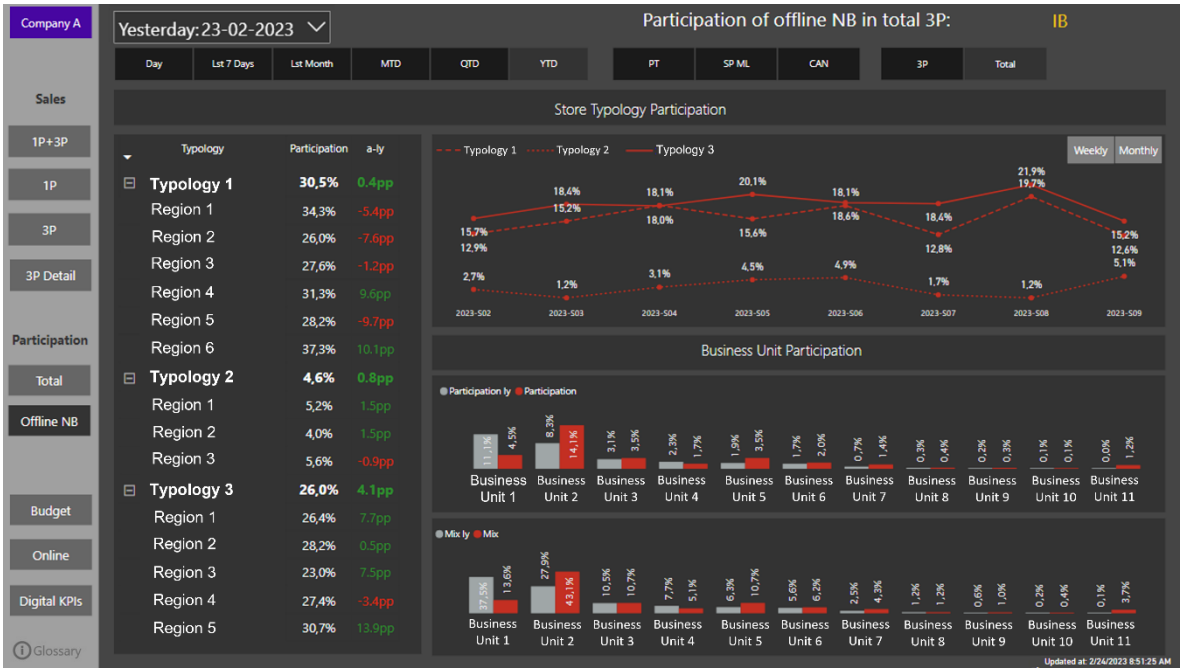

Figure 10 - Dashboard: Participation Offline

Apart from the overall participation, there is also a page dedicated to Offline Participation, where New Business' offline sales are compared to the total 3P offline sales, and the total 1P + 3P offline sales, from another perspective. The table on the right presents the participation by store typology and region and the concept of the remaining visuals is the same as on the previous page.

New Business sales happen mainly online, but there are ongoing initiatives to bring it to the stores, to raise awareness of the customers and to give the possibility of extending stores' product offers and this vision enables users to see how that is performing, what business units have higher customer acceptance and which ones are not worth investing in offline channels.

Often there are also pilot tests occurring and this can be not only a tool to check the performance of past events but can also be used to study the best store typology or region where these pilot tests can be conducted.

Budget

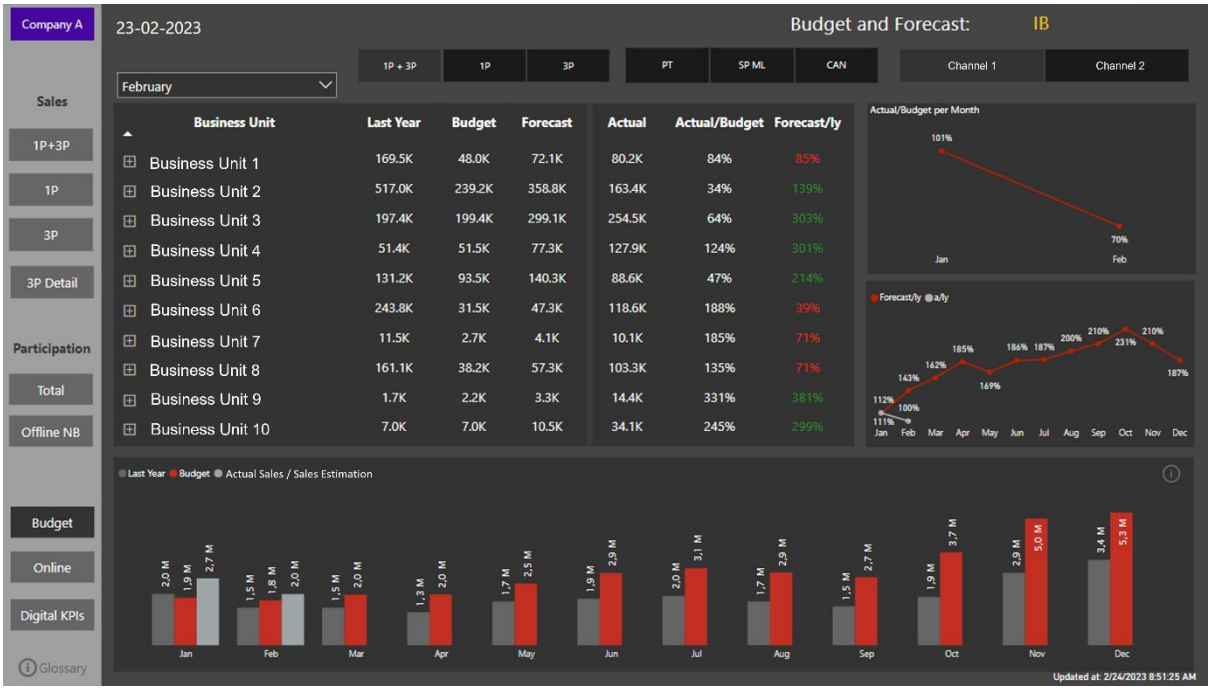

Figure 11 - Dashboard: Budget

The Budget page is dedicated to comparing predictions and expectations with actual values of sales. Budget values represent the target sales value and are established at the beginning of each year, while Forecast values represent how much is expected to sell and are periodically updated based on new inputs that appear throughout the year. The metric Actual/Budget reflects the distance to the target for the current month and whether the target was surpassed or not hit, for already finished months. Forecast/Last Year reflects, for the whole year, if the company is expecting to increase or decrease in comparison to historical data. Users can choose to see this page in aggregate vision or look only at 1P or 3P visions.

The chart at the bottom of the page illustrates the relationship between monthly sales of last year, the budget and the value of actual sales for already finished months, or a prediction of total monthly sales, based on the actual sales values and the days remaining for the end of the month.

Budget and Forecast are utilized essentially to do planning, such as promotional or stock planning and the more accurate they are, the best decisions will be made based on them. Because of that, it is useful to monitor deviations to be able to correct them, but also to have a vision in advance of what is expected to come ahead, so that strategies can be adopted early and initiatives well planned.

Online

The Online button on the lateral menu takes the user, using a web URL, to an already developed dashboard, which values could not be brought to this data model. This way, users can easily access this information, without having to look for it in a separate source.

Digital KPIs

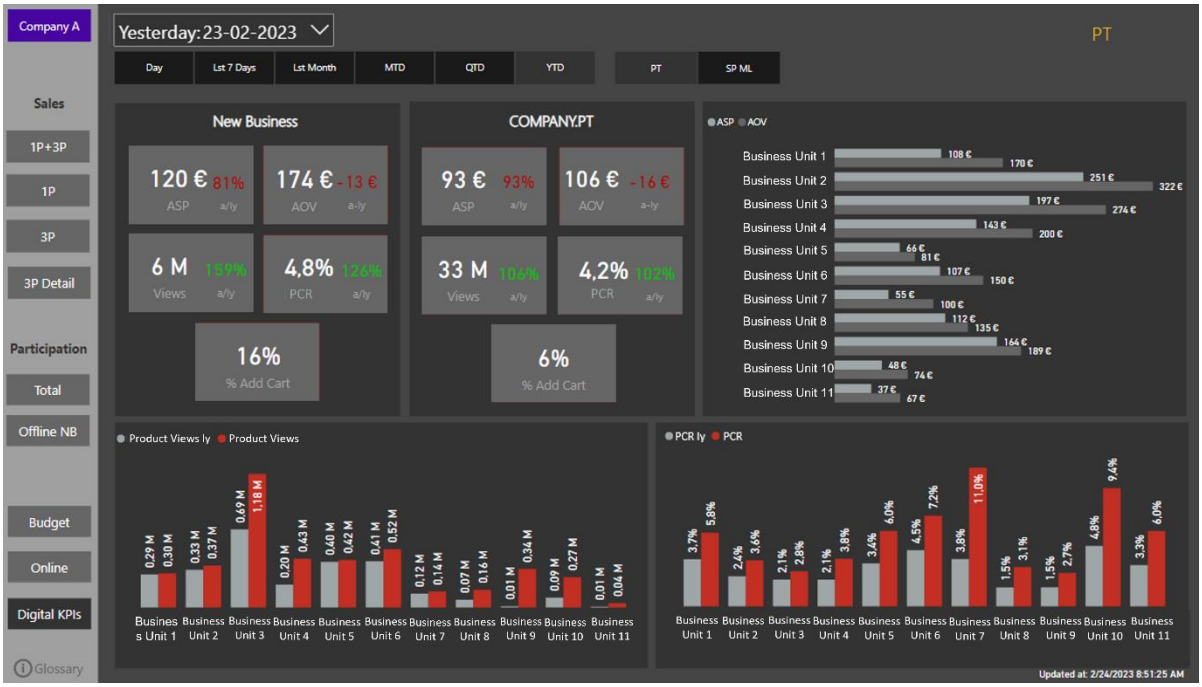

Figure 12 - Dashboard: Digital KPIs

The last section, Digital KPIs, mirrors the main indicators related to the performance of the business units on the website. It has an aggregated vision of the total company and the total New Business, to get an overall image and to establish a comparison point, and then the division of the main metrics by business units. By clicking each of the bars in the bar charts, the user is redirected to a detail page, visually equivalent to the main one, but focused on the selected business unit, presenting details until the category level. Once again, this was done using bookmarks for usability purposes.

Online is the main channel of sales and focus of New Business and the more important indicators to be monitored are represented on this page. The information presented here can be utilized to justify significant and unexpected changes in sales values, but also to do some strategic decisions regarding advertisement, pricing, or other factors. The ratio between product page views and PCR is an important factor to analyse since it can give an idea of groups of products that seem attractive to customers but then are not bought in the same proportion, or the opposite.

4.3.4. Demonstration and Evaluation

After the dashboard was built and ready to be delivered to the New Business team, there was a session where some elements of the business users' team were present and the dashboard functionalities were demonstrated in detail, and a parallelism with the previously shared report was made. Some of the instances of the problem identified in the beginning could easily be proved to be solved, such as the flexibility offered with slicers, filters and drill-down options and the frequency of update of information (daily *versus* weekly). In this case, the demonstration was done by experimentation.

The evaluation process was carried out using two distinct approaches, an iterative process where feedback from the previous delivery was utilized to define a new development pipeline, with necessary corrections or implementation of new features, and, in parallel, a user satisfaction survey.

Iterative evaluation

The core of the evaluation process in DSRM is to measure how well the developed artifact supports the objectives of the solution defined previously. Each of the objectives defined in section 4.3.2 was measured using feedback from both technical and business users and through the observation and analysis of their behavior.

The evaluation of the first deliverable of the project is presented below.

Quantitative objectives

These are the points that can be objectively defined as achieved or not achieved.

1. *Build a data model including sales, budget and online indicators data, and the correspondent metrics:* Achieved.
   The data model includes all data and metrics that were presented in the original report, as well as extra details.

2. *Build a dashboard that is updated daily and automatically, and available to every user:* Achieved.
   The dashboard was published on the company's Power BI App, which enables it to be automatically refreshed every day and easily accessed by every authorized user.

3. *Save around six hours weekly to the BI team:* Achieved.
   The time that used to be allocated to the preparation of the report is not needed in the new one, since its update is automatic. Some time was still dedicated to giving support to the business users in the initial days, but this is part of the change management process and contributes to the correct and complete use of the tool.

4. *Reduce the number of corrections necessary due to errors found:* Partially achieved.
   As expected, in the first times utilizing a new tool, there are small corrections that have to be made. However, those are not corrections due to data inconsistencies or errors and are rather small details, such as a button that is not working or a text box that is not aligned. Major data-related errors were not pointed out.

5. *Provide precise information, with no discrepancies from other official data sources used in the company:* Achieved.
   Directly using the data sources of the company, it is easy to assure that values will be consistent across platforms and tools. Also, decreasing the manual work helps to eliminate sporadic mistakes, that were frequent in the old reporting process.

Qualitative objectives

These are not as easy to measure as the quantitative objectives, but conclusions can be drawn from observing the users' interaction with the tool.

1. *Build a dashboard with visuals that are easy to interpret and, at the same time, provide useful information immediately.*
   In general, users are comfortable using the report and navigating through it. However, from the users' feedback and questions, it can be deduced that some details are not as immediate to understand as they should be, and those points must be improved in further development phases.

2. *Raise awareness of data analytics, BI, their importance, and potential in a business.*
   By making available a new data visualization tool that provides a 360° view of the New Business area, users inevitably become more aware of its benefits, and this will make them have new ideas about the purpose and applicability of BI&A.

3. *Improve the autonomy of users.*
   With the Power BI dashboard, users get much more flexibility due to the greater offer of visuals and filters, this way becoming more autonomous to do their analysis, without the need to request them from an analyst.

4. *Give the possibility to look at data from different angles, enabling new analysis and ideas.*
   Once again, the different filter and drill-down options provide much more visualization perspectives, in comparison to the PowerPoint report, which was static.

The results of this first evaluation of the project, together with suggestions that appeared over time, were used to build a pipeline for a second development phase, iterating back to Activity 3 of the methodology – Design and Development. Further development phases are out of the scope of this report, for timing reasons, but the explained process will be replicated for the remaining stages.

User Satisfaction Survey

To measure the effects on user satisfaction of the implementation of the Power BI dashboard as a replacement for the PowerPoint-based report, a questionnaire was done for both technical and business users of the reports. The research question to be approached was the one defined at the beginning of this document: "How does the implementation of a dashboard change the BI experience?"

This research was relevant to measure the success or failure of the automatization from the point of view of user experience and to investigate what factors are positively or negatively impacted by this modification. The idea, procedure and the basis of the evaluation tool itself were taken from the literature, mainly from Dedić & Stanier (2016), as already explained previously.

This is an analytical study, and, more specifically, a longitudinal study, as it aimed to collect data at more than one point in time (Kelley et al., 2003). In this case, the data was collected from the same sample of the population in both moments, to compare user satisfaction at one point in time to the same factor at another point in time. This was done using an online questionnaire, as it is easy to distribute and enables fast answers, which is an important factor to consider, since, usually, company members are not as available to answer long interviews or participate in other methods that involve greater effort and time.

Regarding the research tool used, it was built based on the already mentioned paper (Dedić & Stanier, 2016), making the necessary adaptations to best suit the specific project to which it is being applied, and the complete list of survey questions can be consulted in Appendix C. The questionnaire was built using the Microsoft Forms (*What Is Microsoft Forms? - Microsoft Support*, n.d.) tool, started with an introduction with a brief explanation of the context and instructions and was then divided into two big sections: a first one related to user experience questions, and a second one with questions about technical aspects of the report. The first section was mandatory for both types of respondents – business users and technical users, while the second one was only mandatory for technical users. All questions were of closed type, using five items Likert scale (Joshi et al., 2015), giving the users the opportunity of classifying their satisfaction regarding each aspect from "Very dissatisfied" to "Very satisfied". These types of questions are easy to administer and can easily be coded and analysed (Kelley et al., 2003). In the end, the respondents could leave additional feedback using an open area designed for that purpose. An overview of the main factors that were intended to be measured and the corresponding questions to do so is presented in Table 9. The factors were attributed to questions based on the literature, particularly Few (2017) on User Satisfaction related questions.

Table 9 - Survey questions and measured factors

Question		**Factor to be measured**
User Satisfaction		
1	Content and relevance of presented information	Usefulness
2	Confidence in the presented information	
3	Easiness of report utilization	Intuitiveness
4	Frequency of information update	Truthfulness
5	Exporting and information-sharing features	
6	Features that enable consolidation of presented information	Completeness
7	Flexibility to alter descriptive content (€ to quantity, time interval)	
8	Flexibility to apply filters and see higher/lower granularities	
9	Formatting and visual presentation of information	Perceptibility
10	Description of visualizations (data labels, subtitles)	
Technical functionality		
1	Speed of initial execution of the report	Agility
2	Speed of update when filters are applied	
3	Work time needed to update the report	Efficiency
4	Work time needed to correct errors	
5	Possibility of adding new information in the same format	Flexibility
6	Support for a possible features' extension in the future	
7	Platform independence (available on any device)	

As already mentioned, this questionnaire was aimed at two distinct groups of users: business users (the ones that consume the report information) and technical users (the ones that produce the report information). So, the potential respondents were the members of the BI team and the members of the New Business team and, because of this, the sampling method adopted was a mixture of non-random and random sampling (Kelley et al., 2003). In what concerns the BI team members, the number of elements that had contact with the preparation of the report is limited, so all of them were approached to fulfil the questionnaire, by the purposive sampling method. The business users were elected by using a random sampling method, the survey was sent by email to the team and some members voluntarily decided to answer. The results are allowed to be generalized to the whole population, because one group of users involves the whole population, and the other was selected using random sampling methods. The eligible elements were contacted by email and 5 technical users, and 7 business users agreed to participate, which gives a response rate of 100% in technical users and around 28% in business users, excluding one invalid answer. One strategy to increase the response rate was adopted. As the questionnaire had to be answered in two different phases and there was a great possibility that users ended up forgetting it, an option was added at the end of the survey to leave an email address to be contacted later to answer the second phase of the questionnaire. This not only decreased the probability of respondents missing the second phase but also allowed them to test the dashboard in greater detail before answering the questionnaire about it.

As the questions were all Likert-type items, the results were analysed using median or mode, which are the adequate central tendency measures to analyse this type of data, and results from the first phase were compared to results from the second phase (Dedić & Stanier, 2016).

To complement the analysis, the Kruskal-Wallis test (Kruskal & Wallis, 1952) was utilized. This is a statistical test that can be used to determine if there is a significant difference between groups of a variable. It was important to use this test to complement the analysis of the survey results, since the differences in median and mode from Phase 1 to Phase 2 can be caused by a random factor and not mean a real statistical difference. This analysis was conducted using Python[8] and considering the following assumptions:

- **Null hypothesis**: Both phases have the same median, and there is no significant difference between them.
- **Alternative hypothesis**: Phase 1 and Phase 2 are significantly different between them.
- $\alpha = 0.05 \rightarrow$ A *p-value* smaller than this will indicate the rejection of the null hypotheses.

[8] "Python is an interpreted, object-oriented, high-level programming language with dynamic semantics." (*What Is Python?*, n.d.)

4.3.5. Communication

In the company, there are specific moments to present the BI developments in course to relevant audiences. There is a meeting twice a week with the BI team together with the Data team, to share ideas, receive feedback and help. The communication to technical audiences was done in those moments and was focused on explaining the development process, in a detailed and technical way.

Management audiences were presented with the final result of each phase, with explanations about the report's functionalities and advantages. Those presentations were focused on presenting the problem faced and the solution developed, emphasizing its relevance and took place in monthly sessions that happen with the presence of the Head of the Commercial area, and other relevant people whose work the developed project might contribute to. This part, together with the demonstration, is crucial to ensure effective change management and make sure users are taking the most advantage of the developed product.

Apart from those moments in the company, the project's development process, results, utility, limitations, and drawbacks are presented also in this report, available to all relevant audiences.

5. RESULTS AND DISCUSSION

After building the dashboard following the DSRM, the results of the work and its impact on the teams were analyzed. This chapter is divided into two subchapters, one focused on the general presentation and analysis of the developed work, and the second one, related to the presentation and analysis of the user satisfaction survey results.

5.1. NEW BUSINESS DASHBOARD

The main objective of the project was to develop the dashboard that would solve the BI&A team time management issue and, at the same time, the data quality issue of the New Business team, stimulating their data-driven mindset and autonomy. After the conclusion of Phase 1, as already explained in Chapter 4, both teams gave feedback about the dashboard. The general feedback was positive from both sides, and the teams gave recommendations for future development phases. Overall, the BI&A team considered it a great improvement regarding time optimization and quality of information shared and the New Business team showed a willingness to start using the dashboard as a work tool, despite some lack of *a priori* knowledge about the behavior of Power BI and its potential, which was addressed with some support sessions. The results of the work developed regarding the dashboard were also mirrored when the initial quantitative and qualitative objectives were evaluated against the final solution, which can be seen in greater detail in section 4.3.4. Summing up, four in five quantitative objectives were successfully achieved after the first phase of development.

This development using DSRM goes in line with the objectives of this project, since the New Business team has now available a tool that is updated daily with the most recent information, validated and complete, with filters and options to enable looking at data from different angles. On the side of the BI&A team, around six weekly hours were released and there is a greater confidence in the shared data, which increases credibility and aggregates value to the developed work.

Clearly, a dashboard is a constant work in progress and that is why it was not identified as completed at the end of Phase 1 of development. New data and visuals will be added or removed over time, adapting to the team's necessities and their evolution.

Answering, in general terms, before moving on to the next chapter where deeper conclusions will be drawn, to the research question: how did the implementation of the dashboard change the BI experience? From the teams' feedback, the implementation of the dashboard saved time and improved the quality of shared inputs, at the same time that raised awareness about the importance and advantages of BI.

5.2. USER SATISFACTION SURVEY

The user satisfaction survey was conducted in the evaluation phase to evaluate the changes to user experience caused by the dashboard implementation – survey-related topics are covered in detail in Chapter 4. Its results were then analyzed using median and mode, referring to its theoretical

definitions and attributes, and comparing the results of each phase of responses – the first one concerning the report shared in PowerPoint, and the second one concerning the report in Power BI.

Each option available to be selected was associated with a numerical value, as follows:

1 – Very dissatisfied; 2 – Dissatisfied; 3 – Neutral; 4 – Satisfied; 5 – Very satisfied; 0 – Not Applicable.

The median and mode were calculated for each question/factor and each phase. After that, the evolution (Δ) was calculated using the formula: Phase 2 – Phase 1, both for each question and for each measurable factor. All the results can be seen in Table 10 and Table 11.

At first glance, every factor has improved both in terms of median and mode, from the first phase to the second one, being the most impacted factors Completeness, Agility and Efficiency, with the greatest evolution values. Usefulness and Flexibility were the least impacted values, with only residual increases in median and mode.

After this general analysis, the Kruskal-Wallis test was performed. Firstly, it was important to test if the two phases had statistically significant differences between them, which ended up being proved, since the *p-value* obtained in the test was $2.5 \times 10^{-33} < \alpha$. With this conclusion, a similar analysis was replicated for each question and measurable factor, to test which of them was causing the difference between phases. The *p-values* resulting from this analysis can be seen in Table 10 and Table 11, being the ones greater than 0.05 an indication that the differences in those questions or factors are not statistically significant and should not be taken into consideration.

Table 10 - Survey results: individual questions

			Phase 1		*Phase 2*		*Δ*		*Kruskal-Wallis (p-value)*
			Median	Mode	Median	Mode	Median	Mode	
Usefulness	1	Content and relevance of presented information	4	4	5	5	**+1**	**+1**	*0.0003*
	2	Confidence in the presented information	3	4	5	5	**+2**	**+1**	*0.0007*
Intui-tivenes	3	Easiness of report utilization	3	3	5	5	**+2**	**+2**	*0.0047*
Truthfulness	4	Frequency of information update	2	2	5	5	**+3**	**+3**	*0.0004*
	5	Exporting and information-sharing features	3	3	4.5	5	**+1.5**	**+2**	*0.0022*

Table 10 - Survey results: individual questions

Completeness	6	Features that enable consolidation of presented information	2	2	5	5	**+3**	**+3**	*0.0004*
	7	Flexibility to alter descriptive content (€ to quantity, time interval)	1	1	5	5	**+4**	**+4**	*0.0000*
	8	Flexibility to apply filters and see higher/lower granularities	1	1	5	5	**+4**	**+4**	*0.0000*
Perceptibility	9	Formatting and visual presentation of information	2	2	5	5	**+3**	**+3**	*0.0000*
	10	Description of visualizations (data labels, subtitles)	2.5	3	5	5	**+2.5**	**+2**	*0.0000*
Agility	1	Speed of initial execution of the report	3	0	5	5	**+2**	**+5**	*0.0226*
	2	Speed of update when filters are applied	0.5	0	5	5	**+4.5**	**+5**	*0.0002*
Efficiency	3	Work time needed to update the report	1	1	3.5	5	**+2.5**	**+4**	*0.2067*
	4	Work time needed to correct errors	1	1	4	4	**+3**	**+3**	*0.0142*
Flexibility	5	Possibility of adding new information in the same format	2.5	1	4	4	**+1.5**	**+3**	*0.0030*
	6	Support for a possible features' extension in the future	2	2	4	5	**+2**	**+3**	*0.2509*
	7	Platform independence (available on any device)	4.5	5	4.5	5	**0**	**0**	*0.7288*

Table 11 - Survey results: measurable factors

	Phase 1		*Phase 2*		*Δ*		*Kruskal-Wallis (p-value)*
	Median	Mode	Median	Mode	Median	Mode	
Usefulness	4	4	5	5	**+1**	**+1**	*0.0000*
Intuitiveness	3	3	5	5	**+2**	**+2**	*0.0047*
Truthfulness	3	3	5	5	**+2**	**+2**	*0.0000*
Completeness	1	1	5	5	**+4**	**+4**	*0.0000*
Perceptibility	2	2	5	5	**+3**	**+3**	*0.0000*
Agility	1	0	5	5	**+4**	**+5**	*0.0000*
Efficiency	1	1	4	5	**+3**	**+4**	*0.0080*
Flexibility	3.5	4	4	5	**+0.5**	**+1**	*0.0266*

This analysis was conducted to study which factors related to data and report characteristics were positively or negatively impacted by the change in the reporting format and which ones were more and less impacted. As already mentioned, the overall impact of the change was positive to the teams' work, being the only question with no alterations registered the one about the report's platform independence. But how exactly did the implementation of the dashboard change the BI experience?

User Satisfaction

The questions in this first section of the survey were mandatory for both types of respondents (business and technical users) and were focused on the overall experience of users when using the reports.

- Usefulness - One of the least positively impacted factors, with only a slight increase. This was motivated by the fact that values in Phase 1 were already high, since the data and metrics presented in both reports are essentially the same. Despite this, inside the Usefulness factor, the level of confidence in the information was more positively impacted than the information content, for the already explained reason.
- Intuitiveness – Values of this factor increased moderately from Phase 1 to Phase 2, meaning that the report became more intuitive and easier to use, but this factor was not on the side of the most impacted ones. In the dashboard, the topics are divided by pages, which facilitates navigation, since users can directly consult the required information, without the need to go through all the slides and look for it, but, on the

other hand, people are used to slide-based presentations and consider it also easy to use and navigate through.

- Truthfulness – With average increases in this factor, users seem to value the fact that information is more frequently updated, since it changed from weekly to daily updates. Regarding the information-sharing features of the report, the most popular value (mode) increased, but the differences were not substantial. This was not expected *a priori* since one of the pain points identified by the New Business team was the unavailability of the report on specific dates to be used in presentations and that issue was tackled with the implementation of the report.
- Completeness – The scores changed significantly in this factor, especially in the questions related to the availability of filters and other perspectives about data. This was already expected, since the PowerPoint report had no possibility of applying filters or seeing different granularities in the data and that was, in fact, one of the greatest upgrades. Considering the overall combination of changes in median and mode and *p-values* analysis, Completeness can be pointed out as the most positively impacted factor, regarding which user satisfaction increased the most.
- Perceptibility – This was expected to be one of the most positively impacted factors, especially in what concerns the visual presentation of the data, but, in fact, it ended up only having an average increase. Despite that, on the individual questions, the increase was higher in the one referring to the report's visuals, meaning that following the data visualization best practices and dedicating some time to organize the visuals impacts the user experience and is something that should be valued when developing such a project.

Technical functionality

This second section of the survey was mandatory only for technical users, since it is more focused on technical aspects of the production and performance of the reports.

- Agility – This was the most positively impacted factor, on the global analysis and on both individual questions that are part of it. However, analyzing the individual questions that influenced it, the greatest influence comes from the question related to the application of filters, which was not possible in Phase 1 of the report, which led most of the users to select the "NA" = Not applicable option. Because of that, this increase in Agility should be disregarded.
- Efficiency – The increase in score in this factor was significant in terms of median but, mainly, in terms of mode. However, due to the *p-value* analysis, the results of the first question - the one related to work time needed to update the report - have to be disregarded, since the Kruskal-Wallis test indicated that the variation between phases

is not statistically significant. This can be explained by the fact that business users do not have much visibility over these topics, which could lead them to random answers.
The second individual question can already be considered, and it changed in 3 points, regarding median and mode. This is a significant increase, meaning that both technical and business users value the faster correction of errors, the first ones because they are aware of the time it used to take them to correct errors, and the second ones because they are aware of the time they had to wait to see the errors corrected.

- Flexibility – This factor was one of the least impacted ones and includes the only question that did not change between phases. Looking at the *p-value*, the results of the last two questions must be disregarded. Because of that, it can be concluded that this factor does not seem to have great importance to users.

Summing up, and considering the changes in median and mode, combined with the analysis of the *p-values* and some domain knowledge, the implementation of the dashboard changes the experience, essentially, in three key points: Perceptibility, Completeness, and Efficiency. Moving from the PowerPoint-based report to the Power BI report transformed the BI experience in a way that users find the information available better visually presented, more complete, and the whole process more efficient. Having this in mind, these factors should be the most valued ones and most time should be dedicated to them, in terms of planning and execution during the project implementation. Factors such as Flexibility are not as valued by the users and, although important, should not be the main focus.

6. CONCLUSIONS

The first objective of this project was to understand the importance of data availability and data quality. This was achieved through the SLR presented in Chapter 2, with the final result being an aggregated view of the main topics and studies about data-related issues, how to overcome them to improve data quality and the importance of complying with data management well-aligned strategies, to assure a correct use of data inside a company.

Similarly, the second objective was also achieved through the SLR. This objective was to describe the relationship between efficient data visualization and informed decision-making. There were synthesized literature findings about data visualization best practices, the advantages of using dashboards in the decision-making process and how to increase their potential and applicability.

The results of both these research objectives contributed to defining the relevant topics that should be taken into consideration when developing the work to achieve the remaining objectives.

Research objective number three was to build the required dashboard and the correspondent data architecture. To do this, it was followed the DSRM which led to an artifact, in this case, the dashboard to be shared with the New Business team. The dashboard was positively evaluated, both in terms of the achievement of quantitative and qualitative objectives and in terms of end users' feedback about it. The ETL process and the development of the dashboard itself took into consideration the SLR findings, together with the company's necessities and best practices.

Regarding the practical contributions of the developed work, it was an important step to improve the efficiency of the teams' work. The release of the dashboard not only eliminated the need for the BI&A team to spend several weekly hours producing the report, but also improved the quality of data shared, reducing the number of errors, by automating the process. Apart from this, it raised awareness among business users about the importance and advantages of using BI to keep track of indicators and also to support decision-making.

Finally, the last research objective was to evaluate the results of the dashboard and compare the new process with the previous one. This was achieved through quantitative data collection and analysis, using a survey to compare the users' satisfaction with the new dashboard *versus* the previously shared PowerPoint-based report. This analysis resulted in the finding of the factors that were most impacted by this change, in this case, Perceptibility, Completeness, and Efficiency. This survey and the analysis methods were built based on the literature findings and recommendations, being the research tool inspired by Dedić and Stanier's (2016) work. The measurable factors attributed to each question of the survey were also taken from the literature.

The contributions of this work are related to, in theoretical terms, the application in a real project of a tool that was just theoretically built and had pointed out as future works its practical utilization. On the other side, to the practitioners, this was important to study what factors should be more focused when developing such a project, and which ones are not as important to users and, therefore, should not be the central focus. Also, as the impacts proved to be positive, it highlights the importance of using this kind of tool in companies.

Summing up, each one of the initially defined research objectives was achieved differently, producing different results that complemented each other and produced the final output of this project. Despite the limitations found and the constant work in progress that BI development involves, having the opportunity of working on such a project in a company was an enriching experience, not only from the point of view of getting to know the business and, especially, in data-related topics, but mainly from the perspective of applying the knowledge acquired during the academic journey in a real project. There are, as expected, many differences and distinct types of challenges, being the main one the "organized chaos" that many companies live in, due to its dimensions and fast-moving environment. Also, dealing with and managing the expectations of people that are not aware of BI topics and do not have an immediate understanding of most problems or, on the other side, the potential of the tools, is not easy in the beginning. Because of this, the project was a learning experience and an excellent complement to the theoretical part of the master's degree.

6.1. LIMITATIONS AND FUTURE WORKS

Despite the positive outcome of the artifact, there were also difficulties faced during the development process that uncovered some limitations. The main limitation was related to the great diversity of tables and data sources in the company's databases. Because the data is not all centralized and sometimes it is not presented with the clearest nomenclature and organization, it took a considerable amount of time to get to know where the relevant data was located and what could be done to aggregate it in the data model.

The other big difficulty was related to having to adopt the Direct Query dataset mode to build the data model. This led to two Power BI files, instead of just one, which was more difficult to manage, since every time a new metric had to be created, consulted, or modified, this had to be done on the data's Power BI, publishing it again, so that the modifications could be reflected in the visuals' Power BI. Apart from this, the Digital KPI's section of the dashboard has as data source an online published Power BI dataset, which causes high dependency on the Online department's work, both in terms of update frequency and in terms of metrics' modification or deletion on their dataset. Future works should consider implementing a database architecture that improves the efficiency of this connection to the Online dataset, recreating the data and metrics in the main data model. Apart from this, future works should include the integration of users' feedback in the next development phases, as was already planned, to integrate new functionalities in the dashboard, and perform corrections identified as necessary through the utilization.

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APPENDICES

APPENDIX A

This is to certify that
Project No.: **OTHER2023-6-89208**
Project Title: **Reporting automation: the impact on BI experience**
Principal Researcher: **Ana Rita Caço**

according to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 6/8/2023.

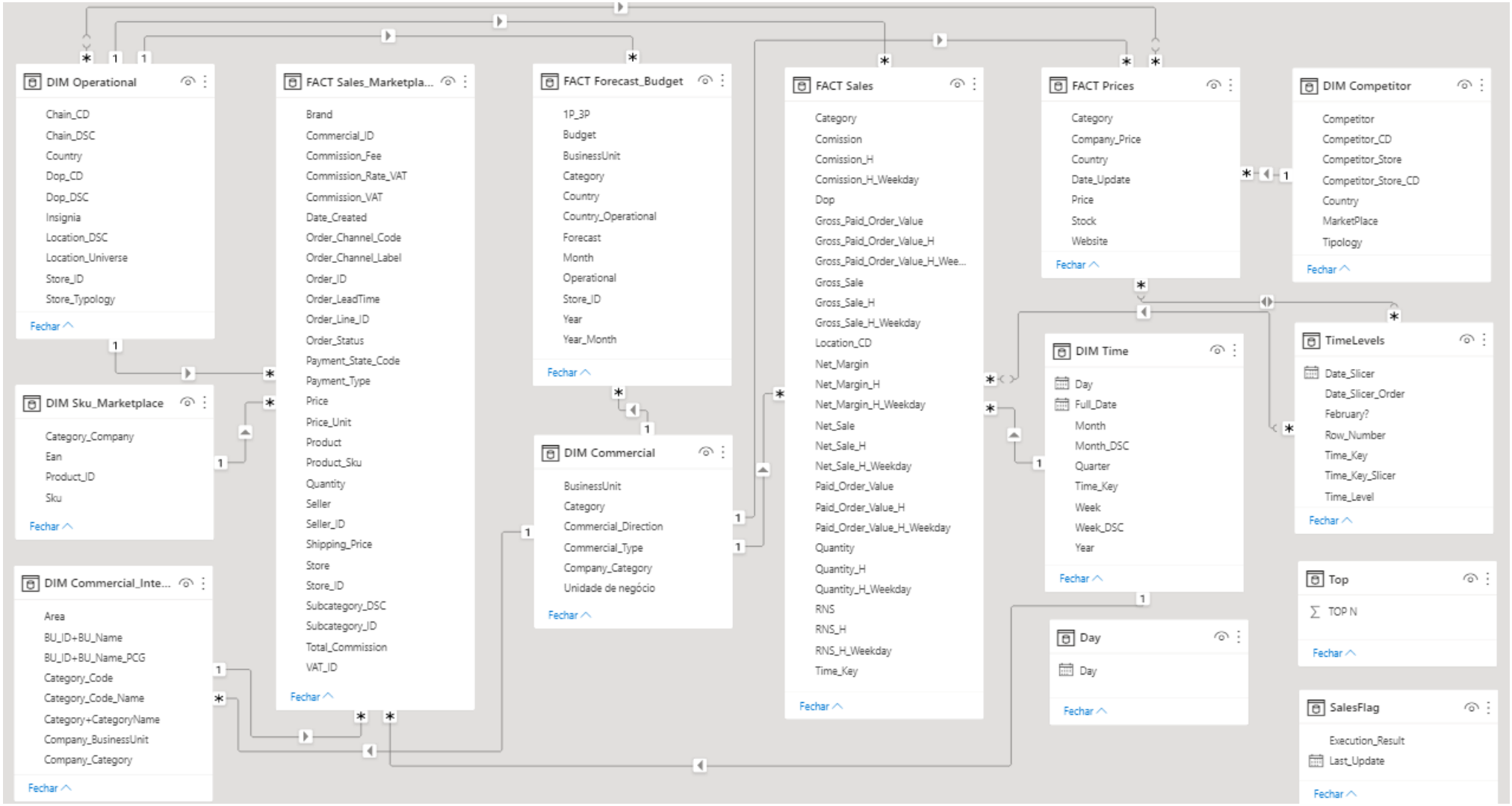
It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of
- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the project.

Lisbon, 6/8/2023

NOVA IMS Ethics Committee
ethicscommittee@novaims.unl.pt

APPENDIX B


DIM Operational
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Location_DSC
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Order_Channel_Label
Order_ID
Order_LeadTime
Order_Line_ID
Order_Status
Payment_State_Code
Payment_Type
Price
Price_Unit
Product
Product_Sku
Quantity
Seller
Seller_ID
Shipping_Price
Store
Store_ID
Subcategory_DSC
Subcategory_ID
Total_Commission
VAT_ID
Fechar
FACT Forecast_Budget
1P_3P
Budget
BusinessUnit
Category
Country
Country_Operational
Forecast
Month
Operational
Store_ID
Year
Year_Month
Fechar
FACT Sales
Category
Comission
Comission_H
Comission_H_Weekday
Dop
Gross_Paid_Order_Value
Gross_Paid_Order_Value_H
Gross_Paid_Order_Value_H_Wee...
Gross_Sale
Gross_Sale_H
Gross_Sale_H_Weekday
Location_CD
Net_Margin
Net_Margin_H
Net_Margin_H_Weekday
Net_Sale
Net_Sale_H
Net_Sale_H_Weekday
Paid_Order_Value
Paid_Order_Value_H
Paid_Order_Value_H_Weekday
Quantity
Quantity_H
Quantity_H_Weekday
RNS
RNS_H
RNS_H_Weekday
Time_Key
Fechar
FACT Prices
Category
Company_Price
Country
Date_Update
Price
Stock
Website
Fechar
DIM Competitor
Competitor
Competitor_CD
Competitor_Store
Competitor_Store_CD
Country
MarketPlace
Tipology
Fechar
DIM Sku_Marketplace
Category_Company
Ean
Product_ID
Sku
Fechar
DIM Commercial
BusinessUnit
Category
Commercial_Direction
Commercial_Type
Company_Category
Unidade de negócio
Fechar
DIM Time
Day
Full_Date
Month
Month_DSC
Quarter
Time_Key
Week
Week_DSC
Year
Fechar
TimeLevels
Date_Slicer
Date_Slicer_Order
February?
Row_Number
Time_Key
Time_Key_Slicer
Time_Level
Fechar
DIM Commercial_Inte...
Area
BU_ID+BU_Name
BU_ID+BU_Name_PCG
Category_Code
Category_Code_Name
Category+CategoryName
Company_BusinessUnit
Company_Category
Fechar
Day
Day
Fechar
Top
TOP N
Fechar
SalesFlag
Execution_Result
Last_Update
Fechar

APPENDIX C

Report New Business

Com o objetivo de avaliar as mudanças provocadas pela automatização em Power BI do report semanal partilhado pela equipa de BI Comercial, com a equipa de New Business, pretende-se medir a satisfação dos utilizadores relativamente a vários fatores, em duas fases:

- Fase 1: antes da automatização e fazendo referência ao report partilhado em PowerPoint
- Fase 2: depois da automatização e fazendo referência ao report em Power BI

Tempo estimado: 3 min

* Obrigatória

1) A que equipa pertence? *
   - ◯ Equipa de BI & Analytics
   - ◯ Equipa de New Business

2) A que fase correspondem estas respostas? *
   - ◯ Fase 1 – Report em PowerPoint
   - ◯ Fase 2 – Report em Power BI

Utilização do report

Esta secção pretende avaliar a satisfação relativamente às funcionalidades e informações apresentadas no report.

3) Avalie cada um dos pontos de acordo com o seu grau de satisfação com cada um deles. *

	Muito insatisfeito	Insatisfeito	Neutro	Satisfeito	Muito satisfeito
Conteúdo e relevância da informação apresentada	◯	◯	◯	◯	◯
Confiança na informação apresentada	◯	◯	◯	◯	◯
Formato e apresentação visual da informação	◯	◯	◯	◯	◯
Facilidade de utilização do report	◯	◯	◯	◯	◯
Frequência da atualização de informação	◯	◯	◯	◯	◯
Funcionalidades de exportação e partilha de informação	◯	◯	◯	◯	◯

Funcionalidades que permitem consolidar a informação apresentada	○	○	○	○	○
Flexibilidade para alterar o conteúdo descritivo (intervalo de tempo, perspetiva de € vs quantidade)	○	○	○	○	○
Flexibilidade para aplicar filtros e ver granularidades mais baixas e/ou mais altas	○	○	○	○	○
Descrição das visualizações (legendas, etiquetas de dados)	○	○	○	○	○

Funcionalidades técnicas

Esta secção permite medir a performance técnica do report e deve ser preenchida de acordo com os conhecimentos técnicos de cada utilizador. Caso não tenha conhecimento sobre algum tópico, selecione a opção NA.

4) Avalie cada um dos pontos de acordo com o seu grau de satisfação com cada um deles.

	Muito insatisfeito	Insatisfeito	Neutro	Satisfeito	Muito satisfeito
Velocidade de execução inicial do report	○	○	○	○	○
Velocidade de atualização quando aplicados filtros	○	○	○	○	○
Tempo de trabalho necessário para atualizar o report	○	○	○	○	○
Tempo de trabalho necessário para corrigir erros	○	○	○	○	○
Possibilidade de acrescentar novos dados no mesmo formato	○	○	○	○	○
Apoio para uma possível extensão de funcionalidades do report no futuro	○	○	○	○	○
Independência de plataformas (pode ser consultado em qualquer computador, dispositivos móveis, etc)	○	○	○	○	○

Notas finais

Caso tenha algum comentário, sugestão ou informação que considere importante referir, pode fazê-lo na área abaixo.

Se respondeu à Fase 1 – Report em PowerPoint e quiser ser relembrado(a) mais tarde para responder à Fase 2 – Report em Power BI, deixe o seu email na área abaixo.

5) Comentários e/ou sugestões: