NOVA IMS Information Management School

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Master Degree Program in

Information Management

Adaptive Model applied in the Banking Sector

Aligning Knowledge Management and Business Intelligence

Verónica Oliveira Filipe

Project Work

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

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

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Adaptive Model applied in the Banking Sector

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by

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

Co-supervised by

Prof. Miguel de Castro Neto, PhD Agronomic Engineering

and

Prof. Luís Pedro Lopes Batista

June, 2024

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.

Lisbon, 10 June 2024

DEDICATION

I dedicate this project to my parents. Although they may not be as present now that I am living in Lisbon, they are the reason I have reached this point. Thank you for your unwavering support throughout my entire life and for always caring about me and my progress in this project, always asking how everything is and how is going school.

I also dedicate this project to my colleague, Tiago Marques. Even though he did not participate in this project, he played a significant role in my first experience working with data. His guidance and enthusiasm sparked my interest in this field, leading me to pursue this master's degree.

ACKNOWLEDGEMENTS

I would like to express my gratitude to my co-supervisor, Prof. Pedro Batista, for his invaluable guidance and feedback throughout this project. I am also deeply thankful to my boyfriend, Pedro, for his unwavering support, understanding, and encouragement during the countless hours I dedicated to this work. Furthermore, I extend my appreciation to my colleagues for their patience and assistance with my numerous queries, particularly when I encountered challenging errors. Lastly, I am grateful to the team members at the bank for their active engagement and support.

ABSTRACT

The project proposes enhancing traditional banks' performance and efficiency to compete with FinTech companies by implementing an adaptive model. This model tailors information access based on user needs, focusing on user technical skills, business context, and changing requirements based on users feedback. The report also describes the different users: data engineers, business analysts, businessmen and viewers. By aligning knowledge management and business intelligence, the model aims to improve information sharing, accessibility, and overall knowledge management culture in the banking sector. It emphasizes tailoring data to meet user-specific needs, ensuring information is accessible, relevant, and actionable for various stakeholders. The methodology involves designing and applying an adaptive model within a banking company, focusing on the product area perspective. Data and information are transmitted through visualization in PowerBI and Excel, giving users autonomy and independence in analysis. The project highlights that an adaptive model not only increases user autonomy but also fosters improved collaboration, emphasizing that crossing knowledge is key.

KEYWORDS

Adaptive Model; Banking Sector; Knowledge Management; Collaborative Information Behavior; Business Intelligence; Centralized Source; Dashboard; Information Accessibility

Sustainable Development Goals (SDG):

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LIST OF ABBREVIATIONS AND ACRONYMS

BI	Business Intelligence
CIB	Collaborative Information Behavior
COS	Communities of Scope
DT	Digital Transformation
IS	Information Sharing
IT	Information Technology
ETL	Extract, Load and Transform
FWA	Flexible Work Arrangements
KM	Knowledge Management
KOLS	Knowledge-oriented leadership style
ML	Machine Learning
OLAP	Online analytical processing
SCC	Supply Chain Collaboration
SCP	Supply Chain Performance

1. INTRODUCTION

1.1. CONTEXT

Achieving competitive advantage and enhancing performance stand as principal objectives for every organization in today's dynamic business environment. To secure these advantages or improve performance, companies employ a variety of methodologies such as redefining cost structures, revising marketing strategies, conducting thorough competition analysis, fostering inter-organizational collaboration, and promoting a robust culture of knowledge sharing within the organizational framework. It is imperative to understand that foundational to every analysis, strategy, and decision-making process, and the very knowledge that organizations rely on is a solid bedrock of data and information.

In an era where countless companies deploy sophisticated tools for data extraction, the true differentiator lies not just in the ability to gather data but in the effective utilization and conversion of raw data into meaningful information and actionable knowledge. According to research by Mujanah, Riyadi, and Sjachriatin (2022), the cultivation of knowledge sharing and the embrace of digital transformation emerge as significant factors in gaining a competitive advantage. Hence, establishing a culture of knowledge management, underpinned by the appropriate sharing and access to data, information, and knowledge, becomes critical to support informed decision-making processes. The effective use of analytical tools has been identified as a key enhancement to both knowledge management and decision-making, as highlighted by Shivakumar (2019).

Collaborative Information Behavior (CIB) plays a pivotal role in achieving a competitive edge, underscored by the positive correlation between information sharing and performance (Chen, Fu & Hua, 2021). Prioritizing information sharing and ensuring accessibility is therefore crucial for fostering CIB and nurturing a knowledge management culture within organizations.

A relevant concept to foster CIB and Knowledge Management is accessibility. As defined by Fidel and Green (2003), accessibility pertains to the ease with which information can be accessed and retrieved from a given source, which significantly influences the selection of information sources. However, this concept remains somewhat abstract, with limited exploration of the mechanisms that underlie it. This report aims to delve deeper into the factors that influence information selection and the ease of access and retrieval. According to Carenini et al. (2012), perceptual speed, visual working memory, and user expertise are significant factors that enhance task efficiency, user preference, and ease of use. This underscores the importance of adaptive models, where users can customize and adapt information to their preferences using familiar visual cues, thereby enhancing efficiency, ease of access, and speed of information retrieval.

In this report, the term adaptive model is used to refer to a framework or conceptual model that helps to understand and describe how systems adapt to changes in the environment or

new conditions. While the concept of adaptive models is widely used in the field of Machine Learning (ML), the objective of this project is to apply this concept to support traditional banks in improving their performance and efficiency, thereby gaining a competitive advantage and narrowing the gap between traditional banks and fintech. This is achieved by applying a model that adapts information access according to the user's skills, context, and background, leveraging feedback as the main trigger.

Although Machine Learning (ML) can enhance performance and efficiency by aiding in decision-making, the adaptive model concept used in this report does not rely on ML algorithms. Instead, it focuses on the user, considering their skills, context, background, and evolving needs, using feedback as a key component to drive adaptation.

In summary, adaptive models are crucial for enhancing information sharing, accessibility, CIB, and fostering a culture of knowledge management. These models ultimately contribute to the competitive advantage that traditional banking sectors need to thrive in an increasingly competitive and technologically advanced market. Establishing a robust knowledge management culture, supported by effective data and information sharing, is essential for companies striving to stay ahead in today's fast-paced business landscape.

1.2. MOTIVATION & RESEARCH GAP

This report examines the cultivation of knowledge sharing and the embrace of digital transformation from the perspective of the banking sector. Traditional banks have been significantly impacted by the digital revolution, facing increased competition from fintech companies that primarily leverage technology and cloud services to deliver financial solutions to customers. As highlighted by Dapp (2014), fintech is transforming the financial industry by driving digital transformation and introducing competition in a technology-driven environment, thereby challenging and eroding conventional banking practices.

The digital gap between traditional banking institutions and fintechs has been narrowing due to the successful implementation of digital transformation initiatives. For banks to bridge this gap, it is essential to establish a shared digital infrastructure and ensure effective communication between organizations, customers, and stakeholders. However, significant obstacles such as cultural barriers and a lack of digital skills must be overcome (Asgari, Rabiei & Sadigh, 2021).

This study focuses on enhancing digital information and effective communication among stakeholders by adopting a culture of knowledge management. Despite the growing recognition of the importance of knowledge management and digital transformation, the approach to information sharing needs to be adaptive to address the discrepancies between the needs of users and the way information is conveyed (Dabbebi et al., 2017). Existing literature predominantly emphasizes the role of visualization in adapting information for end-users. However, the concept of information accessibility, which includes aspects such as user

access, perception, and the influence of diverse user characteristics on accessibility, remains relatively underexplored (Fidel & Green, 2003).

By investigating these factors, the report aims to provide a comprehensive understanding of how traditional banks can leverage knowledge sharing and digital transformation to enhance their competitive position against fintechs. The discussion will include strategies for fostering a culture of knowledge management, ensuring effective communication, and addressing the digital skills gap. It will also delve into the mechanisms of adaptive information sharing, emphasizing the need for a tailored approach that considers the varying needs and characteristics of different users. This approach is crucial for enabling traditional banks to effectively utilize digital tools and resources, thereby improving their operational efficiency and customer satisfaction in a rapidly evolving financial landscape.

1.3. RESEARCH QUESTIONS & FOCUS

This report aims to develop an adaptive model by integrating insights from Dabbebi et al.'s (2017) Adaptive Dashboard Generator and Sarukesi and Uthayakumar's (2011) Adaptive E-Learning System. The core emphasis of this model is on delivering content that is precisely tailored to the users' individual skills and abilities, as underscored by Sarukesi and Uthayakumar (2011). By doing so, the model ensures that users receive information and training that align with their proficiency levels, thereby enhancing their engagement and effectiveness.

The application of this adaptive model will be specifically focused on the product area within the banking sector in Portugal. The product area is a critical segment in the digital transformation journey of banks, relying heavily on data and information for daily operations. This dependency on data is pivotal for the development and continuous improvement of banking products and services.

By implementing an adaptive model in this context, the goal is to significantly enhance how information is managed and utilized within the product area. This model will facilitate a more personalized approach to data delivery and information sharing, ensuring that employees receive the most relevant and comprehensible data tailored to their specific roles and competencies. This personalized delivery is anticipated to improve decision-making processes, foster innovation, and ultimately drive the overall business performance in the banking sector.

Furthermore, this project will explore how the adaptive model can support the broader objectives of digital transformation within banks. This includes not only enhancing operational efficiency but also improving customer satisfaction by enabling more agile and responsive product development processes. By aligning data delivery with user capabilities, the adaptive model seeks to bridge the gap between traditional banking practices and the advanced technological capabilities employed by fintech competitors.

In conclusion, this project will demonstrate how leveraging adaptive models inspired by existing frameworks can transform the product area of banks in Portugal. The proposed model aims to provide a robust framework for delivering tailored content, thereby supporting the digital transformation efforts of banks and ensuring they remain competitive in an increasingly data-driven industry.

The project will approach the following research questions:

- How can companies in the banking sector facilitate easier access to information among team members, focusing in the product area?
- What strategies can be employed to adapt the information accessed by team members to meet their specific needs for product information based on their technical skills?

1.4. Research Goals & Objectives

The primary objective of this project is to develop an adaptive model designed to facilitate seamless access to information among product team members, ensuring the effective dissemination of knowledge throughout the organization. This model is tailored to meet the specific needs of a diverse range of users, including both technical and non-technical stakeholders.

This project aims to significantly enhance performance within corporate banking environments by promoting efficient, data-driven decision-making processes, thereby improving services and products to maintain the bank's competitiveness against fintech companies. The integration of methodologies from knowledge management and business intelligence will underpin this effort, anchored by the adaptive model. This model aims to bridge gaps in information accessibility and usability, thereby fostering a more informed decision-making framework. It is designed to cater to the diverse requirements of users, promoting organizational coherence and efficiency.

By implementing this adaptive model, the project seeks to create a robust system that supports the seamless flow of information, empowering product teams and other stakeholders to make informed decisions swiftly. This initiative is expected to drive better performance, enhance service quality, and sustain the competitive edge of the corporate bank in an increasingly dynamic financial landscape.

1.5. Methodology & Data Sources

The project was undertaken to evaluate its impact on the product team within a banking company in Portugal. The development of the system was structured around the Adaptive E-Learning System framework proposed by Sarukesi and Uthayakumar (2011), segmented into three phases: knowledge acquisition, knowledge representation, and knowledge management. Integrating insights from Dabbebi et al. (2017) on the adaptive dashboard

generator model, the initial phase involved user needs identification and needs assessment analysis. During the knowledge management phase, a user model was developed, which considered personal information, user knowledge, and user visual preferences.

The process began with a thorough exploration of the team's demands, soliciting specific details on the type of information required. This led to the information modeling phase, where Databricks was employed to construct a centralized cloud-based data mart, highlighting the importance of collaboration as emphasized by Hansen & Talja (2006). After defining the information needs, considerations were made regarding the mode of access, end-user profiling, and the intended purpose of the information—whether it served as an intermediary level for analysis or was used directly by end users for decision support. User skill levels were assessed to inform the application of an adaptive methodology, utilizing diverse tools tailored to varying proficiencies. For instance, PowerBI was implemented for its effectiveness in visualization (Shikamuvar, 2019), while Excel was chosen for its simplicity and accessibility for users with lower technical abilities (Domino et al., 2021).

In conclusion, the methodology involved designing a team-specific solution that intricately aligned with both current and anticipated information needs, allowing for adaptable modifications in information perception. Upon deploying the model, feedback was solicited from the team regarding their experience, providing insights into its influence on their collaboration and performance outcomes. This feedback indicated the model's effectiveness in enhancing team dynamics and overall productivity, underscoring the value of a tailored, adaptive approach in meeting the diverse needs of a product team within a banking environment.

1.6. CONTRIBUTIONS AND RESULTS

Through the implementation of the adaptive model, the team experienced a more streamlined method for accessing information, which enhanced end-user support for decision-making and provided a flexible approach to accommodating evolving needs and corresponding analyses. This new approach facilitated a more efficient workflow, enabling team members to access pertinent information quickly and accurately, which in turn improved the overall decision-making process.

The project led to a notable improvement in team performance, fostering greater independence among team members while promoting a culture of knowledge sharing. This observation aligns with the findings of Cheng et al. (2023), which highlight the positive correlation between information sharing and performance. Despite these improvements, the project also introduced a certain degree of resistance to change. The transition to new methods and tools generated some initial uncertainties, necessitating a period of adjustment for the team. Overcoming this resistance required effective change management strategies to ensure a smooth transition and to help team members adapt to the new system.

From an investigative perspective, the project contributed a valuable empirical dimension to the existing literature on adaptive models, performance, and efficiency. It provided practical insights into how adaptive models can be effectively implemented in a corporate banking environment, demonstrating their impact on team performance and knowledge-sharing practices. Additionally, the project underscored the crucial role of information and knowledge sharing within companies and teams, particularly in the banking sector. It highlighted how an adaptive approach to information management can drive performance improvements and foster a collaborative culture, ultimately contributing to the organization's overall efficiency and competitiveness.

In summary, the implementation of the adaptive model not only streamlined information access and improved decision-making processes but also fostered a culture of independence and knowledge sharing among team members. Despite initial resistance, the project demonstrated the positive impact of adaptive models on performance and provided valuable contributions to the body of research on information management in the banking sector.

1.7. STRUCTURE

The report will proceed through the following structured steps:

Introduction: This section will provide a contextualization of the project by presenting the problem scenario within the banking sector's digital domain. It will articulate the motivation behind developing the adaptive model, define the project's objectives, and establish the primary focus. Additionally, it will formulate the key research questions that guide the study.

Literature Review: The literature review will involve an in-depth exploration of existing research on several critical themes: the impact of knowledge management on performance and competitive advantage, the relationship between knowledge management and business intelligence, and the applicability of these concepts through adaptive models. This chapter will lay the theoretical foundation for the project, offering deeper insights and a comprehensive understanding of the relevant academic discourse.

Methodology: This chapter will detail the process and steps involved in developing the adaptive model, encompassing the following components:

- **Research Design and Planning**: This section will describe the current situation, align the business needs of the banking sector with the project's objectives, and outline the concept of the adaptive model. It will draw on the research conducted by Dabbebi et al. (2017) and Sarukesi and Uthayakumar (2011).
- **Requirements Analysis**: This part will specify the tools necessary for implementing the model and outline the conditions required for replicating the model in future scenarios.

Implementing the Model: In this chapter, the model will be applied empirically by collecting and analyzing real-world data. It will document the development process of the model and its application in a practical setting.

Results and Discussion: This section will present and discuss the results obtained from the model's development and application. It will evaluate the model's effectiveness in meeting the project's objectives and provide an in-depth analysis of the findings.

Conclusions and Future Work: The final chapter will draw conclusive insights based on the feedback received and the comprehensive analysis of the results. It will highlight the contributions of the project to the fields of Business Intelligence and Knowledge Management. Additionally, it will propose potential directions for future research and practical applications, suggesting ways to further refine and expand upon the adaptive model.

By following this structured approach, the report aims to provide a thorough examination of the development and application of an adaptive model in the banking sector, offering valuable contributions to both academic research and practical implementations.

2. LITERATURE REVIEW

To fortify the project's development, an extensive literature review was conducted to deepen our understanding of the subject matter. This comprehensive review aimed to uncover insights that would inform our decisions, methodologies, and tools. By meticulously analyzing a range of scholarly works and reports, we developed a robust conceptual framework and identified key trends and gaps in the existing literature.

The literature review focused on several critical areas, including the impact of knowledge management on organizational performance and competitive advantage, the relationship between knowledge management and business intelligence, and the practical application of these concepts through adaptive models. This exploration provided a solid theoretical foundation, offering deeper insights into how these elements interact and their relevance to our project.

Through this rigorous review process, we were able to pinpoint best practices and innovative approaches that have been successful in similar contexts.

The insights gained from the literature review were instrumental in guiding the project's objectives and methodology. They ensured that our approach was methodologically sound and conceptually grounded. By aligning our project with established research and identifying emerging trends, we could design a model that was both innovative and practical.

In essence, the literature review served as a vital compass, providing direction and clarity. It helped to ensure that our project was built on a solid foundation of existing knowledge while also pushing the boundaries of current research. This rigorous approach enabled us to achieve our project's goals with a high degree of precision and academic rigor, ultimately contributing valuable insights to the fields of Business Intelligence and Knowledge Management.

The scope of the literature review encompassed the following subjects:

2.1. KNOWLEDGE MANAGEMENT, INFORMATION SHARING, AND COMPETITIVE ADVANTAGE

Despite the conclusion of the state of alert for the pandemic in Portugal in 2022, remote work has persisted, leading to the establishment of three distinct work systems: full in-person, fully remote, and hybrid. The latter two systems incorporate Flexible Work Arrangements (FWAs), where employees may not engage in physical interactions with their colleagues.

A study conducted by Cheng et al. (2023) revealed that FWAs could negatively impact employees' motivation to share information among peers. The investigation into the relationship between flexible work arrangements, workplace loneliness, and knowledge sharing involved 314 respondents in a web-based survey and 343 employees in a three-wave field research study. The findings indicated several critical insights:

Increased Workplace Loneliness: Employees under FWAs were more prone to experiencing workplace loneliness (Hypothesis 1, H1+). The lack of physical presence and face-to-face interactions contributed to a sense of isolation among remote and hybrid workers.

Reduced Knowledge Sharing: The study also found that employees under FWAs exhibited a reduced willingness to share knowledge with their peers (Hypothesis 2, H2-). The physical distance and lack of regular in-person communication hindered the natural flow of information sharing.

Impact of Task Interdependence: Task interdependence, or the degree to which employees rely on each other to complete their work, negatively impacts workplace loneliness (Hypothesis 4, H4-). When tasks were highly interdependent, employees experienced less loneliness, as they were required to communicate and collaborate more frequently.

Reversal of Loneliness and Knowledge Sharing Relationship: The study found that task interdependence could invert the negative relationship between workplace loneliness and knowledge sharing (Hypothesis 5, H5-). In environments where tasks required close collaboration, the increased interaction reduced feelings of loneliness and encouraged more knowledge-sharing among employees.

These findings are visually represented in the Theoretical Model from Cheng et al. (2023) in Figure 2.1. The model illustrates how FWAs influence workplace dynamics, highlighting the complex interplay between flexible work arrangements, loneliness, and the propensity to share knowledge.

Figure 2. 1 – Theoretical Model from Cheng et al (2023)

While remote work offers potential cost savings for companies, it can also result in diminished performance, collaboration, and knowledge sharing, potentially leading to a competitive disadvantage. An analysis conducted on a US Funds Family assessed the quantity and quality of data sharing, revealing a positive relationship between information sharing and performance. This study highlighted that reducing barriers to information sharing is crucial for

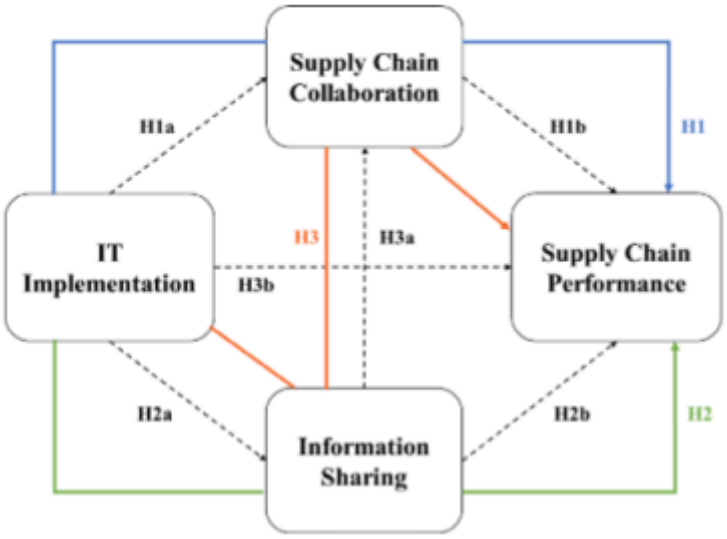
fostering synergies and sustainable growth, thereby achieving a sustainable competitive advantage (Chen, Fu & Hua, 2021).

Integrating the findings of Cheng et al. (2023) with those of Chen, Fu, and Hua (2021) underscores the significant impact of Flexible Work Arrangements (FWAs) on collaboration and competitive advantage.

To address these challenges and bolster competitive advantage, organizations must adopt several strategies. Promoting a knowledge-sharing culture and investing in knowledge-oriented leadership is critical. Additionally, the incorporation of digital technologies and the enhancement of employee skills and competencies are imperative (Mujanah, Riyadi & Sjachriatina, 2022). A study conducted on 206 manufacturing companies in Surabaya, Indonesia, that had implemented IT in their business processes, revealed that information technology implementation positively affects supply chain performance through enhanced information sharing and collaboration. This study concluded that both factors contribute to competitive advantages, and the implementation of information technology can significantly enhance performance, especially during crises like the COVID-19 pandemic.

The following Research Framework (Figure 2.2) from Purwanto, Siagian, and Yuliana (2021) illustrates the relationships among these concepts. The framework shows how the implementation of information technology facilitates information sharing and collaboration, which in turn enhances supply chain performance and contributes to competitive advantage.

Figure 2. 2 - Research Framework from Purwanto, Siagian and Yuliana (2021)



Information Technology (IT) plays a pivotal role in enhancing Supply Chain Collaboration (SCC) – H1a, which is indispensable for key Supply Chain Management (SCM) functions such as cost calculation, profit management, demand forecasting, and inventory control. By fostering strong inter-organizational relationships, IT not only improves customer satisfaction but also provides a competitive edge in the market. The integration of IT into business processes

facilitates real-time information sharing (collaboration), thereby significantly boosting Supply Chain Performance (SCP) – H2b. In today's competitive global market, the demand for swift responses drives continuous advancements in supply chain information technology. Additionally, IT impacts Information Sharing (IS) – H2a by enabling joint decision-making and Electronic Data Interchange (EDI), both crucial for operational performance. Effective IS, achieved through cooperation and coordination, enhances competitive advantage and ultimately contributes to SCP – H2b. SCC ensures the provision of accurate and timely information, enabling better collaborative decision-making. Technological advancements further enhance companies' ability to engage in effective IS, thereby improving SCP. IT supports communication and IS, leading to increased efficiency, effectiveness, competitiveness, and profitability. IS and information quality act as mediators in the relationship between IT and SCP, with IT directly enhancing SCP by improving the quality and exchange of information.

Summarizing the framework proposed by Purwanto, Siagian, and Yuliana (2021), it generates three hypotheses:

- H1 - SCC mediates the impact of IT on SCP
- H2 - IS mediates the impact of IT on SCP
- H3 - Both IS and SCC mediate the impact of IT on SCP.

To effectively address the challenges posed by reduced performance associated with loneliness in Flexible Work Arrangements (FWAs), it is essential to prioritize fostering interdependence and collaboration among team members (Cheng et al., 2023). This proactive approach can be further bolstered by integrating Information Technology (IT) into business processes and embracing digital transformation. Companies must strategically design systems that support collaborative information seeking and retrieval, thereby enhancing Collaborative Information Behavior (CIB) and facilitating more efficient task completion and problem-solving (Hansen & Talja, 2006).

According to Hansen and Talja (2006), Communities of Scope (COS) are formed by groups of individuals who come together based on shared information needs. These communities drive collaborative efforts in seeking, retrieving, and utilizing information through various strategies such as sharing search methodologies, pooling search results, and exchanging retrieved information objects to achieve common goals. This cooperative approach ensures thorough and relevant information gathering, ultimately enhancing the efficiency and effectiveness of their collective information retrieval processes.

Beyond the initial stages of information gathering, COS involves additional critical steps to ensure that information is usable and valuable to the community. This includes interpreting data, filtering out irrelevant or redundant information, synthesizing various pieces into a coherent whole, and organizing for future reference. This meticulous process ensures that

information is not only collected but also refined and preserved in a manner that benefits the entire community, supporting ongoing collaboration and knowledge sharing.

The successful operation of COS relies on several key factors: a community of engaged practitioners committed to shared goals, a robust socio-technical infrastructure that supports seamless collaboration, and the establishment of a common language for clear communication. These elements collectively enable effective collaboration within the community, facilitating the creation of a valuable collective knowledge repository that enhances organizational agility and responsiveness.

In summary, by fostering interdependence, integrating IT solutions, and leveraging digital transformation strategies, organizations can mitigate the challenges associated with FWAs. Emphasizing collaborative information behaviors, such as those facilitated by COS, not only enhances information sharing but also cultivates a culture of innovation and collective problem-solving.

In table 2.1 it is possible to find the main ideas from part I from the literature review.

Table 2. 1 – Keys ideas from KM, Information sharing and Competitive Advantage

Authors	Year	Title	Concepts	Key idea
Cheng, Li, Sun and Zhong	2023	Flexible Work Arrangements and Employees' Knowledge Sharing in Post-Pandemic Era: The Roles of Workplace Loneliness and Task Interdependence	FWA	Flexible Work Arrengements impacts negatively employees' intentions to share knowledge
Mujanah, Riyadi and Sjachriatina	2022	The effects of knowledge-oriented leadership style, digital transformation, and human resource development on sustainable competitive advantage in East Java MSMEs	KOLS, DT, HRD and SCA	Knowledge-oriented leadership style (KOLS), digital transformation (DT), and human resource development (HRD) on sustainable competitive advantage (SCA)
Purwanto, Siagian and Yuliana	2021	The Effect of Information Technology Implementation on Supply Chain Performance through Information Sharing and Supply Chain Collaboration	IT in Business	IT in business improves performance enabling companies to share information quickly and in real-time
Chen, Fu and Hua	2021	Information Sharing and Sustainable Growth: Evidence from the US Mutual Fund Family	Sustainable Competitive Advantage	Positive relationship between the degree of information sharing and performance
Hansen and Talja	2006	Information Sharing	Collaborative information behavior (CIB)	Activity where individuals work together to identify and retrieve information to accomplish a task or solve a problem.
Hansen and Talja	2006	Information Sharing	Communities of Scope (COS)	Knowledge Management concept reffering groups of individuals who come together based on shared information needs, driving their collaborative efforts in seeking and retrieving information.
Hansen and Talja	2006	Information Sharing	Information Retrieval systems	IR systems and interfaces to accommodate group seeking and collaboration

2.2. DIGITAL TRANSFORMATION AND THE BANKING SECTOR

In the contemporary financial landscape, digital transformation has emerged as a defining imperative for banking institutions worldwide. Several studies provide valuable insights into the challenges and opportunities associated with this transition. A research conducted by Diener and Špacek (2021) examines the obstacles faced by German banks, while Asgari, Rabiei, and Sadigh (2021) investigate the complexities of digital technology integration within Bank Maskan in Iran. Additionally, Dapp's (2014) study for Deutsche Bank elucidates the transformative impact of financial technology (Fintech) on the banking sector. Together, these studies offer a comprehensive understanding of the strategies necessary for banks to successfully navigate the digital revolution.

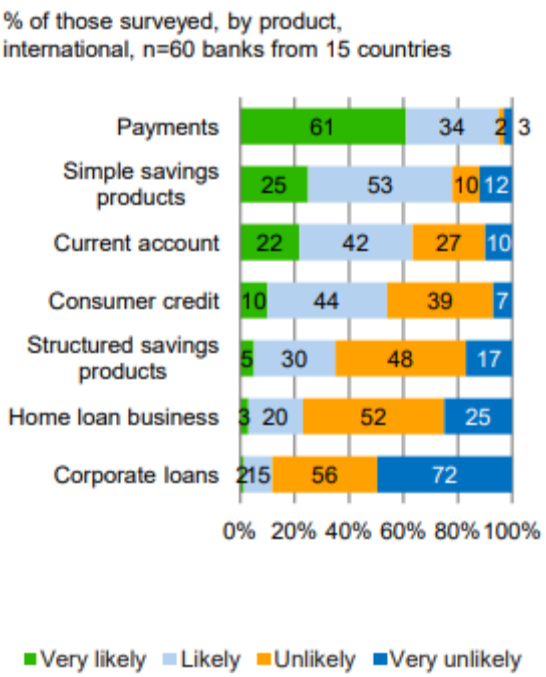
Diener and Špacek (2021) conducted an in-depth investigation into the hurdles to digital transformation within German savings banks. Their methodology included contextual interviews, content analysis, and the examination of best practices within the industry. The study identified several significant obstacles, including the lack of a clear strategy and effective management during the digital transition, coupled with high technical and cost-related expenditures. These findings underscore the need for a well-defined digital strategy and robust management practices to mitigate the challenges associated with digital transformation.

In parallel, Asgari, Rabiei, and Sadigh (2021) explored the complexities of integrating digital technology within Bank Maskan in Iran. Utilizing the Delphi method, their research involved iterative questionnaires and a comprehensive gap analysis across the domains of Process, Technology, and Human Resources. This approach allowed them to devise actionable strategies to bridge the gap between current banking practices and optimal digital adoption. The study emphasized the importance of embracing cutting-edge technologies, such as the Internet of Things (IoT) and Big Data, as essential components for banks to navigate the rapidly evolving digital landscape.

Dapp's (2014) study for Deutsche Bank highlighted the transformative impact of Fintech on the banking sector. As economic activities increasingly shift to digital platforms, banks must swiftly adapt their operational processes and business models to sustain international competitiveness amidst profound digital structural changes. Dapp's research underscores the necessity for banks to respond proactively to the rise of Fintech to avoid losing market share to more agile digital competitors.

According to Dapp's (2014) findings, depicted in Figure 2.3, traditional banks face significant threats from Fintech in several key areas. These areas include payments, simple saving products, current accounts, and consumer credit, with more than 50% of these services likely or very likely to transition to Fintech solutions. This highlights the urgent need for traditional banks to innovate and adapt to the digital environment to maintain their competitive edge.

Figure 2. 3 – Threat to retail banking from new market participants in the next 3 years from Dapp's (2014)



In conclusion, the confluence of findings from these studies paints a clear picture: to thrive in the digital age, banking institutions must overcome substantial barriers and embrace digital transformation wholeheartedly. This involves not only adopting new technologies but also rethinking organizational structures, management practices, and customer engagement strategies to the main pain points from daily products and daily transaction.

By doing so, banks can enhance their operational efficiency, offer superior customer experiences, and secure their position in an increasingly digital financial ecosystem.

In table 2.2 it is possible to find the main ideas from part II from the literature review.

Table 2. 2 – Digital Transformation and the Banking Sector

Authors	Year	Title	Concepts	Key idea
Diener and Špacek	2021	Digital Transformation in Banking: A Managerial Perspective on Barriers to Change	Digital Transformation Barriers	Digital transformation within the banking industry encounters numerous barriers
Asgari, Rabiei and Sadigh	2021	Digital Transformation in the Value Chain Disruption of Banking Services	Overcoming digital gap in the banking sector	The adoption of new digital technologies by organizations to significantly change their performance and capture new opportunities.
Dapp	2014	Fintech – The digital (r)evolution in the financial sector	Impact of fintech on the financial sector	There is the need for urgent action in the financial sector to remain competitive in the digital era

2.3. ADAPTIVE MODELS TO ENHANCE PERFORMANCE

Understanding the intricate interplay between collaboration, technology, performance, and competitive advantage necessitates the introduction of the concept of accessibility. This exploration is grounded in empirical research, including interviews with thirty-two engineers from a manufacturing company using the Cognitive Work Analysis framework. This framework provided deeper insights into the complex interactions between task performance, cognitive and social activities, and subjective preferences. Despite the complexity surrounding the notion of accessibility, individuals typically choose information sources based on factors such as format superiority, information centralization, time efficiency, and familiarity (Fidel & Green, 2003).

While the possession of necessary technology for facilitating Collaborative Information Behavior (CIB) is crucial, it is equally important to consider the individuals who access this technology and information. Fidel and Green's (2003) paper, however, remains ambiguous about the specific characteristics that define accessibility, failing to provide detailed specifications. Personal aspects, including social and cognitive domains, vary significantly among individuals, introducing potential diversity in the perception and experience of accessibility.

Concerning technological proficiency, Bezerianos, and Elias's (2011) paper, "Exploration Views: Understanding Dashboard Creation and Customization for Visualization Novices," offers valuable insights. The Exploration Views (EV) system is designed to assist novice users in effortlessly creating and personalizing Business Intelligence (BI) dashboards. Individuals with lower technical skills often face challenges in navigating and comprehending dashboard systems. The EV system mitigates these difficulties, thereby enhancing efficiency and performance for these users.

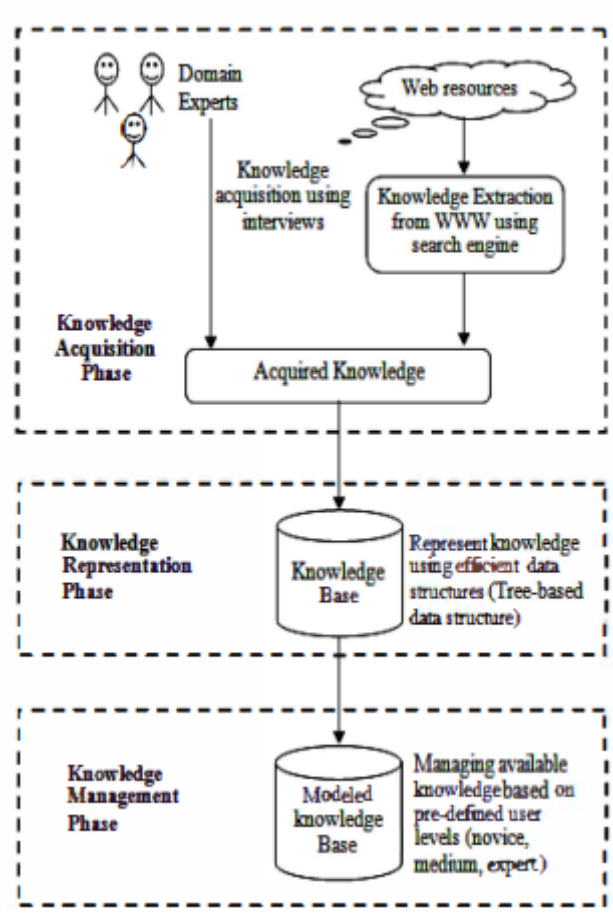
From a personal characteristics perspective, the study "Towards Adaptive Information Visualization: On the Influence of User Characteristics" by Carenini et al. (2012) analyzed factors such as perceptual speed, verbal working memory, visual working memory, and user expertise. The findings indicated that these characteristics significantly impact task efficiency, user preference, and usability within visualizations such as bar graphs and radar graphs. Thus, individuals' expertise in technology and their specific work contexts significantly influence the effectiveness of information perception.

Building on this understanding, Dabbebi et al. (2017) proposed that adaptive dashboards play a crucial role in bridging the gap between users' needs and desired features. Their paper focuses on elucidating user requirements and developing a conceptual framework for generating adaptive dashboards tailored to individual user needs and objectives. However, this approach primarily addresses the adjustments needed to meet user requirements, often overlooking the varying levels of expertise and skills among end users. In contrast, Sarukesi and Uthayakumar (2011) provide additional insights by proposing a three-phase methodology

for developing an adaptive e-learning system based on the user's knowledge level and profile (Figure 2.4).

This comprehensive approach highlights the importance of incorporating both technological and personal aspects when designing adaptive systems. The three-phase methodology by Sarukesi and Uthayakumar (2011) begins with knowledge acquisition, followed by knowledge representation, and concludes with knowledge management. Each phase is tailored to the user's knowledge level and profile, ensuring a more personalized and effective learning experience.

Figure 2. 4 - Adaptive e-learning system from Sarukesi and Uthayakumar (2011)



- Phase 1: Acquiring knowledge from field specialists and the internet.
- Phase 2: Organizing and representing the knowledge into a tree-based data format, specialized data structure for storing information hierarchically.
- Phase 3: Adaptive e-learning system design - Understanding users' knowledge and skill levels and representing knowledge in various adaptive formats.

In summary, to enhance organizational performance and promote collaboration effectively, teams require technological solutions that provide centralized access to information through customizable dashboards and reports, tailored to meet diverse user needs. These solutions must be capable of adapting to current and future requirements, accommodating varying levels of user skills and expertise. Achieving these objectives involves implementing an adaptive model, beginning with the construction of a robust knowledge base where pertinent information and knowledge are identified and organized hierarchically. This foundational step is followed by the design and implementation of the adaptive system, which must align closely with the specific characteristics and preferences of the end users.

However, existing literature often lacks detailed insights into the specific tools, infrastructure requirements, and technical intricacies essential for developing adaptive models and dashboards. Addressing this gap is critical to ensuring the successful implementation of adaptive technologies that effectively support organizational goals of enhancing performance and facilitating collaborative workflows. By delving deeper into the methodologies, frameworks, and practical applications outlined in future research, organizations can better navigate the complexities involved in adopting and optimizing adaptive technologies within their operational contexts. This strategic approach not only enhances the usability and effectiveness of adaptive systems but also promotes innovation and responsiveness in a dynamic business environment.

In table 2.3 it is possible to find the main ideas from part III from the literature review.

Table 2. 3 – Keys ideas from the topic Adaptive Models to Enhance Performance

Authors	Year	Title	Concepts	Key idea
Dabbebi, Garlatti, Gilliot, Iksal and May	2017	for Learning Analytic: An Approach for Conceptu	Adaptive Dashboard	Understanding the gap between desired aspects and current features
Carenini, Conati, Haraty and Toker	2012	Information Visualization: On the Influence of U	User Characteristics	Perceptual speed, verbal working memory, visual working memory, and user expertise significantly affect task efficiency, user preference, and ease of use
Bezerianos and Elias	2011	standing Dashboard Creation and Customization	Novice visualization users	Building dashboard applications for novice visualization users, based on the needs and behaviors observed during the evaluation of exploration views
Sarukesi and Uthayakumar	2011	ıptive E-Leaming System using Knowledge Manag	Model	1. acquiring knowledge, 2. modeling of the knowledge base and 3.designing of the adaptive e-learning system.
Fidel and Green	2003	s of accessibility: engineers perception of inform	Accessability	Accessibility refers to the factor that influences selection of information sources. The ease with which can be access and retrieve information from a particular source. It encompasses factors such as the format of the information, the level of detail provided, the availability of a large amount of information in one place, familiarity with the source, and the time-saving aspect.

2.4. TOOLS, SOFTWARE AND ITS USABILITY FOR DIFFERENT USERS AND BIG DATA

In the pursuit of developing an adaptive model for enhancing information sharing, a crucial initial step involves defining the essential software tools and platforms. Mahdawi's (2022) comparative analysis of cloud services—Cloudera, Azure, and AWS—within the realm of Big Data applications underscores the pivotal role of cloud technologies in facilitating remote access to data and applications, thereby promoting collaboration, especially in environments with flexible work arrangements (FWA).

AWS and Azure, both comprehensive cloud service providers, share significant similarities while offering complementary services tailored to diverse organizational needs. AWS, for instance, provides a range of services including ECS, storage solutions, and databases, with data retention capabilities extending beyond account expiration periods. In contrast, Azure also offers a broad spectrum of services, some of which are available for extended durations, such as the 12-month offerings. Notably, Microsoft's introduction of Azure Arc, a multi-cloud fabric controller enabling Azure to host AWS machines, signifies a growing trend towards hybrid cloud solutions that integrate different cloud environments seamlessly.

Cloudera stands out by providing a robust software platform designed for data processing and analysis, deployable across both cloud-based and on-premise environments. This flexibility makes Cloudera an ideal choice for organizations seeking scalable solutions based on Hadoop technologies.

Shivakumar (2019) employed a dual approach to comparison—comprising theoretical analysis and practical feedback via questionnaires—to evaluate various analytical tools and techniques. The questionnaire, spanning three months and gathering responses from 75 participants ranging from interns to managerial levels, aimed to identify factors influencing knowledge management processes. Concurrently, the theoretical comparison involved an exhaustive review of literature from articles, journals, and online sources, assessing tools such as SPSS, Google Sheets, Tableau, Power BI, and Google Data Studio for data visualization processes.

In terms of user interface and usability, Google Data Studio emerges as a leading tool for its efficiency and intuitive design, closely followed by Power BI, renowned for simplicity, reliability, and seamless integration with diverse add-ons. Despite its complexity, Tableau offers robust visualization capabilities that appeal to users requiring advanced data presentation features. Google Sheets remains a viable option for basic-level dashboards, particularly when other tools may not be accessible, supported further by its utility in processing data alongside coding functionalities and validations.

Examining the intersection with Big Data, Alali and Almeri (2020) developed a model for a joint-venture project in Sweden, leveraging Big Data software for data preparation, analysis, and visualization. The project highlighted the critical role of cloud connectivity in enhancing information-sharing and decision-making processes. Utilization of cloud-based Power BI

dashboards facilitated real-time project status updates, fostering seamless collaboration and mitigating challenges stemming from organizational and cultural differences.

Allam, Ankam, and Nalmala (2023) underscore the defining properties of the Snowflake schema, emphasizing its independence and separability from other schemas. These attributes ensure operational efficiency and eliminate redundancy, making the Snowflake schema particularly suitable for integration with big data systems.

Domino et al. (2021) contributed an analytical perspective through their case study on challenges related to acquiring data analytics skills in accounting. Their research emphasizes the critical role of critical thinking in decision-making processes, advocating for the use of pivot tables in Microsoft Excel to effectively summarize and categorize large datasets into concise reports. This approach enhances user-friendly adaptability and provides substantive support for decision-making processes.

In conclusion, the integration of advanced software tools and cloud technologies plays a pivotal role in developing adaptive models for information sharing. By leveraging insights from comprehensive analyses and case studies, organizations can strategically select and deploy technologies that enhance collaboration, improve performance, and ensure competitive advantage in an increasingly digital landscape.

In table 2.4 it is possible to find the main ideas from part IV from the literature review.

Table 2. 4 – Keys ideas from the topic Tools, Software and its Usability and Big Data

Author	Year	Title	Concepts	Key idea
Allam, Ankam, and Nalmala	2023	Cloud Data Warehousing: How snowflake is transforming Big Data management	Snowflake Schema	Snowflake stands as a revolutionary presence within the realm of big data management, with its cloud-native design, remarkable scalability and cost-effectiveness.
Mahdawi	2022	A comparative study in Cloudera, Azure and AWS	Cloudera, Azure and AWS	Cloudera is a better choice for Hadoop distribution, while AWS and Azure are better for cloud distribution services for comparison. Azure have better performance, while AWS excels in auto scalability.
Domino, Schrag, Troy and Webinger	2021	Linking data analytics to real-world business issues: The power of the pivot table	Excel	Pivot tables to summarize and analyze large datasets quickly and effectively, connecting to Tableau to enhance visualization.
Alali and Almeri	2020	The application of Big Data technology to improve the information sharing and enhance the decision-making process in construction projects	Big Data and Power BI	Big Data technology can enhance information sharing and improve decision-making processes. Big Data visualization capabilities of Power BI enable control over the quantity and complexity of data visualization in an efficient manner. The software improved information sharing and decision-making, even with limited expertise with Power BI.
Shivakumar	2019	Implementation and Effective Utilization of Analytical Tools and Techniques in Knowledge Management	Analytical Tools	Google Data Studio is the most effective tool for data visualization, followed by Power BI and Tableau. Google Apps Script coding and basic Excel techniques are more effective for automating repetitive tasks.

3. METHODOLOGY

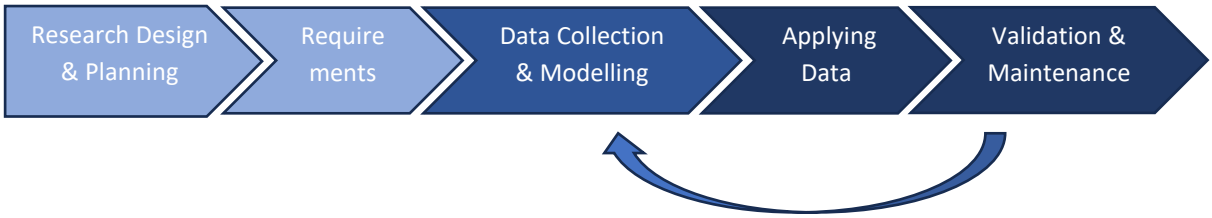
This chapter provides an extensive and thorough exploration of the methodological framework employed to conduct rigorous research, aimed at achieving specific research objectives and addressing complex research questions. The approach outlined encompasses foundational principles, detailed methodologies, procedural steps, and overarching guidelines that guide the investigative process, ensuring clarity, rigor, and systematic development of the research artifact.

The research journey, illustrated in Figure 3.1, unfolds through a series of meticulously planned phases, each playing a crucial role in shaping the overall methodology:

- **Research Design Phase:** This initial phase is characterized by meticulous planning and strategic decision-making. It involves defining the scope and boundaries of the study, identifying key research questions and objectives, and selecting appropriate methodologies for data collection and analysis. Clear delineation of these aspects ensures alignment with the overarching goals of the research, setting a solid foundation for subsequent phases.
- **Preparation and Requirements Analysis:** Following the comprehensive planning stage, the focus shifts to assessing and fulfilling the prerequisites necessary to move forward. This includes evaluating logistical needs, securing necessary resources, and ensuring methodological readiness for effective data collection and modeling.
- **Data Collection and Modelling**: Central to the research process is the meticulous execution of data collection methodologies and the construction of a robust conceptual model. This phase involves systematic gathering, organization, and synthesis of relevant data to inform the development of the theoretical framework or conceptual underpinning of the artifact.
- **Applying Data**: With the conceptual groundwork laid, the subsequent phase transitions from theory to practice. Here, the emphasis is on translating theoretical constructs into a tangible artifact or prototype. Detailed methodologies and procedures are outlined for the practical implementation of the conceptual model, ensuring that the artifact aligns closely with the identified research objectives and contributes meaningfully to advancing knowledge in the field.
- **Validation and Maintenance**: As the artifact nears completion, rigorous validation and verification processes become essential. These critical steps are designed to assess the accuracy, reliability, and applicability of the artifact within its intended context. Validation involves thorough evaluation against established criteria and may necessitate iterative refinements to ensure robustness and integrity. Addressing any identified limitations or challenges during this phase further enhances the credibility and validity of the research outcomes.

In conclusion, this chapter offers a comprehensive roadmap of the systematic approach adopted to conduct rigorous research. By adhering rigorously to established methodologies and principles across each phase, the research aims not only to achieve its specified objectives effectively but also to make a significant and enduring contribution to the broader academic and practical domains within which it operates.

Figure 3. 1 – Methodology Process



Theoretical Research

Building the Model (explored in chapter 4. Implementing the Model)

Applying the Model (explored in chapter 4. Implementing the Model)

3.1. RESEARCH DESIGN & PLANNING

3.1.1. Current Problem and Scenario

The rapid evolution of the banking sector necessitates the integration of digital technologies for traditional banks to maintain competitiveness against internet-based entities. Despite ongoing efforts, many traditional banks have yet to fully capitalize on customer information and advanced data analysis techniques, limiting their ability to offer personalized products and services (Dapp, 2014). This shortfall presents significant challenges in their journey towards digital transformation. While there is a discernible shift towards digitalization in banking, a complete reinvention remains elusive, prompting traditional banks to enhance their utilization of customer data to remain relevant and competitive.

A critical obstacle in the digital transformation of banks is the lack of clear and cohesive components within the digitalization context. These components are crucial for guiding strategic decision-making, setting clear objectives, and facilitating a smooth transition to digital processes within the banking industry (Diener & Špacek, 2021). However, during this transition phase, there often exists a gap between the digital transformation initiatives and the end-users of the information. Resistance to change and the substantial costs associated with digital infrastructure further complicate these challenges. The absence of well-defined goals and objectives can exacerbate these costs, making the digitalization process more daunting.

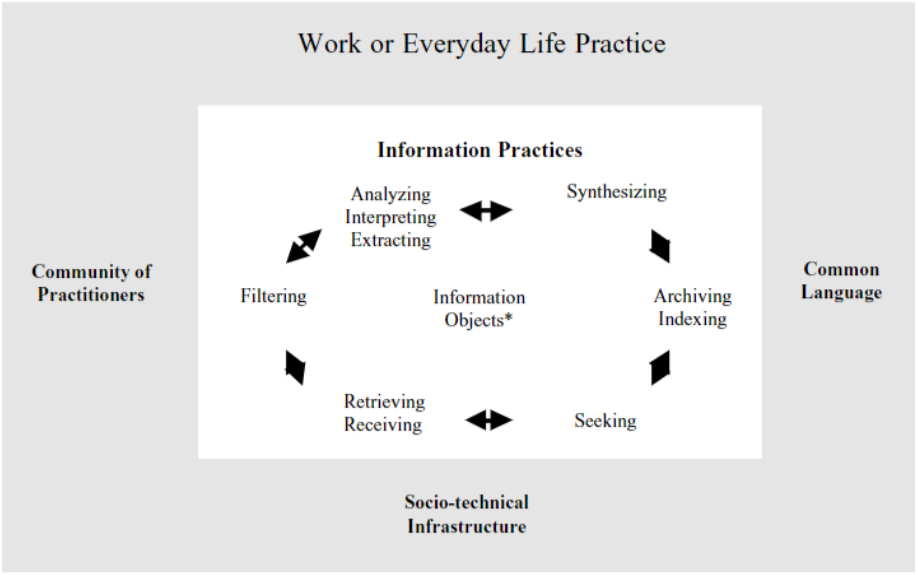
Achieving sustainable competitive advantage in the banking sector demands more than just investing in digital transformation initiatives. Mujanah, Riyadi, and Sjachriatina (2022) emphasize that sustainable competitive advantage hinges on factors such as Knowledge-oriented Leadership Style (KOLS), robust digital transformation strategies (DT), and comprehensive human resource development (HRD). While banks are actively investing in digital transformation, bridging the gap between these initiatives and end-users necessitates additional investments in knowledge management and human capital development.

The social practice approach to Collaborative Information Behavior (CIB), as outlined by Hansen and Talja (2006), underscores the importance of cultivating a community of engaged practitioners within banking. This approach advocates for establishing a strong socio-technical infrastructure and fostering a common language to facilitate effective collaboration. In banking contexts, analysts and information users are pivotal members of this community, yet other elements require equal attention and development.

Examining the social practice approach to CIB (as depicted in Figure 3.2), parallels can be drawn to Online Analytical Processing (OLAP) models. Constructing such models involves interpreting data, filtering out irrelevant or redundant information, synthesizing diverse pieces into a cohesive whole, and archiving data for future use—analogous to the Extract, Transform, Load (ETL) process. The infrastructure supporting these processes is crucial, as it

serves as the platform for accessing and utilizing data effectively. This integration underscores the critical role of robust data management and infrastructure in enabling informed decision-making and maintaining competitive advantage in the dynamic banking landscape.

Figure 3. 2 – The social practice approach to CIB from Hansen and Talja (2006)



* human sources, documents, document parts, document bundles, document repositories

In the realm of data analytics within banking, it is crucial to recognize that analysts and users bring diverse knowledge, backgrounds, and perspectives to their interactions with data, leading to a lack of unified language across all stakeholders. This diversity highlights the importance of tailoring data and information to meet the specific needs of users, whether for analytical purposes, informational insights, or decision support. This customization ensures that information not only becomes accessible but also remains relevant and actionable within the banking ecosystem, catering to the distinct requirements of different stakeholders.

Currently, there exist several approaches to adaptive models that consider how user characteristics influence data visualization (Carenini et al., 2012), the customization of visualization tools (Bezerianos & Elias, 2011), and the conceptualization of adaptive dashboards, as illustrated in Figure 3.3 showcasing the dashboard generator (Dabbebi et al., 2017). These studies primarily emphasize the final stages of visualization and dashboard creation, aiming to enhance adaptability and user interaction.

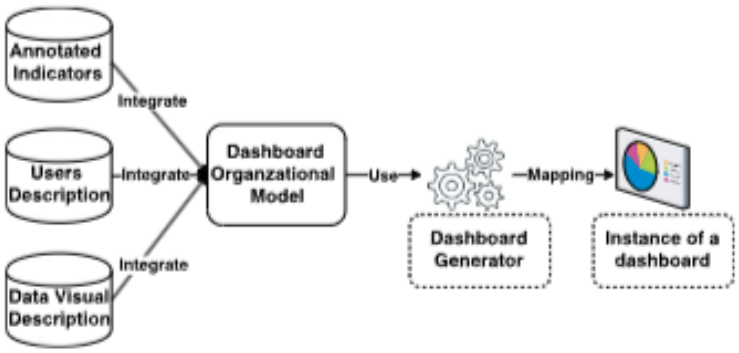
However, it is important to note that these references often concentrate narrowly on the outputs rather than encompassing the broader scope of adaptive models. There remains a gap in addressing the comprehensive lifecycle of adaptive models, which should ideally span from initial data collection and analysis through to visualization and dashboard development.

Therefore, there is a clear need for further exploration to develop holistic adaptive models that integrate all stages of the process seamlessly.

In this context, the current project seeks to expand upon existing models by incorporating detailed user analysis alongside advanced visualization techniques. By augmenting the model in this manner, the aim is to provide a more comprehensive understanding of how adaptive approaches can effectively enhance knowledge management practices within the banking sector. This holistic approach not only acknowledges the varying needs and preferences of users but also aims to optimize data utilization and decision-making processes through tailored, user-centric solutions.

By bridging the gap between data analytics and user requirements, the project intends to contribute to the evolution of adaptive models, fostering a more nuanced approach to data-driven decision-making in banking. Ultimately, this endeavor strives to empower stakeholders with actionable insights that are both insightful and tailored to meet diverse user needs across the banking landscape.

Figure 3. 3 – Dashboard Generator Model of Dabbebi et al. (2017)



Recognizing the multifaceted challenges confronting traditional banks, it becomes evident that the scope extends beyond the optimization of dashboards to encompass how business personnel access and leverage information effectively. Sarukesi and Uthayakumar (2011) advocate for a comprehensive approach to adaptive models, emphasizing not only visualization but also learning through a structured framework: the knowledge acquisition phase, knowledge representation phase (knowledge base), and knowledge management phase (modeling and managing knowledge according to predefined user levels).

Drawing on insights from diverse studies on adaptive models, learning methodologies, and visualization techniques, this project seeks to operationalize these concepts within the banking sector. The primary aim is to enhance information sharing, improve accessibility, foster collaborative information behavior (CIB), cultivate a robust knowledge management

culture, and ultimately gain a competitive edge to navigate the evolving landscape alongside Fintech companies.

Through the integration of adaptive models that encompass knowledge modeling and e-learning systems, traditional banks can empower their workforce to make informed decisions based on a profound understanding of customer data and sophisticated data analysis techniques. This holistic approach not only optimizes the utilization of available data resources but also facilitates continuous learning and adaptation within the organization. By doing so, traditional banks position themselves strategically to effectively compete with Fintech firms in the dynamic and competitive banking industry.

By embracing adaptive methodologies that span knowledge acquisition, representation, and management, traditional banks can foster an environment where employees are equipped with the necessary tools and insights to navigate complex market challenges. This approach supports agility, responsiveness, and innovation, enabling banks to leverage their existing strengths while adapting to emerging trends and customer expectations. Through continuous refinement and enhancement of adaptive models, banks can sustain long-term relevance and resilience in an increasingly digital and competitive banking landscape..

3.1.2. Aligning Business Needs and Research Objectives

Given the current dynamics within the banking sector and the identified research gap surrounding adaptive information and knowledge sharing, several critical needs emerge for banking institutions:

- **Defining Specific and Clear Goals for Digital Transformation**: It is essential for banking companies to establish precise objectives that guide their digital transformation initiatives. Clear goals ensure alignment across departments and facilitate focused efforts toward leveraging technology to enhance operational efficiency and customer experience.
- **Aligning Cultures of Knowledge Management and Business Intelligence**: Integrating knowledge management and business intelligence cultures is crucial for fostering a unified approach to data utilization. This alignment ensures that insights derived from data are effectively communicated and utilized across the organization, promoting informed decision-making and strategic planning.
- **Establishing a Centralized Source for Information and Data Access**: Providing a centralized platform accessible to all employees facilitates seamless access to critical information and data resources. This centralized source enhances collaboration, reduces silos within departments, and promotes a culture of transparency and shared knowledge across the organization.

In addressing these foundational needs, the development of an adaptive model becomes paramount. This model aims to facilitate universal access to data within banking companies, tailoring information to meet the specific needs of individual users. By

adapting data accessibility and presentation according to users' requirements and technical skills, the adaptive model ensures that information is not only accessible but also actionable and relevant to support decision-making and operational tasks.

The planning and implementation of this adaptive model will be guided by the identified needs and aimed at addressing the following research questions:

- How can banking companies facilitate easier access to information among team members in the product area?
- What strategies can be employed to adapt the information accessed by team members to meet their specific needs for product information based on their technical skills?

These research questions underscore the importance of developing tailored solutions that enhance information accessibility and usability within banking organizations.

3.1.3. Planning and Designing the Model

Beginning with the first need: establishing specific and clear objectives to drive digital transformation within the banking sector's product domain, this initiative focuses on managing diverse data streams. These encompass critical elements such as client information, product specifications, and essential financial metrics like revenue, costs, and profitability derived from product sales. In practice, banking institutions utilize this data to inform strategic initiatives, including promotional campaigns and innovation endeavors. This study particularly examines the pivotal role played by dedicated teams, especially within the product team, in the analysis and interpretation of data. The primary aim of digital transformation efforts is to enhance the accessibility of information within this framework, thereby streamlining internal data access and ensuring alignment with the varied technical proficiencies of team members.

How can companies in the banking sector provide easier access to information within team members in the product area?

Transitioning to the second imperative, there is a crucial need to harmonize the cultures of Knowledge Management (KM) and Business Intelligence (BI) while concurrently establishing a centralized repository. This repository is designed to facilitate cross-functional access to information and data across all tiers of the organization. Drawing insights from Chen, Fu, and Hua (2021), who emphasize the positive relationship between information sharing and organizational performance, and building upon the advocacy of Hansen and Talja (2006) for centralized collaborative platforms, the proposed model advocates for a unified structural framework. Central to this framework is the establishment of a centralized platform equipped with tools that nurture a knowledge management culture. This culture ensures equitable access to relevant information for all team members, fostering an environment conducive to the exchange of insights, conclusions, and expertise.

However, preceding the implementation of a centralized repository, the development of a robust information retrieval model is essential. This foundational step, led by the Business Analyst team, involves the construction of a model interconnected with diverse data sources. This initiative requires comprehensive data organization and transformation processes to convert raw data into actionable insights accessible to the product area. Consequently, the transformed information becomes readily available through meticulously designed reports and intuitive dashboards.

Given the extensive and historical nature of data prevalent in the traditional banking sector, the creation of a centralized repository, often referred to as a Data Lake, becomes indispensable. Within this repository, the product model is constructed by synthesizing and structuring data using schema-on-read principles. This approach is particularly adept at accommodating the vast volumes of data inherent to the sector. Given the sector's data-intensive nature, a focused strategy targeting the product domain is paramount. This entails the development of a dedicated data mart, specifically tailored to facilitate efficient data management and utilization within the product area.

In summary, addressing these needs necessitates a comprehensive approach that integrates digital transformation initiatives with robust knowledge management practices and efficient data utilization strategies. By leveraging these methodologies, banking institutions can enhance information accessibility, foster collaborative decision-making, and ultimately position themselves competitively in the evolving banking landscape.

How can companies in the banking sector adapt the information accessed by team members to meet their specific needs for product information based on their technical skills?

Addressing the third imperative involves implementing adaptive models to ensure comprehensive access to information across various organizational functions, extending beyond traditional IT teams or Business Analysts. Drawing insights from the adaptive model framework proposed by Sarukesi and Uthayakumar (2011), which emphasizes tailoring information to meet specific needs and technical competencies, becomes paramount in this context.

Initially, a foundational step entails establishing a robust knowledge base aligned with the methodologies outlined by Sarukesi and Uthayakumar (2011) and further detailed by Dabbebi et al. (2017). Sarukesi and Uthayakumar (2011) advocate for acquiring knowledge from domain experts through structured interviews, while Dabbebi et al. (2017) delineate essential components for model integration, as depicted in Figure 3.3:

- **User Description (Knowledge Acquisition)**: This phase involves identifying the contextual requirements of users, operationalized through inquiries into "Who," "What," "When," and "How," thereby facilitating a comprehensive needs assessment analysis.

- **Annotated Indicators for the User Model (Knowledge Acquisition)**: Incorporating personal information, user knowledge levels, and visual preferences ensures the adaptive system can tailor information delivery to individual user profiles effectively.
- **Data Visual Description (Model Knowledge Management)**: Defining visualization formats, data volume and dimensions, metadata specifications, granularity levels, data structures, and the intended purpose of visualization ensures that the adaptive model aligns with user expectations and operational needs.

Initiating this foundational phase typically involves convening meetings with key stakeholders from the product sector within the organization. These initial engagements aim to gather comprehensive contextual insights, including:

- **Conceptual Understanding**: Acquiring in-depth knowledge and background contextualization about the specific product area and its operational nuances ("Who?").
- **Identifying User Needs**: Clarifying which types of data are essential for meeting operational objectives and timing their availability ("What?" / "When?").
- **Assessing User Skills**: Recognizing the technical proficiencies and capabilities expected of future users of the adaptive model ("How?").

Subsequently, informed by the insights gleaned from this knowledge base, the adaptive system is meticulously designed. This design phase focuses on tailoring the system to accommodate the diverse user profiles prevalent within the organization. It ensures that the information accessed is not only relevant but also aligned with each user's technical skills, thereby optimizing the efficiency of data utilization and decision-making processes.

By systematically integrating adaptive models into the information management framework, banking institutions can foster a culture of informed decision-making, enhance operational agility, and sustain competitive advantage in a rapidly evolving financial landscape.

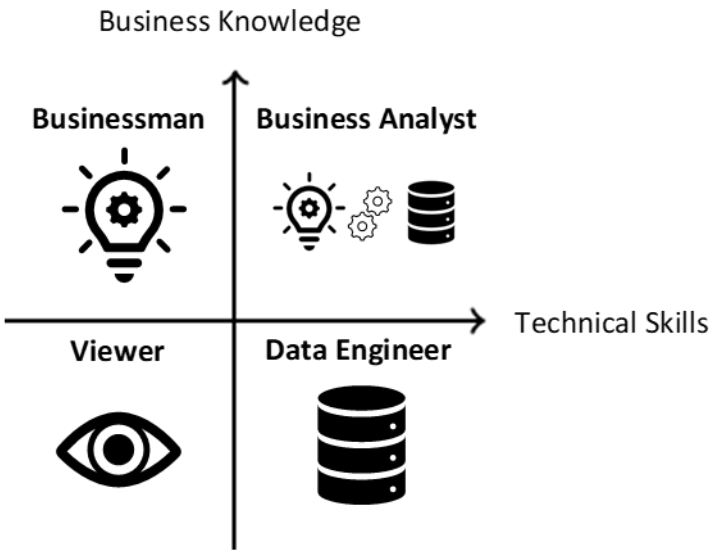
As depicted in Figure 3.4, there may be four distinct user types:

- **Data engineers**, situated outside the team, possess high technical skills with minimal or no business expertise.
- **Business analysts**, and internal team members, possess a blend of business knowledge and technical expertise.
- **Viewers**, external to the team, exhibit minimal or no proficiency in both business and technical domains.
- **Businessmen**, and internal team members, possess high business insight but limited technical skills.

To ensure transversal access to information across all user types, the adaptive system must be designed with flexibility and inclusivity in mind. This may entail implementing user-friendly interfaces, customized dashboards, and tailored data visualization techniques to cater to the

unique needs and competencies of each user category. Additionally, the system should incorporate features such as role-based access controls and personalized recommendations to facilitate seamless information retrieval and utilization for all users, regardless of their technical proficiency levels.

Figure 3. 4 – Users involved in Developing an Adaptive Model



Within the adaptive model framework illustrated in Figure 3.5, distinct roles and responsibilities delineate how various user categories interact with data to support decision-making and operational processes within banking institutions.

Data Engineers: Data engineers are pivotal in the initial stages of the data lifecycle, focusing on data ingestion from diverse sources and its integration into a centralized repository, typically a Data Lake. Their primary mandate encompasses ensuring seamless access to original data sources and managing the infrastructure of the Data Lake platform. This foundational role ensures that data is available in its raw form for subsequent processing and analysis by other teams.

Business Analysts: Positioned as intermediaries between raw data and actionable insights, business analysts leverage the Data Lake platform to access, transform, and organize data into meaningful information. Their expertise lies in interpreting data trends, generating reports, and developing strategic recommendations. By harnessing analytical tools within the data mart, business analysts play a critical role in translating complex data into accessible insights for decision-makers across the organization.

Viewers: Viewers, though external to the primary data analysis team, play a crucial role in leveraging organizational data for informational purposes. Their involvement typically revolves around accessing pre-configured reports and dashboards disseminated across the organization. This passive engagement allows viewers to stay informed about organizational trends and performance metrics, supporting their awareness and facilitating informed decision-making processes.

Businessmen: Integral to the product team, businessmen are actively engaged in leveraging data insights to drive strategic decisions regarding product strategies, promotions, and campaigns. Traditionally reliant on business analysts for data access and analysis, businessmen benefit significantly from direct access to the data mart through simplified tools. This streamlined access empowers them to independently explore data, perform ad-hoc analyses, and derive actionable insights crucial for enhancing product competitiveness and market responsiveness.

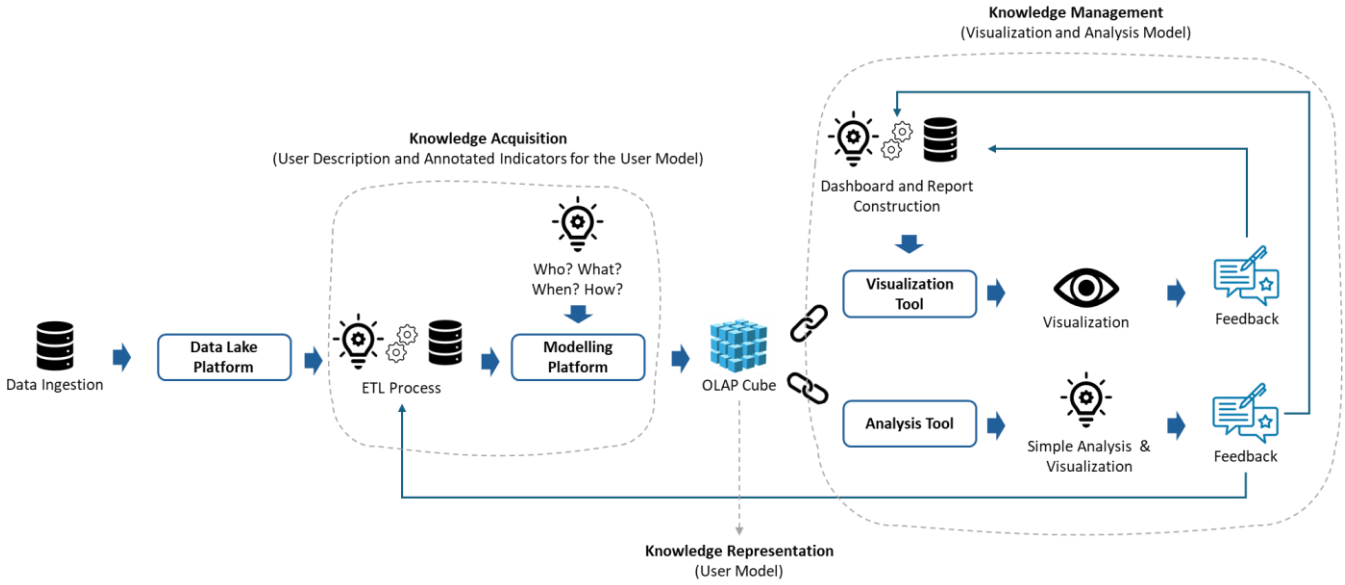
The adaptive model featured in Figure 3.5 facilitates personalized information delivery tailored to the specific needs of each user category:

- **Viewers**: Access standardized reports and dashboards distributed organization-wide, providing comprehensive insights into key performance indicators and organizational metrics.
- **Businessmen**: Utilize personalized connections within the data mart, offering direct access to detailed datasets and analytical tools customized to individual team members' requirements. This enables independent analysis and informed decision-making aligned with strategic business objectives.
- **Business Analysts**: Access the data mart for extensive data exploration and analysis, leveraging sophisticated analytical capabilities to uncover trends, patterns, and correlations critical for strategic planning and operational excellence.

An integral feature of the adaptive model is its incorporation of feedback mechanisms to enhance collaboration and user engagement. By soliciting user feedback and insights, the model continuously evolves to align with changing organizational needs and user expectations. Moreover, the provision of distinct connections tailored to individual users ensures that each team member accesses data and information resources tailored to their specific roles and responsibilities.

In summary, the adaptive model not only optimizes data accessibility and utilization across diverse user categories but also fosters a collaborative data-driven culture essential for maintaining competitive advantage and operational efficiency within the dynamic banking sector.

Figure 3. 5 – Adaptive Model inspired by from Dabbebi et al. (2017) Adaptive Dashboard Generator and from Sarukesi and Uthayakumar (2011) Adaptive E-Learning System



The primary benefit of the adaptive model lies in its capacity to empower businessmen within the banking sector through direct connectivity, offering several key advantages:

- **Real-time Data Refreshment**: The model facilitates real-time updates to accommodate new data influxes swiftly. This capability ensures that businessmen have access to the most current information available, enabling timely decision-making and responsiveness to market changes.
- **Dynamic Analytical Capabilities**: Leveraging relationships and hierarchies within the data mart, businessmen can perform dynamic analyses. This includes exploring data from different dimensions, conducting drill-down analyses, and uncovering hidden patterns or correlations that contribute to informed decision-making.
- **Customization of Visualizations**: Unlike static reporting, the adaptive model supports the customization of visualizations tailored to individual preferences. Businessmen can configure dashboards and reports according to their specific needs, choosing relevant metrics, charts, and graphical representations that facilitate clear and insightful data interpretation.
- **Online Storage of Information**: All data and analytical outputs are stored online within the adaptive model's infrastructure. This centralized storage ensures accessibility from any location with internet connectivity, promoting seamless collaboration and information sharing among team members.

Beyond enhancing individual autonomy, the adaptive model fosters synergies between businessmen and business analysts. As businessmen engage in daily analyses, they may discover unique insights and observations that enrich the dashboard creations crafted by

business analysts. This collaborative exchange of insights enhances the overall effectiveness of decision-support tools and promotes a culture of continuous improvement in data-driven decision-making practices.

Moreover, the adaptive model aligns principles of knowledge management, collaboration, and business intelligence. By integrating diverse perspectives and expertise, it facilitates a holistic approach to leveraging organizational data for strategic advantage.

However, a notable drawback of the adaptive model is the time required for connecting to and updating information. This challenge is primarily attributed to the complexities involved in establishing connections to the entire semantic model and ensuring data integration across various sources. Efforts to minimize latency and streamline data access remain crucial to optimizing the model's operational efficiency and maximizing its utility for end-users.

In conclusion, while the adaptive model offers substantial benefits in terms of autonomy, dynamic analytics, customization, and collaborative insights generation, addressing connectivity and update challenges will be pivotal in realizing its full potential within the banking sector.

3.2. REQUIREMENTS

The construction of the adaptive model requires a meticulous approach to selecting suitable tools and technologies. Essential to this process is the establishment of a centralized data repository, commonly known as a Data Lake, within the banking institution. This repository serves as a comprehensive storage solution for integrating and managing vast volumes of data from diverse sources. Concurrently, team members require access to tools equipped with necessary licenses that facilitate seamless connections, as well as the publication and sharing of dashboards and reports across the organization.

A pivotal consideration in this endeavor involves evaluating offerings from industry-leading providers such as Cloudera, Azure, and AWS for constructing the data mart. Cloudera specializes in delivering robust data management and analytics solutions leveraging open-source technologies, catering specifically to enterprises requiring scalable and secure data handling capabilities. In contrast, Azure and AWS offer extensive cloud computing platforms encompassing a wide array of services designed for application development, deployment, and management. These platforms provide flexible infrastructure solutions that support the deployment of data mart environments, enabling efficient data processing and analytics (Mahdawi, 2022).

Insights drawn from Mujanah, Riyadi, and Sjachriatin (2022) emphasize the strategic advantages of utilizing cloud platforms in fostering a knowledge-oriented culture and gaining a competitive edge in the banking sector. Cloud infrastructure facilitates ubiquitous access to information via internet connectivity, facilitating seamless document sharing, version control,

and collaboration, particularly beneficial in the context of remote work settings and distributed teams.

For data visualization purposes, the adoption of cloud-based Power BI dashboards emerges as pivotal. These dashboards play a crucial role in presenting project statuses and performance metrics in a visually intuitive manner, thereby promoting effective collaboration and bridging organizational and cultural disparities (Alali & Almeri, 2020). Furthermore, tools like pivot tables in Microsoft Excel serve as indispensable aids for simplifying data analysis tasks. They enable the summarization and categorization of extensive datasets into concise reports, enhancing user-friendly adaptability and providing robust decision-making support across different operational domains (Domino et al., 2021).

Lastly, contingent upon the connectivity options available on the Data Lake platform, businessmen within the banking institution may require additional tools to seamlessly integrate the Data Lake with other operational platforms and systems. This integration ensures the comprehensive utilization of data assets across various organizational functions, fostering a cohesive approach to leveraging data-driven insights for strategic decision-making.

In summary, the construction of the adaptive model within the banking sector necessitates a strategic alignment of technological tools and platforms that facilitate efficient data management, analytics, and visualization. By leveraging advanced capabilities offered by cloud platforms and specialized analytics tools, banks can enhance operational agility, foster collaborative information practices, and maintain competitive relevance in today's dynamic financial landscape.

4. IMPLEMENTING THE MODEL

4.1. DATA COLLECTION & MODELLING

4.1.1. Knowledge Acquisition Phase

In the initial phase of knowledge acquisition, it was essential to align the product team's perspective with the theoretical model already described. This alignment was achieved through stakeholder meetings, where key information crucial for model development was obtained.

The model caters to three distinct user groups:

Business Analysts: These users are proficient in directly connecting to Databricks. They can utilize and adapt the model according to evolving needs and changes, ensuring that the model remains relevant and up-to-date.

CFO and Other Stakeholders (Viewers): External to the team, these users can visualize information through a Power BI dashboard shared across the company. This allows them to access critical data without requiring deep technical expertise.

Team Members (Businessmen): While they lack the technical expertise to make changes in Databricks, they can analyze different perspectives using Excel for pivots and information analysis. This capability aligns with their daily operational needs, enabling them to derive insights and make informed decisions.

Data Engineers are primarily involved in the model during the ingestion of new data or when addressing errors or delays in the ingestion routine.

The business needs identified within the product area of the banking sector include:

- The year-to-date volume of commissions from the area
- Monthly commission volume
- Distribution of commissions
- Year-to-date volume of net income
- Monthly net income volume
- Year-to-date volume of transactions
- Monthly transaction volume
- Types of transactions
- Most utilized transaction channels
- Common client transactions
- Monthly acquisition of new products
- Locations of new product sales
- Most frequently used products by clients

- Age demographics contribute significantly to net income, commissions, and transactions
- Percentage increase in usage
- Performance comparisons year-over-year

Upon comprehensively understanding the business context, background, rules, and practices, the team was ready to progress to the subsequent stage.

4.1.2. Modelling Data Mart (Knowledge Representation Phase)

After gaining context and knowledge about the product area, it became possible to identify the key relevant business processes and data required to address the business needs of the product team. Additionally, it was observed that all teams within the bank primarily utilized data and information in Portuguese. Consequently, while the following measures and attributes will be described in English, their names will be retained in Portuguese to maintain consistency with the bank's internal practices and ensure clarity for the teams. This approach ensures that the terminology remains familiar to the bank's personnel while providing the necessary descriptions in English.

In the modeling data mart phase, the focus shifted to representing knowledge through the development of a comprehensive data mart. This phase involved identifying and integrating key business processes and data elements relevant to the product team. The aim was to create a robust and dynamic data model that could effectively support the identified business needs.

Creating a conceptual model representing the business processes and dimensions. This model captured various aspects of product lifecycle, transactionality, commissions, and net income, providing a detailed view of the business operations.

4.1.2.1. Business Processes

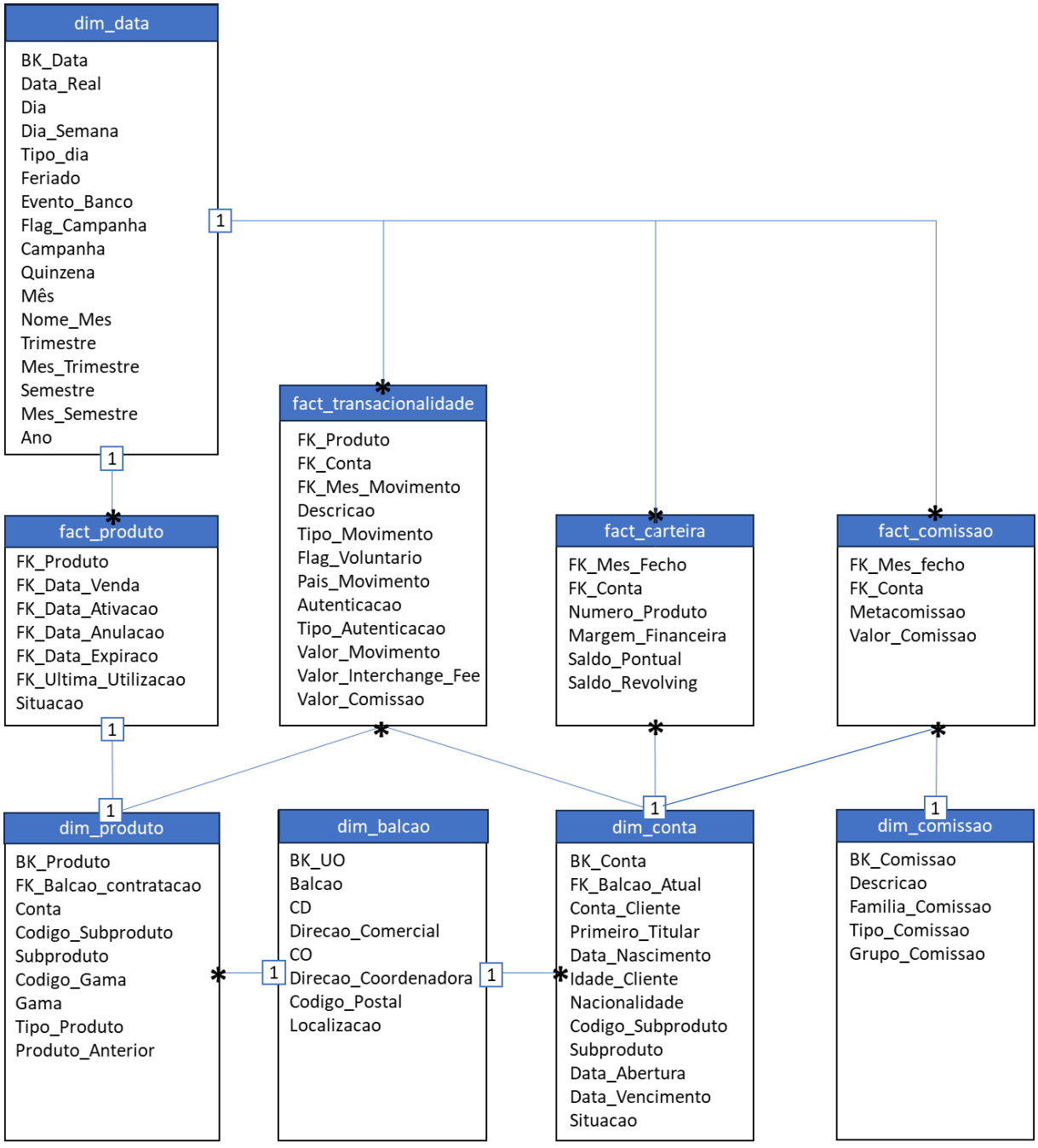
- Product Life-Cycle from 1922 until 2024
- Net Income Information from September 2023 until February 2024
- Commissions from September 2023 until February 2024
- Transactionality from 2022 until 2024

Product would be a purchase made by the client from the banck . The client owns the product for a period of time until it expires (Product Life-Cycle) then it renovates, creating a new product, with a new life-cycle. About the transactionality, the product can be used to make purchases (like with a credit or debit account), loans (like mortgage loan) or insurances (like car insurance). The product generates revenues like commissions/interests. The interest is a revenue, but as banks have funding costs, the difference between the interest and the funding cost is the Net income.

4.1.2.2. Schema

The schema implemented for the Product Data Mart is the snowflake schema as displayed in figure 4.1. As detailed by Allam, Ankam, and Nalmala (2023) in their study titled "Snowflake is transforming Big Data Management". This schema facilitates lighter storage of tables and enables expedited computation through "Near-Infinite Scalability".

Figure 4. 1 – Dimensional Model



4.1.2.3. Grain

To accurately delineate the records associated with each business process, it is imperative to establish the granularity of each fact table. The granularity refers to the level of detail or specificity at which data is recorded in the fact tables. It determines the scope and depth of analysis that can be performed on the data. The granularity of various business processes within the system is elucidated as follows:

- **Product Life-Cycle:** Produto (Produto, Conta); Data_Venda (Dia, Dia_semana, Quinzena, Mes); Data_Ativacao (Dia, Dia_semana, Quinzena, Mes); Data_Expiracao (Dia, Dia_semana, Quinzena, Mes); Data_Anulacao (Dia, Dia_semana, Quinzena, Mes); Ultima_Utilizacao_POS (Dia, Dia_semana, Quinzena, Mes);
- **Product Transactionality:** Conta (Conta, Conta_Cliente, Cliente); Produto (Produto, Conta); Mes_Movimento (Mes, Trimestre, Semestre, Ano).
- **Net Income Information:** Conta (Conta, Conta_Cliente, Cliente); Mes_Movimento (Mes, Trimestre, Semestre, Ano).
- **Comissions:** Mes_Fecho (Mes, Trimestre, Semestre, Ano); Conta (Conta, Conta_Cliente, Cliente); Comission_ID (Descricao; Familia_Comissao; Tipo_Comissao; Grupo_Comissao).

Furthermore, due to the utilization of the Snowflake Schema, dimensions of accounts and products exhibit a more complex granularity, despite not being directly associated with specific business processes.

- **Account:** Balcao_atual (Balcao, Direcao Comercial, Direcao Coordenadora).
- **Product:** Balcao_contratacao (Balcao, Direcao Comercial, Direcao Coordenadora).

4.1.2.4. Fact Tables

Four distinct business processes are delineated through four respective fact tables, each representing a unique aspect of the organization's operations. These fact tables provide a structured and detailed view of various key performance indicators and metrics relevant to their respective processes.

fact_produto

The Product Lifecycle is summarized within the fact_produto table (table appendix.1). This table comprehensively records pertinent temporal milestones throughout the lifecycle of a given product, encompassing stages such as sale, activation, utilization, and termination through annulment or expiration. Moreover, it includes the current status of the product, indicating whether it is active, inactive, or cancelled, among other states.

This dataset spans product transactions from the year 1992 to 2024. The primary key of the table is composed of the dates and the Product ID, ensuring unique identification of each record.

fact_carteira

The Net Income information is summarized within the fact_carteira table (table appendix.2). This table provides comprehensive details regarding the net income of products, aggregated by account and month. It encompasses records spanning from September 2023 to February 2024.

Key attributes of this table include the account number, net income volume, and associated drivers such as the number of products within the account, current balance, and revolving status.

fact_transacionalidade

The representation of Product Transactionality is summarized within the fact_transacionalidade table (table appendix.3). This dataset provides comprehensive insights into all transactions conducted by-products from the year 2022 to 2024, aggregated by month.

Key attributes of this table include the product and account numbers associated with each transaction, alongside transaction-specific characteristics such as transaction type, country of origin, channel of transaction, authentication method, and payment method. Additionally, the table includes transaction volume, the count of transactions made by each product in each month, and earnings derived from transactions, including interchange fees and applied commissions.

fact_comissao

The fact_comissao table represents commissions within the model and constitutes the least complex fact table (table appendix.4). It delineates commissions generated by account, aggregated monthly, spanning from September 2023 to February 2024.

This table provides information on the volume of commissions generated and includes descriptions of each commission.

4.1.2.5. Dimension Tables

Dimension tables serve the essential purpose of describing the various aspects of a business process and primarily function to support filtering operations. These tables provide contextual information that allows users to slice, dice, and analyze the data in the fact tables more effectively.

dim_produto

The dim_produto table (table appendix.5) serves as the dimension describing products within the system. This table encompasses attributes such as the product number, product identification and description, previous product number indicating whether it is a new product or a substitution, and the location where the product was sold.

dim_conta

The dim_conta table (table appendix.6) captures information about accounts within the system. It comprehensively includes details such as account characteristics, account life cycle, status, associated product, current branch allocation, and account owner (client).

A significant distinction between dim_produto and dim_conta lies in their life cycles. While the product life cycle is crucial for analysis and is represented within the fact_produto table, the account life cycle primarily serves as a filtering mechanism and is presented within dim_conta.

dim_balcao

dim_balcao serves as a subdimension capturing the characteristics of branches within the system. This dimension (table appendix.7) encompasses attributes related to the branch's commercial and coordinating management, as well as its respective localization.

dim_comissao

dim_comissao represents the Commission's dimension within the system. This dimension provides additional information regarding product commissions, including their descriptions and the commission group to which they are allocated (table appendix.8).

dim_data

dim_data serves as a date dimension within the system, offering granularity down to the day level (table appendix.9). This dimension comprehensively describes each day, providing information such as the day of the week, fortnight, and month in which it is allocated. Additionally, dim_data includes pertinent details such as whether the day is a workday, holiday, or weekend, as well as any ongoing product campaigns or events such as the launch of a new product. Furthermore, this dimension describes each month, including attributes such as the month, the trimester, the semester, and the year to which it belongs. Additionally, it indicates the sequence number of each month within its corresponding trimester, semester, and year.

4.1.2.6. Hierarchies

Hierarchies comprise various levels of a dimension attribute and establish many-to-one relationships among these levels. The definition of hierarchies facilitates data analysis across different levels of granularity.

Product Dimension

The hierarchies within the product dimension aid in categorizing all products according to their associated accounts (figure 4.2) or grouping them based on their product type, subproduct, family, and category (figure 4.3). This hierarchical structure provides a more aggregated perspective on product data.

Figure 4. 2 – Product Hierarchy

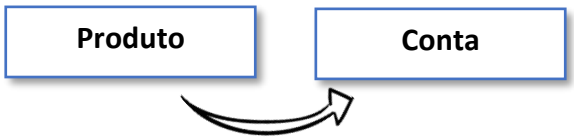
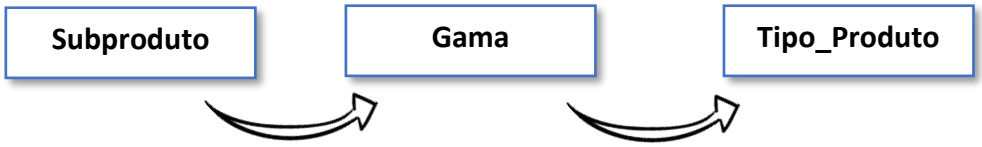


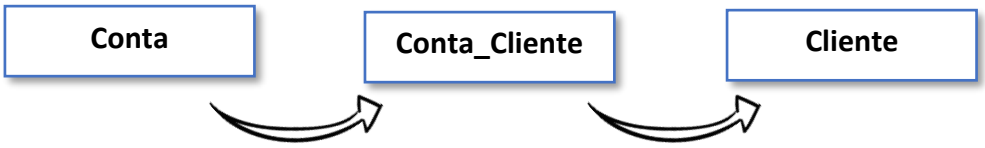
Figure 4. 3 - Product Type Hierarchy



Account Dimension

The account hierarchy (figure 4.4) enables users to analyze transactionality, net income, and commissions by grouping measures according to account, client's account, and client.

Figure 4. 4 – Account Hierarchy



Branch Dimension

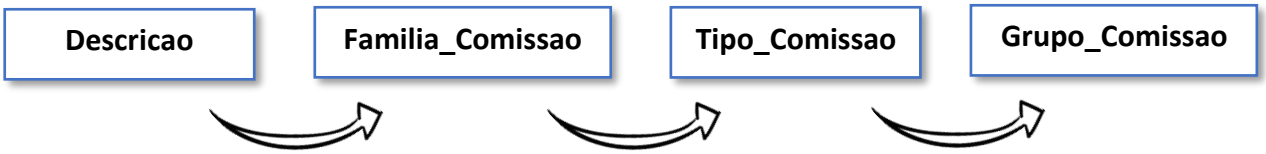
The branch hierarchy (figure 4.5) facilitates the analysis of all business processes by grouping records based on branch, commercial management, and coordinating management. As a subdimension within a snowflake schema, it maintains relationships with product and account dimensions, thus linking to the corresponding fact tables associated with those dimensions.

Figure 4. 5 – Branch Hierarchy

Commissions Dimension

The commission dimension showcases descriptions derived from products. Notably, commissions are categorized into groups, some directly linked to the product while others indirectly related. Within each group, various types of commissions are further segregated by commission family. As such, the commission hierarchy (figure 4.6) facilitates the analysis of commissions, enabling aggregation by description, family, type, and group.

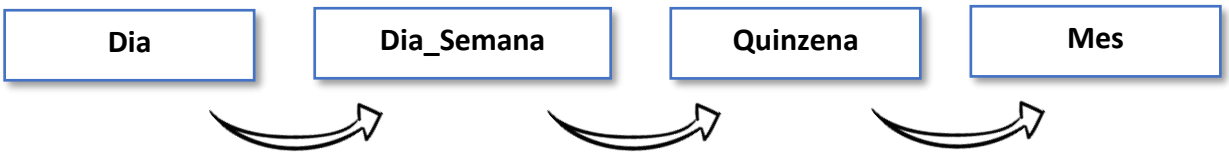
Figure 4. 6 – Commission Hierarchy



Date Dimenion

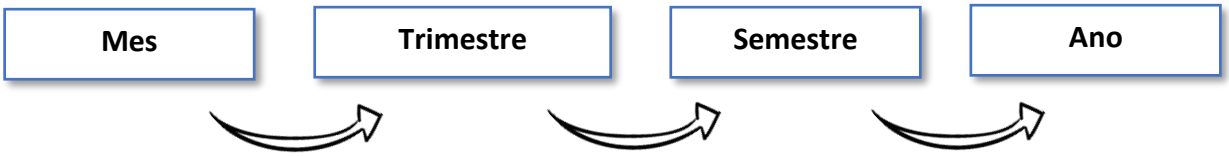
The day hierarchy (figure 4.7) enables users to analyze the product life cycle and transaction occurrences by day, weekday, fortnight, and month. This hierarchical structure facilitates the identification of patterns and trends throughout the month.

Figure 4. 7 – Day Hierarchy



The month hierarchy (figure 4.8) enables users to analyze information regarding transactionality, net income, and commissions by month, quarter, semester, and year. This hierarchical structure facilitates the identification of patterns and trends throughout the year.

Figure 4. 8 – Month Hierarchy



4.1.3. Integration with the Data Mart (Knowledge Management Phase)

Following the design of the data mart model, the next critical task involves establishing connections to the necessary platforms to ensure seamless data flow and accessibility. This phase is pivotal for enabling comprehensive data analysis and visualization, which are integral to meeting the identified business requirements.

Azure plays a central role in this integration, offering robust support for connecting the data mart with Power BI. This connectivity allows for the creation of dynamic reports and dashboards directly linked to the data mart, providing real-time insights and a comprehensive view of the business metrics. These visual representations are essential for addressing the business requirements identified earlier, as they enable stakeholders to monitor key performance indicators and make informed decisions.

For businessmen, establishing a connection from the data mart to Excel is equally important. Each team member needs this connection to perform detailed analysis and create custom reports. Initially, the IT department within organizations must assist in ensuring that business users are successfully connected to the data mart. This initial setup includes configuring user access and establishing secure connections. Once the initial connection is established, business users can independently refresh data, leveraging their credentials to maintain up-to-date analyses.

Following the design and construction of the data mart model, Chapter 4 of this study focuses on the empirical application of the model using real-world data from a banking sector company, specifically from the product area perspective.

4.2. APPLYING DATA

Although Mahdawi (2022) highlighted AWS as a viable cloud platform, it was not available for use during the development phase of this model. As a result, the project will utilize Microsoft Azure, specifically leveraging Azure Data Bricks as the primary data repository. This decision aligns with the project's requirements and ensures a robust and scalable infrastructure for data management.

Microsoft Azure Data Bricks offers a versatile platform that integrates a wide range of data sources within a cohesive Data Lake framework. This integration is crucial for managing large volumes of data efficiently and ensuring that disparate data sources can be seamlessly unified.

4.2.1. Data Source and Transformations

The Data Lake infrastructure will act as a staging area, housing both transformed tables and raw tables sourced from the company's central platform, as well as tables provided by the team through the workbench. This staging area is essential for organizing and processing diverse data sources before they are utilized for analysis and reporting.

The transformation and integration of these varied data sources were executed within the Databricks Workbench environment. The following methodologies were employed to ensure the data was suitable for the intended analytical purposes:

- Filtering Tables: Selectively retaining information relevant to the product domain to maintain focus and avoid unnecessary complexity.
- Removing Redundant Columns: Eliminating columns containing extraneous information to streamline the datasets and enhance processing efficiency.
- Concatenating Columns: Consolidating related data fields to simplify the structure and improve data readability.
- Renaming Columns: Enhancing clarity and consistency by assigning meaningful names to columns.
- Aggregating Information: Summarizing data based on specified levels of granularity to provide meaningful insights at the required detail levels.
- Deduplicating Tables: Removing redundant records to ensure data accuracy and reliability.
- Applying Filters: Ensuring that only current and updated data is included in the analysis, thereby maintaining data relevance.
- Enriching Data: Merging codes with their corresponding descriptions to enhance interpretability and usability of the data.
- Creating Computed Columns: Adding calculated fields to facilitate specific analyses, such as determining client age, setting flags, and grouping data by counts.

Upon completion of these transformations, four fact tables and five-dimension tables were generated. These tables collectively capture various aspects of the product business processes, providing a robust foundation for in-depth analysis and reporting.

The fact tables are designed to store quantitative data related to business processes, while the dimension tables provide contextual information that allows for comprehensive and multidimensional analysis. This structured approach ensures that the data is well-organized and readily accessible for business intelligence applications, enabling stakeholders to derive actionable insights and make informed decisions.

By employing these methodologies within the Databricks Workbench environment, the project ensures that the data is not only clean and well-organized but also enriched and optimized for analytical purposes. This thorough data preparation process is critical for the

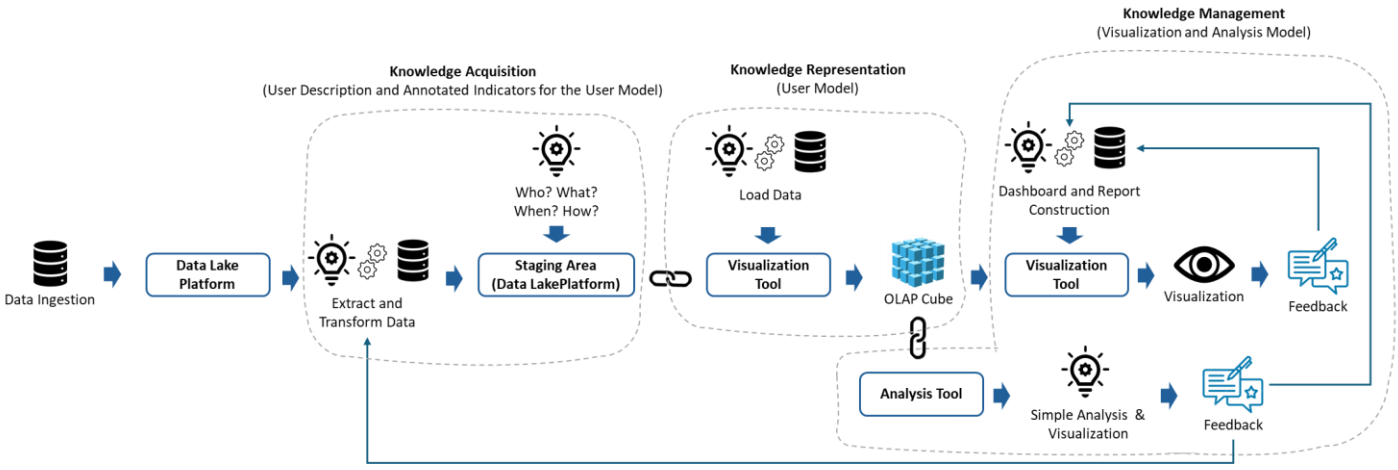
successful implementation of advanced analytics and business intelligence solutions, ultimately driving better business outcomes.

4.2.2. Data Mart Construction and Connectivity

Despite encountering limitations on platform accessibility, developing the semantic model directly on Databricks proved unfeasible. While the construction of fact and dimension tables was achievable, Databricks lacked support for relational models or hierarchies. Therefore, its primary role was confined to serving as a staging area and facilitating the creation of essential tables, programming workflows, and routines for data updates.

As a consequence, the adaptive model (Figure 4.9) required adaptation, with Power BI emerging as the preferred tool within the organization for working with relational tables.

Figure 4. 9 – Adaptive Model Adaptation

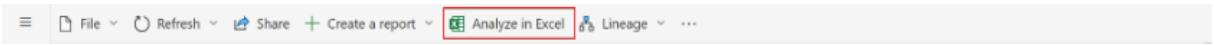


In practice, the Data Lake functioned as the principal data source, Databricks served as the staging environment, and Power BI—with its seamless integration capabilities with Databricks—functioned as the platform where relationships and hierarchies were established to construct the data mart, ultimately culminating in the creation of the Product OLAP Cube.

Upon completing the OLAP Cube, the next crucial step involved establishing necessary connections. However, due to the necessary adjustments, direct connectivity from Databricks to Excel became less practical. The relational tabular model was now housed within Power BI, making it possible to connect Excel to the physical model but lacking access to the semantic model. This setup would result in the loss of crucial elements such as relationships, hierarchies, Key Performance Indicators (KPIs), and measures utilized within Power BI.

To address this challenge effectively, businessmen required direct access to the semantic model residing in Power BI. The entire model's functionality could be explored within an online workspace (as depicted in Figure 4.10), where Power BI generates an Excel workbook and saves it to the businessman's OneDrive or SharePoint account. This underscores the significance of cloud-based tools in fostering collaboration and driving digital transformation initiatives.

Figure 4. 10 – Selection of Analyze in Excel on PowerBI



However, to leverage this feature, businessmen would need access to the appropriate workspace. Originally, the plan was to publish within the company's common workspace, allowing business analysts and the Business Intelligence (BI) team to collaborate on dashboard development. Yet, granting businessmen access to this shared workspace posed potential challenges such as confusion, complexity, and security risks, given its broader scope beyond product-specific information.

A viable alternative would be to establish a dedicated workspace specifically for the Product team, ensuring that the model and associated dashboards are published there. This approach would streamline access for businessmen, enabling them to utilize the "Analyze in Excel" functionality without compromising security or encountering unnecessary complexity.

Importantly, these adjustments do not impact viewers, who will continue accessing finalized dashboards online without requiring access to the underlying workspace. This approach maintains simplicity for end-users while ensuring that business stakeholders have the tools and access needed to drive informed decision-making and operational efficiency within the organization.

4.3. Validation and Maintenance

Validation Process

Upon completion of all steps in the model, both viewers and businessmen are tasked with validating the accessible information. This validation phase is critical to ensure the accuracy, relevance, and usability of the information provided by the system.

Businessmen play a particularly significant role in this phase. Leveraging their deep business knowledge and autonomy, they create their visuals in Excel, ensuring that the data is presented in a manner that is meaningful and actionable. By accessing the workspace and

utilizing commenting capabilities, they can provide detailed feedback, suggest improvements for visualization, and identify any errors or inconsistencies in the information. This process is vital for refining the model and ensuring it meets the practical needs of the business.

Even though viewers may lack the technical expertise to validate the information thoroughly, they contribute by providing feedback on the interpretability of the dashboard. They can identify typographical errors, comment on the overall clarity of the visuals, and offer general feedback on usability. This input helps to ensure that the dashboard is user-friendly and accessible to a broader audience.

Addressing Issues

Several problems encountered in the OLAP Cube require correction to ensure data integrity and accuracy:

- **Duplicated Information**: Errors in table relations can lead to duplicated information within dimensions, which must be resolved to maintain data consistency.
- **Discrepancies from Different Sources**: Inconsistencies in information from various sources need to be identified and rectified.
- **Data Transformation Errors**: Mistakes during data transformation, such as applying incorrect queries (e.g., using AVG instead of SUM or MAX instead of MIN) or summing the wrong columns, must be corrected to ensure accurate data representation.

One of the primary challenges encountered during the development of visualizations was related to usability, particularly when selecting filters. Some dimensions contained information unrelated to products, causing confusion and difficulty for viewers when navigating through the available filters. Addressing this issue involves refining the filters to ensure they are relevant and intuitive for users.

Transfer to the Business Analyst Team

After developing the artifact, it was transferred to the current business analyst team within the product team. To ensure effective project maintenance, a dedicated workbench was established where all queries were developed and stored. These queries were written in SQL and included comprehensive comments and reviews. This meticulous documentation was intended to prevent future uncertainties and facilitate understanding for future users, particularly business analysts. This setup not only ensures the continuity of knowledge but also allows for adaptation to future needs and challenges.

Moreover, the metadata associated with these queries was shared with the team, providing additional context and clarity. Another significant advantage of using Databricks is its inherent

flexibility. Even if future business analysts prefer languages such as Python, the platform accommodates this by supporting the creation of tables through notebooks. Additionally, Databricks enhances efficiency and routine management by allowing tables to be automated through the creation of job routines. This adaptability ensures that the platform remains a robust and versatile tool for handling evolving business requirements.

Conclusion of Validation Phase

In conclusion, the validation process is a critical step in ensuring the accuracy and usability of the information provided by the model. Businessmen and viewers both play essential roles in this process, contributing their expertise and feedback to refine the model. Addressing issues in the OLAP Cube, usability challenges in visualizations, and ensuring effective project maintenance through comprehensive documentation and flexible platforms like Databricks are all crucial for the project's success. By doing so, the project not only meets its immediate objectives but also ensures long-term adaptability and relevance in an ever-evolving business environment.

5. RESULTS AND DISCUSSION

5.1. CONFIDENTIALITY

At the beginning of the project, the bank authorized the use of their data and the development of the project on their platform. However, due to confidentiality agreements, I am unable to disclose the name of the bank or display the actual screens of the developed dashboards. Consequently, during our discussion, I will present blurred versions of the screens alongside their corresponding mockups. This approach will enable us to effectively discuss the project details while adhering to the confidentiality requirements.

5.2. COMPARING RESULTS WITH PRIOR RESEARCH

Throughout the course of project implementation, the emphasis on fostering cross-functional collaboration across diverse stakeholders from various departments, both within and outside the product team, emerged as crucial for achieving the desired outcomes. This collaborative approach not only facilitated the necessary adjustments to the project methodology as implementation progressed but also yielded invaluable insights that directly influenced the subsequent results and conclusions drawn from the study.

Enhancing Cross-Knowledge Integration

During the initial phases of conceptualizing the model, there was a prevailing perception that data engineers played a secondary role compared to businessmen, who were primarily viewed as auxiliary analysts supporting the core activities of business analysts. However, as the model unfolded and was put into practice, it became increasingly evident that both data engineers and businessmen play critical and substantial roles throughout the process. While business analysts typically bear the primary responsibility for constructing and maintaining the model, the integration of both data engineers and businessmen proved indispensable to the model's comprehensive development and ongoing refinement.

Despite businessmen typically having lower technical proficiency compared to data engineers, they are pivotal in initiating analyses and adapting them to align with daily business operations. The dynamic nature of adaptive models underscores the continual need for adjustments, not only for new analyses but also for refining existing ones based on real-time business insights. This underscores the importance of businessmen possessing a certain level of technical acumen to facilitate effective communication with data engineers and enhance the relevance and applicability of analytical outcomes.

Data engineers contribute significantly by leveraging their expertise in managing table repositories and metadata, which are essential for maintaining data integrity and facilitating agile responses to evolving business needs identified by businessmen. Their role extends to

implementing changes prompted by shifts in business processes, thereby ensuring that the model remains responsive and aligned with organizational objectives. The collaborative effort between data engineers and businessmen is further enhanced by their shared understanding of business operations, allowing them to detect errors and collaborate effectively to optimize the model's performance over time.

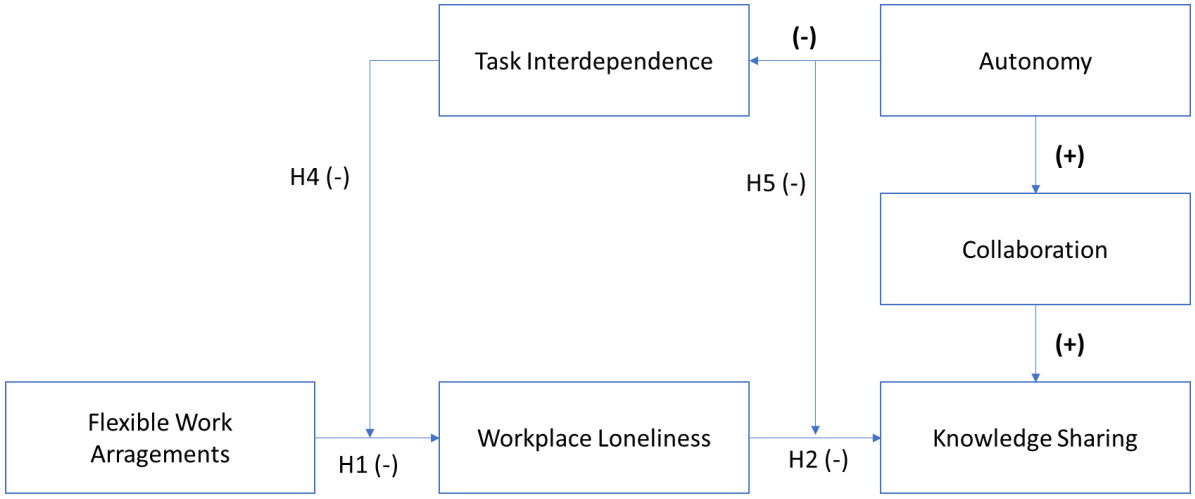
The collaborative interactions between businessmen and data engineers are not only crucial for ongoing model maintenance and improvement but also underscore the importance of all users possessing a blend of business acumen and technical skills relevant to their respective roles within the organization. This interdisciplinary knowledge-sharing aligns closely with the findings of Mujanah, Riyadi, and Sjachriatina (2022), who advocate for fostering a culture of knowledge-sharing, investing in knowledge-oriented leadership, integrating digital technologies, and enhancing employee skills to gain a sustainable competitive advantage in the banking sector.

Balancing Collaboration with Autonomy

One of the significant benefits of the adaptive model lies in its ability to enhance information accessibility for businessmen and other stakeholders, thereby breaking down traditional barriers and empowering businessmen to conduct independent analyses. This increased autonomy not only fosters enhanced collaboration within teams but also allows businessmen to complement the efforts of business analysts and collectively refine the model based on their unique insights and perspectives. These observations resonate strongly with research findings by Chen, Fu, and Hua (2021), highlighting that removing barriers to information sharing promotes synergies and supports sustainable growth within organizations. Additionally, insights from Hansen and Talja (2006) corroborate this notion by suggesting that systems facilitating collaborative information-seeking and retrieval significantly enhance task efficiency and problem-solving capabilities across teams.

In contrast to findings by Cheng et al. (2023), instead of emphasizing interdependence, the adaptive model places a strong emphasis on minimizing barriers and promoting autonomy among users. This strategic approach contributes to improved performance metrics, reduced interdependencies, and strengthened interactions among team members, ultimately fostering more effective teamwork and continuous refinement of the adaptive model. However, this doesn’t invalidate Cheng et al (2023) model, otherwise it complement it by adding Autonomy as illustrated in figure 5.1.

Figure 5. 1 – Adding Autonomy to the Theoretical Model from Cheng et al (2023)



Interaction vs Visualization

Another significant observation from the study is the higher level of interaction and feedback among businessmen who accessed information via Excel compared to viewers. The detailed data provided by Excel facilitated easier validation of information, enhancing their ability to verify and interpret data compared to relying solely on visualization. This finding resonates with existing research indicating that individuals with limited technical skills may find traditional dashboard systems challenging to navigate and comprehend effectively (Bezerianos & Elias, 2011).

Moreover, it underscores the tendency of businessmen accustomed to performing daily analyses using Excel to engage more actively with familiar tools. This engagement is supported by their proficiency in leveraging both verbal and visual working memory, as well as their deep user expertise developed over time (Carenini et al., 2012). The preference for Excel among businessmen highlights its role not only as a tool for data analysis but also as a platform that supports their cognitive processes and decision-making capabilities within the banking sector.

5.3. Project Evaluation and Discussion

Objective Achievement and Impact

The primary aim of this project was to enhance information accessibility within the banking sector, with a specific focus on the product area. This encompassed addressing how organizations can facilitate easier access to information among team members and devising strategies to tailor information to meet their specific needs based on their technical skills.

The implementation of the project centered on providing the product team with centralized access to information through the development of a robust data mart. This centralized repository streamlined data access by offering tailored connections that catered to the diverse

needs of users. Such an approach empowered users to leverage information more effectively, adapting it to their familiar analytical methods, whether for routine daily analyses or more intricate data interpretation and visualization tasks according to their specific requirements.

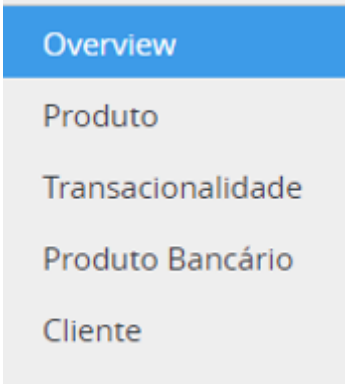
For businessmen within the organization, the project emphasized the provision of direct connectivity through Excel. This strategic approach aimed to empower businessmen to independently construct and customize their analyses. Recognizing their proficiency in using Excel for detailed data exploration and interpretation, this approach enabled them to bypass predefined visualizations and delve deeper into the data.

Conversely, viewers accessed information through a purpose-built Power BI dashboard featuring five distinct screens. Each screen was meticulously designed to present detailed insights derived from the primary fact tables, supplemented with relevant information from dimension tables. Notably, this dashboard was tailored in Portuguese, the operational language of the bank, to optimize comprehension and usability for viewers across the organization.

The initial screen serves as an overview, summarizing pertinent information extracted from all fact tables. Subsequent screens delve deeper into specific dimensions, providing comprehensive insights and facilitating detailed analysis relevant to the roles and responsibilities of the viewers.

This structured approach ensures that viewers have access to comprehensive and actionable information, thereby supporting informed decision-making and strategic planning within the organization. By enhancing information accessibility and customization capabilities, the project not only addresses immediate operational needs but also strengthens the organization's analytical capabilities and overall competitiveness in the dynamic banking sector landscape.

Figure 5. 2 – Mockup Dashboard Five Screens



The Overview screen (Figure 5.3 – Overview Blurred Screen, and Figure 5.4 - Overview Mockup Screen), as previously mentioned, serves as a consolidated summary of the key metrics extracted from all primary fact tables, prioritizing measures over the intricacies of dimension details. This screen is strategically designed to provide stakeholders with a high-level snapshot of critical performance indicators and essential data points across various operational facets within the banking sector.

Through its design, the Overview screen aims to streamline information consumption for users, allowing them to grasp essential trends and patterns briefly. This approach is particularly valuable for executives, managers, and other decision-makers who need to stay informed about the organization's performance without delving into detailed dimensional data.

Figure 5. 3 - Overview (Blurred Screen Version)

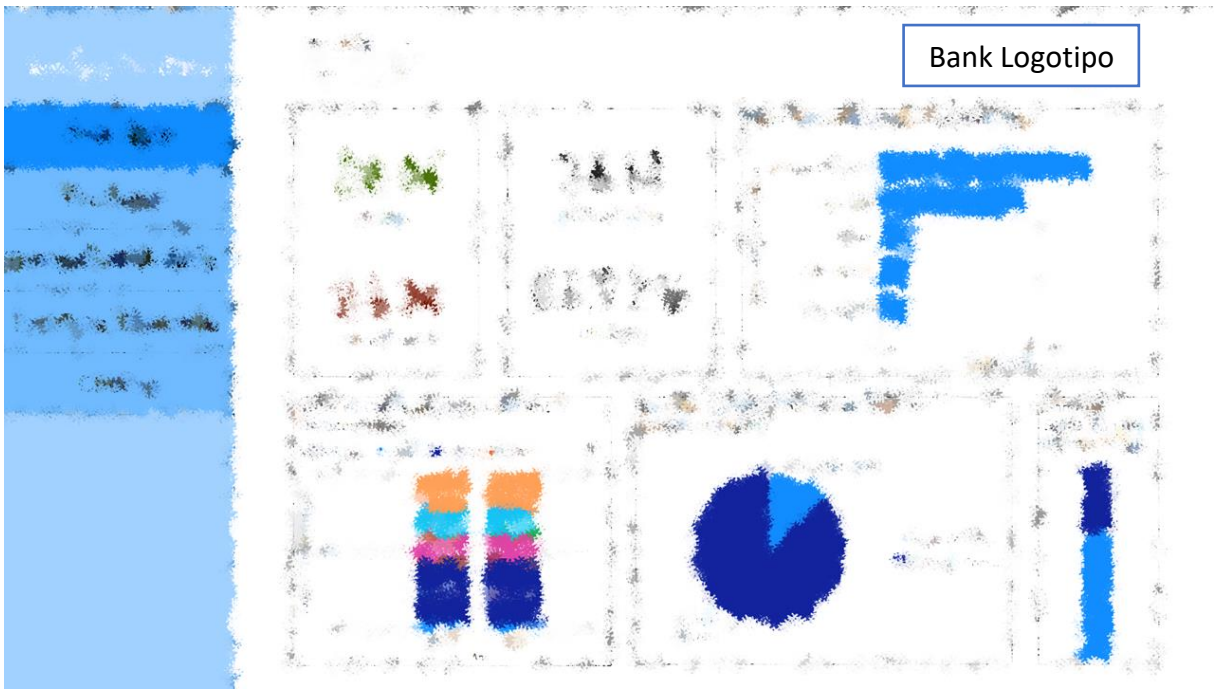
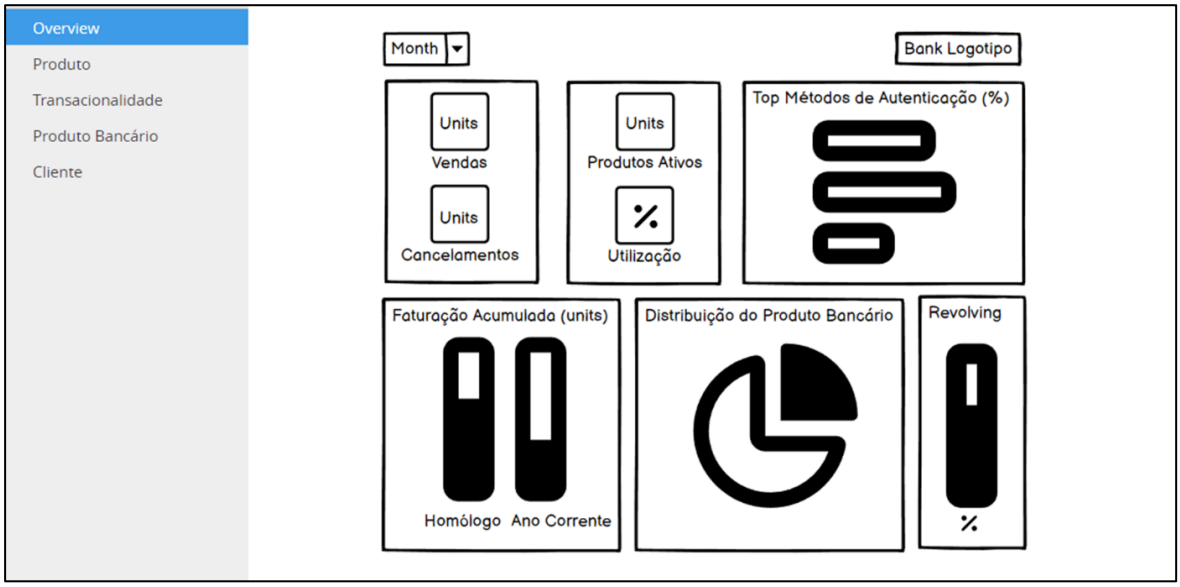


Figure 5. 4 – Overview (Mockup Screen Version)



In the dashboard's initial sections, two distinct areas feature cards displaying key performance indicators (KPIs). These cards use a color-coded system, with KPIs highlighted in red or green based on whether their measures exceed the year-to-date (YTD) average. It's important to note that both the averages and the metric labeled "Utilização" are calculated outside the relational model discussed in Chapter 4.

Additionally, the overview section includes a bar chart showcasing the top five authentication methods based on their frequency. The section labeled "Faturação Acumulada" presents stacked columns illustrating the cumulative billing amount distributed across different transaction types, comparing YTD figures with the previous year (YTD-1). Another stacked column labeled "Revolving" displays the percentage of revolving balance relative to the current balance. Furthermore, a pie chart provides a visual breakdown of commissions and net interest distribution.

To facilitate dynamic data exploration, a month combo box is prominently featured across all dashboard screens. This interactive element allows viewers to select the specific month for which they wish to view cumulated information, enhancing usability and relevance.

Moving to the "Produto" screen (Figure 5.5 as blurred screen and Figure 5.6 as Mockup Screen), viewers gain access to more detailed insights from the "fact_produto" dataset. This screen serves as a gateway to explore comprehensive product-related information, enabling deeper analysis and understanding of product-specific metrics and trends within the banking context.

Figure 5. 5 – Produto (Blurred Screen Version)

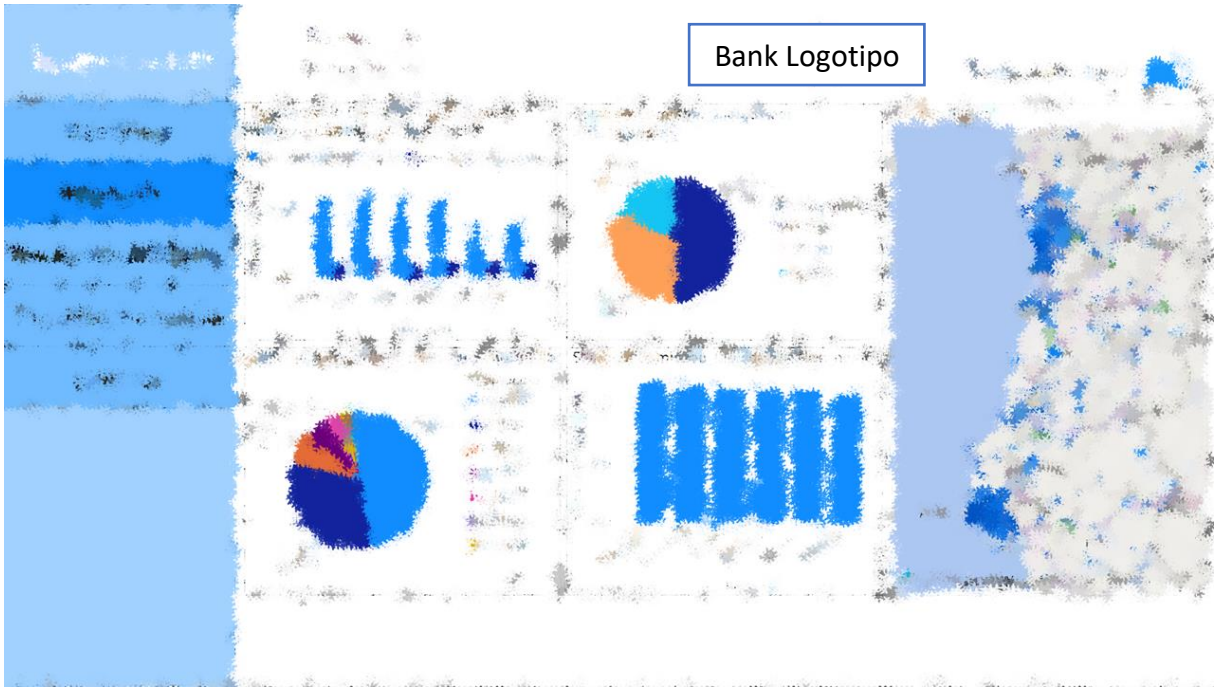
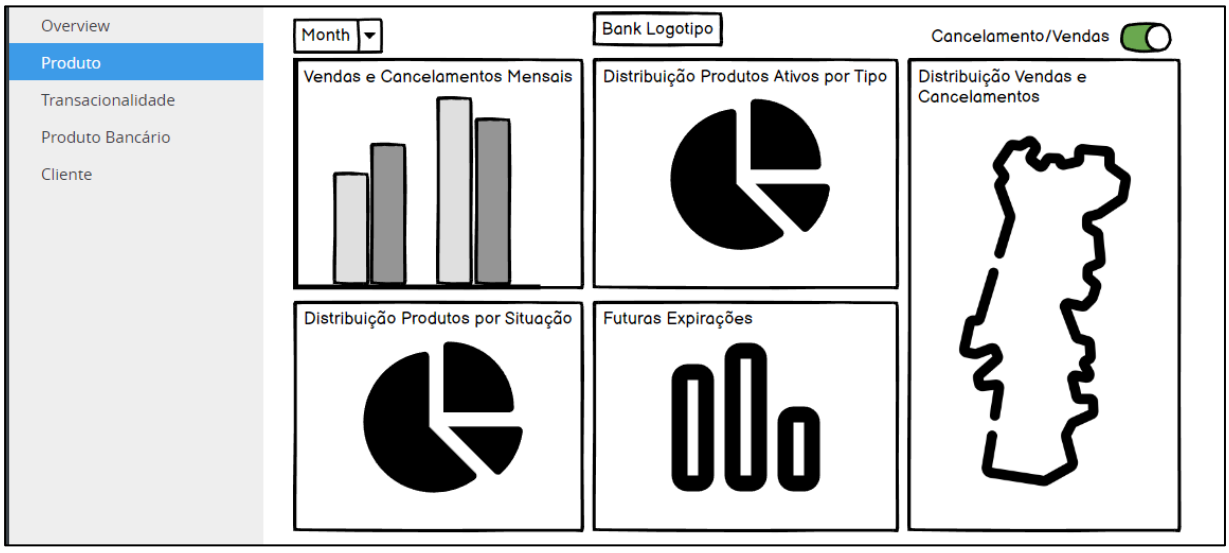


Figure 5. 6 – Produto (Mockup Screen Version)



In this particular screen, detailed insights into the product life cycle are provided, integrating key metrics with dimensions from both the date and product dimensions. The data is aggregated by month and year for the date dimension, while for the product dimension, it's categorized by branch localization and product type.

The first column chart illustrates the evolution of sales and churn over closed months. It offers insights into how these metrics have fluctuated over time, providing a comparative view of product status distributions. This distribution focuses specifically on activated products, categorizing them by product type using separate pie charts. Another aspect addressed in this chart is the quantity of expired products in upcoming months, as represented by the "Data_Expiração."

The map feature enhances visualization by depicting the geographical distribution of sales and churn across Portugal. Users can toggle between views to analyze both metrics within different regions of the country, providing a spatial perspective on performance trends.

Moving to the third screen (Figure 5.7 as blurred screen and Figure 5.8 as mockup screen), the "Transacionalidade" section draws insights from the "fact_transacionalidade" and "fact_carteira" datasets. It offers detailed information regarding the transactions associated with the product and the credit utilized for these transactions. This screen enables deeper exploration into transactional patterns and credit utilization dynamics, supporting informed decision-making related to product management and strategy.

Figure 5. 7 – Transacionalidade (Blurred Screen Version)

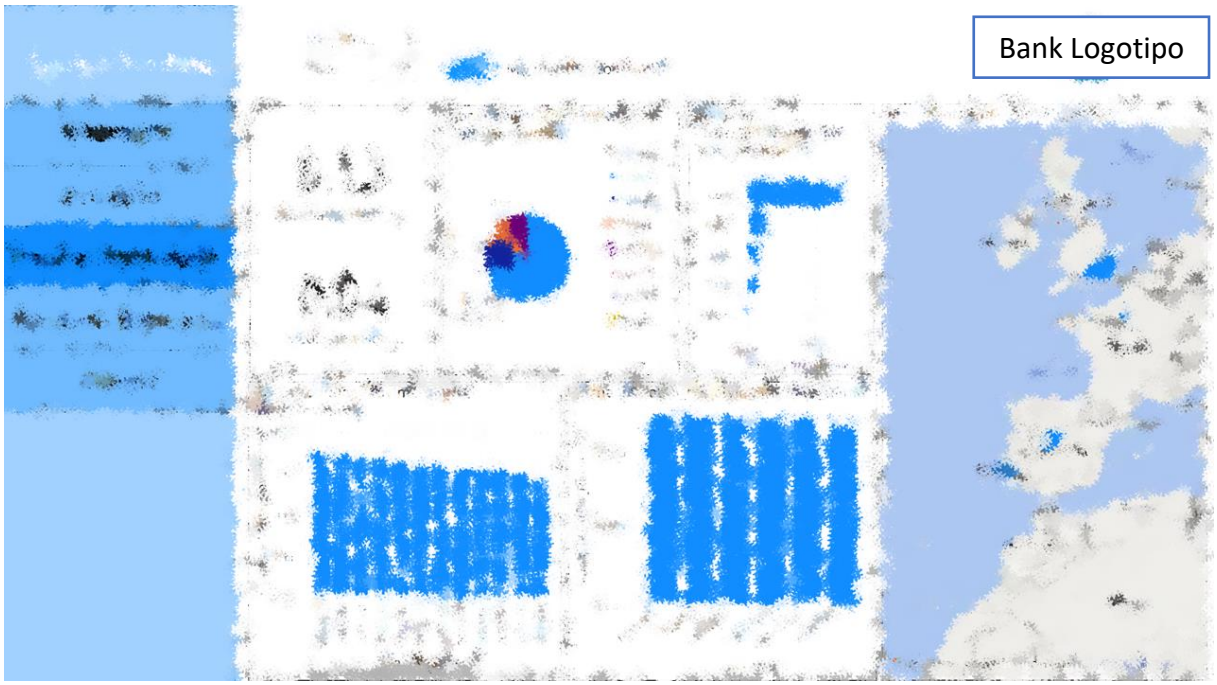
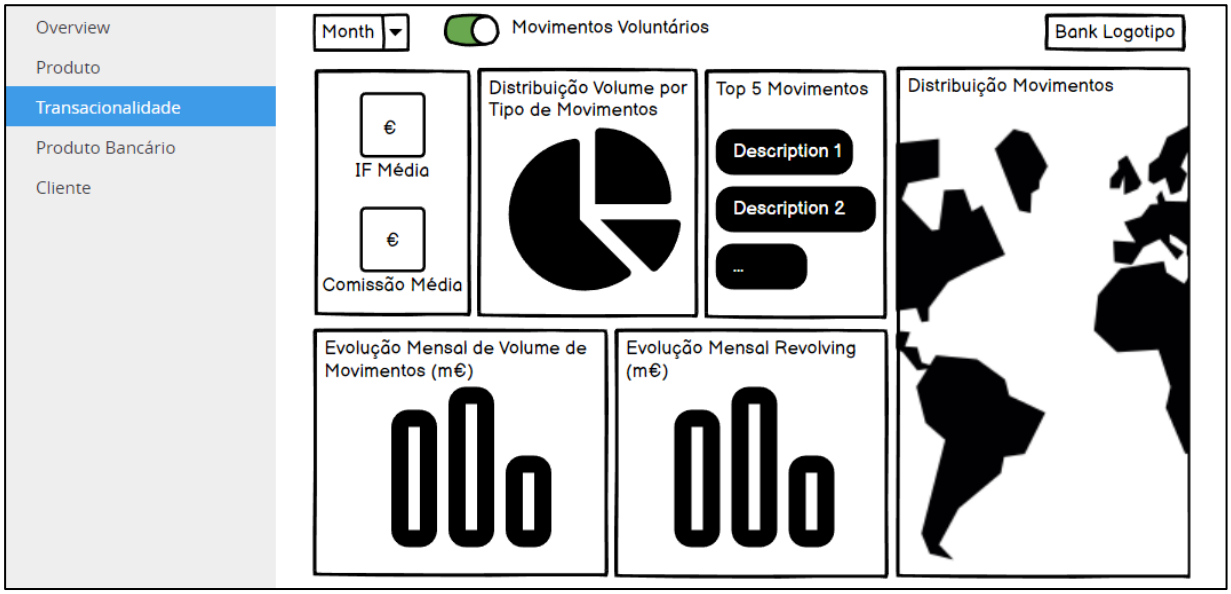


Figure 5. 8 – Transacionalidade (Mockup Screen Version)



In this screen, users can access a variety of key insights and metrics related to banking operations. It features two card elements displaying the average commission and interchange fee per operation, providing a quick overview of financial metrics associated with transactions. Additionally, a pie chart illustrates the distribution of billing amounts categorized by operation type, offering a visual breakdown of revenue sources. A bar chart complements this by highlighting the top five most frequent operation descriptions recorded.

Two column charts depict the monthly evolution of billing amounts and revolving balances, enabling users to track trends over time and identify seasonal variations in financial activities. The world map visualization offers geographical insights, showcasing the countries where clients predominantly conduct their operations, thereby supporting strategic decision-making based on regional transaction patterns.

Users can toggle between viewing all voluntary operations such as payments or transfers, accessed via a top-screen button. Conversely, deactivating this option reveals all operations, including non-voluntary transactions like commissions or taxes associated with the product.

This screen integrates data from multiple sources, leveraging measures and attributes from two distinct fact tables. It incorporates detailed information from the date dimension to provide comprehensive insights into transaction volumes, revenue streams, and operational trends within the banking sector.

Moving to the "Produto Bancário" screen (Figure 5.9 as Blurred Screen and 5.10 as Mockup Screen), it focuses on banking product revenues generated by the bank, consolidating data from "fact_comissao" for commissions and "fact_carteira" for net interest. This screen enables a detailed exploration of revenue sources tied to banking products, facilitating

strategic analysis and decision-making related to product profitability and financial performance.

Figure 5. 9 – Produto Bancário (Blurred Screen Version)

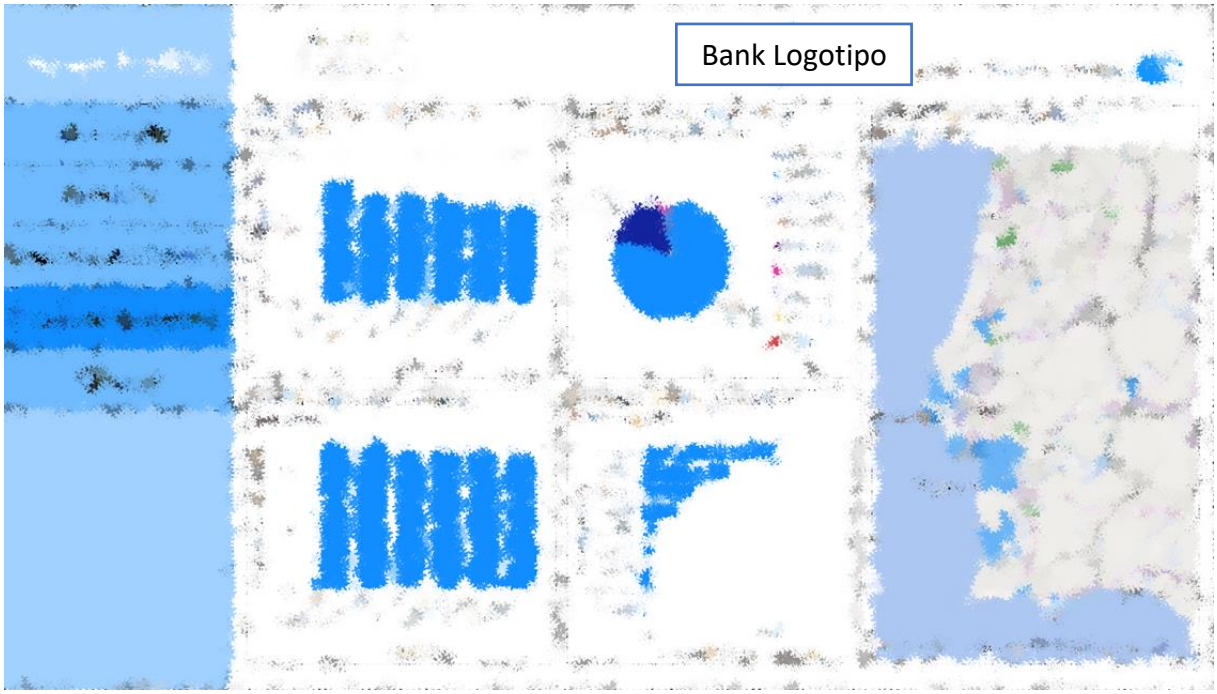
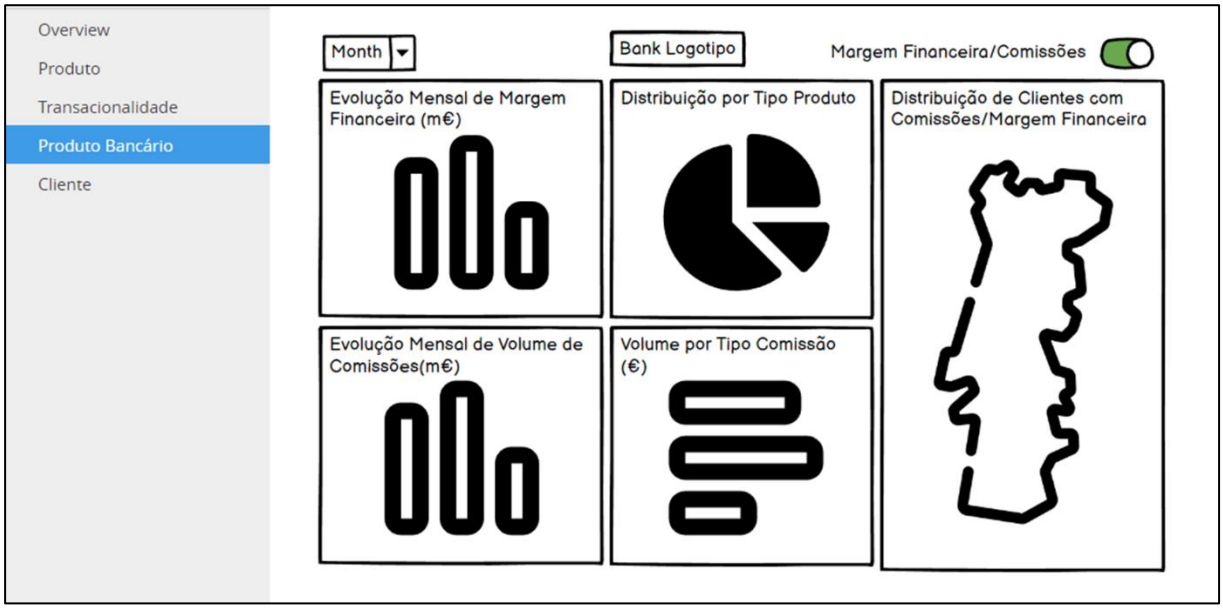


Figure 5. 10 – Produto Bancário (Mockup Screen Version)



This screen provides a comprehensive view of the monthly evolution of Net Interest and Commissions through column charts, offering insights into the financial performance trends over time. The pie chart details Net Interest by product type, highlighting which products contribute most to interest income. Simultaneously, the bar chart breaks down Commission earnings by type, elucidating the distribution of revenue sources across different commission categories.

A dynamic feature of this screen is the Portugal map, which visually represents both Net Interest and Commission data across geographical regions. Users can toggle between views using the top switch button, facilitating comparative analysis and geographical insights into revenue distribution patterns.

Strategically, this screen serves to illustrate revenue trends, identify the most profitable products, and pinpoint regions where clients generate the highest Net Interest and Commissions. It provides actionable insights for optimizing revenue generation strategies and resource allocation based on regional client activity.

The screen integrates data from multiple sources, drawing from two distinct fact tables, namely "dim_conta," "dim_balcao," "dim_comissao," and "dim_date." This multi-dimensional approach enriches the analysis by incorporating client account details, branch information, commission types, and temporal aspects to deliver a comprehensive understanding of revenue dynamics within the banking sector.

Finally, transitioning to the last screen (Figure 5.11 as blurred screen and Figure 5.12 as mockup screen) focuses on client demographics. This screen offers insights into the bank's client base composition, providing demographic analytics that supports targeted marketing strategies and client segmentation initiatives.

Figure 5. 11 – Cliente (Blurred Screen Version)

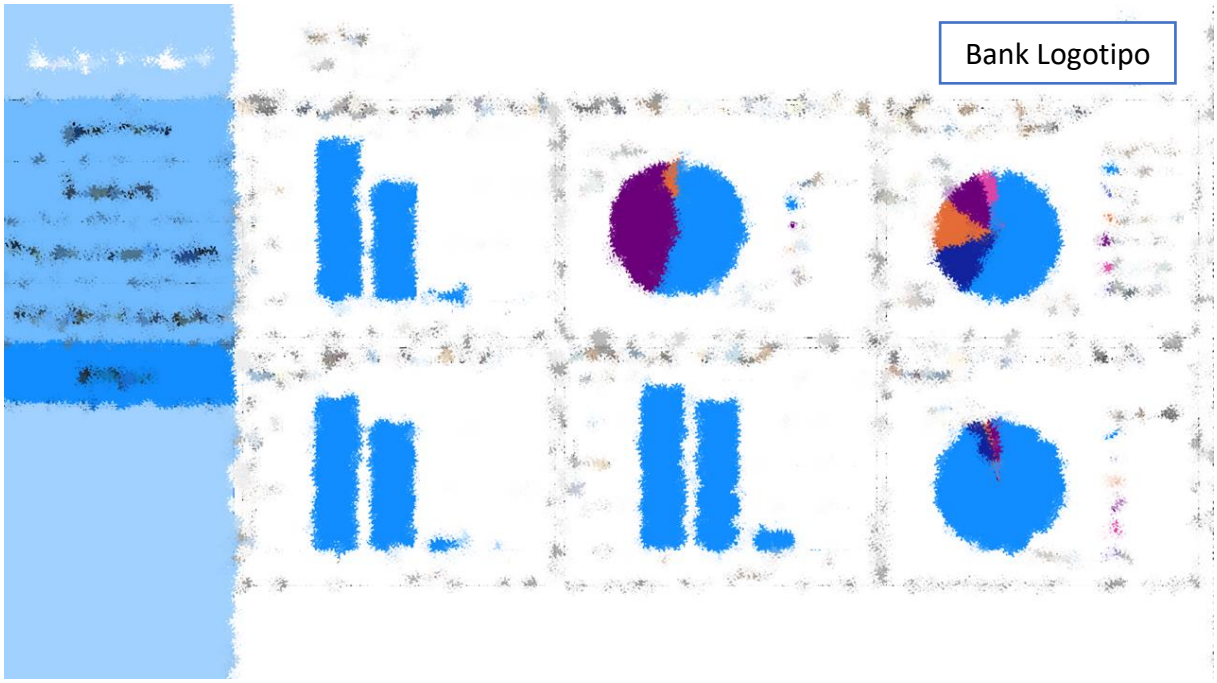
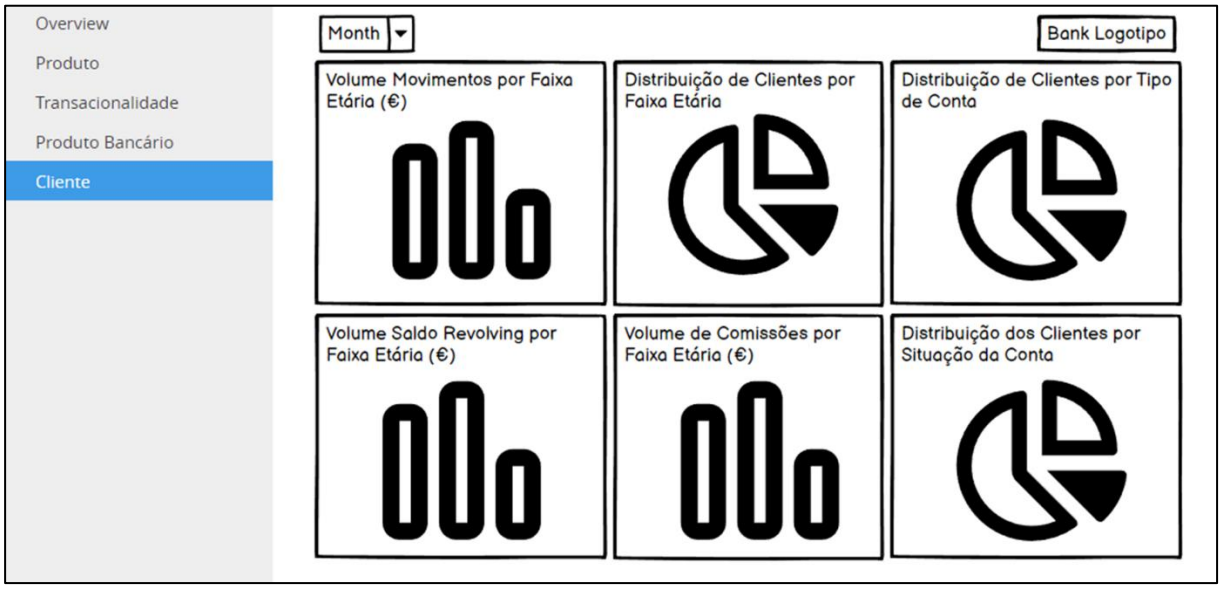


Figure 5. 12 – Cliente (Mockup Screen Version)



The "Cliente" Screen consolidates data from fact_comissao, fact_transacionalidade, and fact_carteira, leveraging dimensions such as dim_conta, dim_balcao, and dim_date to provide comprehensive insights grouped by client demographics.

To begin, three column charts highlight the volume of commission, net interest, and billing amounts categorized by age groups. This visualization enables stakeholders to discern which

age demographics contribute most significantly to profitability within the bank's client base, guiding targeted marketing and service strategies.

Additionally, the screen features three pie charts that offer further insights. The first pie chart depicts the distribution of clients contributing to revenues through net interest or commission, segmented by age groups. This analysis helps identify the age demographics that are most present in the bank. The second pie chart illustrates the distribution of clients across different account products, shedding light on the types of accounts preferred by clients within each age group. The third pie chart categorizes the status of clients' accounts, providing an overview of account conditions across different age segments. These last pie charts are interactive, allowing users to select specific age groups from the remaining charts to view corresponding distributions, facilitating deeper insights into client demographics and account behaviors.

The number of clients within each age group is calculated separately as a count distinct, complementing the graphical representations with quantitative data on client base composition.

Moreover, while certain measures and attributes are not utilized within the dashboard, they remain available for deeper analysis in Excel. This flexibility caters to the needs of businessmen who may require more detailed data exploration beyond the dashboard's predefined visualizations.

In conclusion, the implementation of this project effectively addresses the research questions by delivering a scalable model applicable to any product team within the banking sector, whether within the same organization or across different companies. By enhancing information accessibility and promoting transversal information sharing based on specific user needs, the project aims to increase efficiency across technical and non-technical team members. This strategic approach supports digital transformation initiatives focused on improving daily product operations and service delivery, thereby empowering informed decision-making and maintaining competitiveness against emerging FinTech competitors.

Looking forward, this model equips banks to strategically leverage data insights to identify areas for service enhancement, optimize client engagement, and proactively respond to market challenges posed by new entrants such as FinTechs. By adopting a data-driven strategy, banks can fortify their position in the retail banking sector and mitigate potential threats from evolving market dynamics, as anticipated in Dapp's (2014).

General Limitations

While the project has effectively achieved its objectives, the replication process may encounter several challenges that warrant careful consideration.

One significant challenge involves the financial implications associated with providing Pro licenses in Power BI to individuals outside the IT team. These licenses are essential for enabling non-IT team members to share dashboards and semantic models with their peers across the organization. However, the cost of extending licenses beyond the centralized IT team may present budgetary constraints in some organizational settings, potentially limiting widespread adoption and collaboration.

Another potential hurdle relates to the processing capacity required to manage large volumes of data, particularly concerning connections with Excel. Depending on the organization's infrastructure and data requirements, there may be limitations in processing capabilities that necessitate strategies such as data volume reduction or the implementation of optimized data mart views. These measures are crucial for maintaining system performance and ensuring efficient data handling across the organization.

Moreover, the feasibility of establishing direct connections from the Data Mart to Excel can be another challenge. Depending on the Extract, Transform, Load (ETL) platform in use, direct connectivity may not always be technically feasible or optimal. During the project, adaptations were made to integrate Power BI with relational tables to facilitate data access and visualization, ensuring compatibility and usability across different analytical tools.

Although not extensively covered in this report, security considerations emerge as a critical concern, especially in environments where data sharing extends across multiple teams within the organization. While the project successfully managed security within the confines of a specific team, extending data access and sharing privileges across departments raises pertinent issues regarding data sensitivity, privacy, and compliance. Organizations must implement robust security measures and protocols to mitigate risks associated with unauthorized access, data breaches, and compliance violations in inter-team data sharing scenarios.

In navigating these challenges, organizations can leverage lessons learned from the project to refine replication strategies, optimize resource allocation, and prioritize security enhancements. By addressing these challenges proactively, organizations can streamline the replication process, foster broader adoption of data-driven insights, and enhance collaboration across diverse teams, thereby maximizing the project's impact and sustaining competitive advantage in the evolving landscape of banking and financial services.

Model Differences and Contributions

Throughout the duration of the project, the foundational principles of adaptive learning and adaptive modeling, which have been extensively explored by Dabbebi et al. (2017) and Sarukesi and Uthayakumar (2011), were meticulously integrated and applied. These theoretical frameworks were further strengthened by a renewed emphasis on the pivotal role of feedback mechanisms, as elucidated in the aforementioned studies. While prior research recognized the importance of feedback, its explicit integration into the model was initially

overlooked. However, acknowledging its profound impact on facilitating adaptation and continuous improvement, deliberate efforts were undertaken to embed robust feedback loops into the design process, thereby highlighting its critical relevance.

In addition to achieving tangible practical outcomes, this project also made significant strides in advancing the theoretical underpinnings of adaptive models through the deliberate incorporation of feedback mechanisms. By examining the dynamics of feedback within the context of adaptive learning, the project contributed to a deeper comprehension of how adaptive models can evolve and enhance performance over time. Moreover, the exploration of feedback mechanisms enriched scholarly discourse by illuminating the intricate interplay between business intelligence and knowledge management strategies. This exploration not only broadened the scope of research in the field but also underscored the practical implications of integrating adaptive models with feedback mechanisms to bolster organizational agility and decision-making capabilities.

Fundamentally, this project not only validated the theoretical frameworks proposed by Dabbebi et al. (2017) and Sarukesi and Uthayakumar (2011) but also extended their applicability by seamlessly integrating feedback mechanisms into adaptive modeling. In doing so, it contributed to both theoretical advancements and practical insights into how organizations can effectively harness adaptive models to navigate intricate environments and cultivate sustainable competitive advantages through informed decision-making and strategic adaptation. This holistic approach underscores the transformative potential of adaptive modeling in enhancing organizational resilience and operational efficacy across diverse industry landscapes.

6. CONCLUSIONS AND FUTURE WORKS

6.1. OVERVIEWING AND CONCLUDING THE PROJECT

This project aimed to implement advanced information management practices within the banking sector by integrating principles from knowledge management, digital transformation, adaptive modeling, and software usability. The overarching objective was to enhance performance, collaboration, and competitiveness in an increasingly digital landscape.

Knowledge Management

The project delved into the intricate relationship between flexible work arrangements and effective knowledge sharing. It underscored the necessity of fostering a culture of knowledge sharing and the importance of investing in digital technologies to maintain a competitive edge. By doing so, it highlighted the critical role of knowledge management in organizational success.

Digital Transformation

In the context of digital transformation, the project tackled the significant challenges faced by financial institutions. It emphasized the adoption of cutting-edge technologies to sustain competitiveness and navigate the evolving digital environment. The project showcased how digital transformation could be strategically leveraged to enhance operational efficiency and customer satisfaction.

Adaptive Models and Accessibility

The exploration of adaptive models highlighted the role of accessibility in promoting effective collaboration and information sharing within organizations. The project identified user-centric design and adaptability as essential components for accommodating variations in user skills and preferences. By focusing on these elements, it aimed to create a more inclusive and efficient information management system.

Phases of Implementation

Drawing from the models proposed by Sarukesi and Uthayakumar (2011) and Dabbebi et al. (2017), the project unfolded in three distinct phases:

1. **Knowledge Acquisition Phase**

This phase involved establishing a comprehensive knowledge base by:

- Identifying user context and needs.
- Annotating indicators for the user model.
- Defining data visualization parameters.

An adaptive system was designed to cater to diverse user profiles, facilitating personalized information delivery and enhancing user autonomy.

2. **Knowledge Representation Phase**

This phase focused on developing the data mart, addressing challenges such as time requirements for data connectivity and updates. A conceptual model was created to represent four business processes and six dimensions, detailing various aspects of product lifecycle and transactionality, commissions, and net income. This model provided a robust foundation for data management and analysis.

3. **Knowledge Management Phase**

In this phase, the data mart was connected with Power BI to enable visualization and its semantic model to Excel for in-depth analysis. The project recommended the use of cloud-based Power BI dashboards and Microsoft Excel pivot tables to cater to different visualization and analysis needs. This approach ensured flexibility and accessibility for users across various roles.

Validation and Feedback

Upon completing the model steps, validation of accessible information was conducted by viewers and businessmen. Businessmen provided feedback based on their business knowledge, which was crucial for refining visuals and identifying errors. Viewers contributed insights on interpretability and typographical accuracy.

These interactions underscored the importance of interdisciplinary knowledge-sharing. Research advocates for a culture of knowledge-sharing and investment in employee skills to foster competitive advantage. Although task interdependence can hamper sharing, the project's approach minimized barriers, boosting performance, autonomy, and interaction. This, in turn, facilitated more effective teamwork and model refinement.

Conclusion

The project successfully achieved its objective of improving information accessibility within the banking sector's product teams. It enabled easier access to centralized data through a data mart and customized information access based on users' needs. This enhancement fostered efficiency, collaboration, and competitive advantage.

Future Challenges and Opportunities

While the project was successful, potential challenges may arise during replication, such as:

- **Licensing Costs**: Providing Power BI Pro licenses to non-IT team members could present budgetary constraints.

- **Data Processing Capacity**: Managing large volumes of data, especially in Excel, may require optimized data mart views or reduced historical data.
- Security Considerations: Extending data access across multiple teams necessitates robust security measures to protect sensitive information.

Theoretical and Practical Contributions

Despite these challenges, the project contributes significantly to the advancement of adaptive models by integrating feedback and exploring synergies between business intelligence and knowledge management. It enriches existing research in this domain and provides practical insights for organizations aiming to leverage adaptive models for enhanced decision-making and strategic adaptation. This project offers a comprehensive approach to developing adaptive models that meet the evolving needs of modern organizations, ensuring sustainable competitive advantages in an increasingly data-driven world.

6.2. WHAT CAN BE IMPROVED?

While the project has been successfully implemented and shows potential for replication across various product lines within the same organization and other entities, there are several areas where improvements can be made.

Enhanced Visualization Techniques

One significant improvement involves a stronger emphasis on visualization techniques. Although the project effectively addressed the needs identified during the acquisition phase, there is a vast array of advanced visualization methods that can be tailored to meet specific user requirements. By incorporating these methods, navigation within dashboards can be greatly improved, leading to better information absorption and understanding.

Comprehensive Knowledge Management

The scope of knowledge management extends beyond the mere sharing of information. To complement the existing model, it would be beneficial to develop a centralized repository for conducting analyses, incorporating metadata from the data mart, and offering guidance on navigating the dashboard. Additionally, providing lectures and training sessions on both technical skills and business knowledge can further enhance stakeholders' capabilities. Implementing these knowledge management practices can refine analytical skills and improve efficiency, as previously discussed.

Integration of IT and Business Teams

It is also crucial to avoid segregating IT teams from business teams. Establishing mixed teams that include members from both IT and business units can facilitate better collaboration and synergy. This integration allows for a more cohesive approach, ensuring that technical solutions are closely aligned with business objectives and needs.

User-Friendly Platforms

In terms of the model, providing access to more user-friendly platforms like Excel, with enhanced capacity, can enable detailed analysis. Excel remains a powerful tool for many business users, but ensuring other platforms that can handle larger datasets will make it more effective for in-depth analysis.

Utilization of Relational Tables

Employing a platform that allows for working with relational tables outside of Power BI can simplify the process and reduce the complexity of connections. This approach can make data handling more efficient and flexible, thus enhancing the overall user experience.

Transition to Automated Processes

A significant area for improvement lies in transitioning from manual processes to automated ones using machine learning (ML) and artificial intelligence (AI). With the data mart in place, ML algorithms can analyze data and identify patterns that may not be immediately obvious to business users. According to Dabbebi et al. (2017), future projects should focus on using dashboard interactions to identify needs rather than solely relying on user input. While businessman interactions should still guide the initial user-centered model, ML and AI can serve as valuable complements.

AI-Powered Data Visualization

AI can also enhance data visualization by selecting the most effective graphics or even creating a storytelling approach for dashboards. However, it is essential to validate these AI-driven insights with input from business analysts and users to ensure accuracy and relevance. AI can improve the efficiency of information transmission, but ensuring easy access for business users is crucial so they can make informed decisions, conduct their analyses, and validate AI insights.

Conclusion

In conclusion, while the project has achieved its objectives, there are several areas for potential improvement. By focusing on enhanced visualization techniques, comprehensive knowledge management, integration of IT and business teams, user-friendly platforms, utilization of relational tables, and the transition to automated processes through ML and AI, organizations can further refine their strategies. These enhancements will not only streamline replication but also foster broader adoption of data-driven insights, enhance collaboration, and ultimately sustain a competitive edge in the banking and financial services sector.

Final Thoughts:

The synergy between business intelligence (BI) and knowledge management (KM) is essential for organizational success. Business intelligence, which includes data analytics, visualization tools, and the necessary infrastructure, equips organizations with the ability to gather, process, and present data in a manner that supports informed decision-making. On the other hand, knowledge management involves the systematic handling of information within an organization, ensuring it is effectively organized, stored, and disseminated.

Neither business intelligence nor knowledge management functions effectively in isolation. Business intelligence provides valuable insights through data visualization and analytics, but without effective knowledge management, these insights may not be optimally organized or shared. Similarly, knowledge management relies on the robust data analytics and visualization capabilities of BI to transform raw data into actionable information. The interplay between these two disciplines is crucial in ensuring that data is not only collected and analyzed but also properly formatted, organized, and distributed to meet the diverse needs of users across the organization.

This project underscores the importance of an adaptive model that bridges the gap between business intelligence and knowledge management. By integrating these functions, the project ensures that data collection, organization, and distribution processes are tailored to user needs, thereby enhancing the overall efficiency and effectiveness of information handling within the organization.

An adaptive model is particularly valuable because it can dynamically adjust to changing requirements and user feedback. This flexibility is crucial in a rapidly evolving business environment where new data sources and analytical techniques continually emerge. By incorporating robust feedback loops, as highlighted in the works of Dabbebi et al. (2017) and Sarukesi and Uthayakumar (2011), the project fosters continuous improvement and adaptation. This approach not only enhances the accuracy and relevance of BI outputs but also ensures that KM practices are aligned with organizational goals and user needs.

Moreover, the project contributes to advancing theoretical frameworks by demonstrating the practical application of adaptive learning and modeling principles. Integrating feedback mechanisms into the design process, highlights the importance of user interactions and real-world application in refining and optimizing adaptive models. This integration is critical for developing systems that are not only theoretically sound but also practically viable and effective in real-world settings.

In addition to its theoretical contributions, the project offers practical insights for organizations seeking to enhance their BI and KM capabilities. It provides a roadmap for developing systems that can efficiently handle large volumes of data, support complex analytical tasks, and facilitate effective information sharing across diverse teams. By leveraging advanced visualization techniques, robust knowledge management practices, and

adaptive modeling strategies, organizations can improve their decision-making processes, enhance collaboration, and maintain a competitive edge in their respective industries.

In essence, this project presents a novel perspective on addressing the complexities inherent in integrating business intelligence and knowledge management. It underscores the critical importance of synergy between these functions and offers a comprehensive approach to developing adaptive models that meet the evolving needs of modern organizations. By focusing on both the technical and organizational aspects of BI and KM, the project lays the groundwork for creating more efficient, responsive, and user-centric information systems. This holistic approach ensures that organizations can harness the full potential of their data assets, drive informed decision-making, and achieve sustainable competitive advantages in an increasingly data-driven world.

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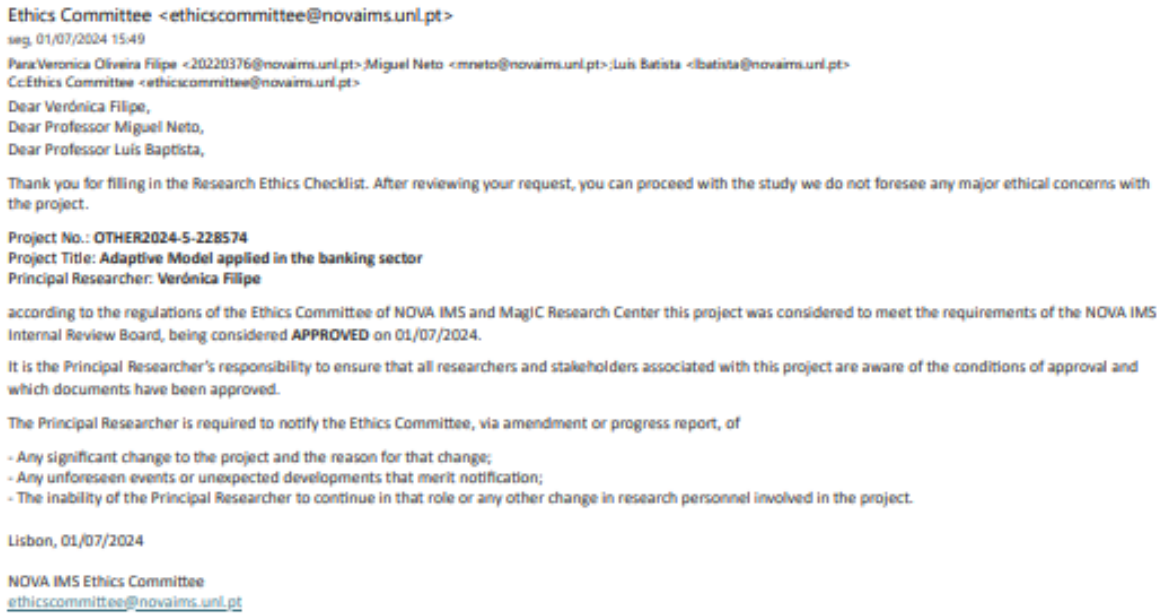
APPENDIX

Figure appendix. 1 - Ethics Committee Report



Ethics Committee <ethicscommittee@novaims.unl.pt>
seg, 01/07/2024 15:49

Para:Veronica Oliveira Filipe <20220376@novaims.unl.pt>;Miguel Neto <mneto@novaims.unl.pt>;Luis Batista <lbatista@novaims.unl.pt>
Cc:Ethics Committee <ethicscommittee@novaims.unl.pt>

Dear Verónica Filipe,
Dear Professor Miguel Neto,
Dear Professor Luis Baptista,

Thank you for filling in the Research Ethics Checklist. After reviewing your request, you can proceed with the study we do not foresee any major ethical concerns with the project.

Project No.: **OTHER2024-S-228574**
Project Title: **Adaptive Model applied in the banking sector**
Principal Researcher: **Verónica Filipe**

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 01/07/2024.

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, 01/07/2024

NOVA IMS Ethics Committee
ethicscommittee@novaims.unl.pt

Datamart Metadata:

Table appendix. 1 – fact_produto metada

Variables	Description
FK_Produto	Foreign key referencing dim_produto and identifying the product ID
FK_Data_venda	Foreign key referencing dim_dia and identifying the day when the product was sold
FK_Data_ativacao	Foreign key referencing dim_dia and identifying the day in which the product was activated
FK_Data_anulacao	Foreign key referencing dim_dia and identifying the day in which the product was nullified
FK_Data_expiraco	Foreign key referencing dim_dia and identifying the day in which the product expired
FK_ultima_utilizacao	Foreign key referencing dim_dia and identifying the day of the product last utilization
Situacao	Product status

Table appendix. 2 – fact_carteira metada

Variables	Description
FK_Mes_Fecho	Foreign key referencing dim_mes and identifying the record date

FK_Conta	Foreign key referencing dim_conta and identifying the account number ID
Numero_Produto	Number of products in each account (units)
Margem_Financeira	Net Income volume (euros)
Saldo_Pontual	Current balance volume (euros)
Saldo_Revolving	Current revolving volume (euros)

Table appendix. 3 – fact_transacionalidade metada

Variables	Description
FK_Produto	Foreign key referencing dim_produto and identifying the product ID
FK_Conta	Foreign key referencing dim_conta and identifying the account number ID
FK_Mes_Movimento	Foreign key referencing dim_mes and identifying the month where the transactions where made
Descricao	Transaction description
Tipo_Movimento	Transaction type
Flag_Voluntario	Flag identifying when the transactions are voluntarily or not
Pais_Movimento	Country where the transactions occurred
Autenticacao	Authentication method description
Tipo_Autenticacao	Authentication type
Valor_Movimento	Volume of the transaction (euros)
Valor_Interchange_Fee	Volume of the IF applied in the transactions (euros)
Valor_Comissao	Volume of the commissions applied in the transactions (euros)

Table appendix. 4 – fact_comissao metada

Variables	Description
FK_Mes_fecho	Foreign key referencing dim_mes identifying the month where the commissions were received
FK_Conta	Foreign key referencing dim_conta and identifying the account number ID
Metacomissao	Commission description
Valor_Comissao	Volume of commissions received (euros)

Table appendix. 5 – dim_produto metada

Variables	Description
BK_Produto	Business key identifying the product ID number
FK_Balcao_contratacao	Foreign key referencing dim_balcao and identifying the brach ID number
Conta	Account ID number associated with the product
Codigo_Subproduto	Subproduct ID
Subproduto	Subproduct description
Codigo_Gama	Product Family ID
Gama	Product Family Description
Tipo_Produto	Product type description
Produto_Anterior	Previous product IF number

Table appendix. 6 – dim_conta metada

Variables	Description
BK_Conta	Business key identifying the account number
FK_Balcao_Atual	Current branch allocated to the account
Conta_Cliente	Client account number
Primeiro_Titular	Client ID number
Data_Nascimento	Client's birthday
Idade_Cliente	Client's age
Nacionalidade	Client's nacionality
Codigo_Subproduto	Account subproduct ID
Subproduto	Account subproduct description
Data_Abertura	Date when the account was open
Data_Vencimento	Date when account was closed
Situacao	Account status

Table appendix. 7 – dim_balcao metada

Variables	Description
BK_UO	Business key identifying the branch ID
Balcao	Branch's description
CD	Commercial Management ID
Direcao_Comercial	Commercial Management description
CO	Coordinating Management ID
Direcao_Coordenadora	Coordinating Management description
Codigo_Postal	Branch Zip code
Localizacao	Branch Localization

Table appendix. 8 – dim_comissao metada

Variables	Description
BK_Comissao	Business key identifying the commission ID
Descricao	Comission's description
Familia_Comissao	Family's commission description
Tipo_Comissao	Comission's type description
Grupo_Comissao	Group's comission description

Table appendix. 9 – dim_data metada

Variables	Description
BK_Data	Business key identifying the date ID
Data_Real	Real date
Dia	Day
Dia_Semana	Weekday identification
Tipo_dia	Identifying if it is workday, holyday or weekend.
Feriado	Holiday description
Evento_Banco	Bank event
Flag_Campanha	Flag identifying if it is occurring a product camapaign
Campanha	Campaing's description
Quinzena	Fortnight
Mes	Month
Nome_Mes	Month's description
Trimestre	Quarter of the year
Mes_Trimestre	Month of the quarter
Semestre	Semester of the Year
Mes_Semestre	Month of the semester
Ano	Year

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