Decision Support Guidelines for Integration of Application Support in the Banking Area

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Master's Degree in Information and Business Systems

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Acknowledgments

Along the way from the dissertation completion to now, I had the lucky opportunity to meet several precious individuals who contributed to my growth at different times of this process.

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Dedication

With all my love, I dedicate this work to my husband and best friend. His presence, love, care, and patience were the foundation on which I could learn and grow, not just over the years of our union but especially during the development of this project. His faith in me and his constant encouragement were guiding lights on my journey, inspiring me to pursue my dreams with determination.

Integrity Declaration

I hereby declare that I have conducted my dissertation with integrity. I confirm that I have not used plagiarism or any form of falsification of results in the process of the thesis elaboration.

I further declare that I have fully acknowledged the Disciplinary Regulations of the Universidade Aberta (regulation published in the official journal Diário da República, 2. a série, N.o 215, de 6 de novembro de 2013).

Universidade Aberta, 22nd of May 2024

Full name: Tainá Pereira Holtz

Abstract

In the banking sector, a highly competitive and regulated environment, effective collaboration between application development and support teams has emerged as a critical factor in maintaining service quality, customer satisfaction, and operational efficiency.

In this context, this study aims to delve deeper into this interaction, exploring in detail the main challenges faced by these teams and proposing a comprehensive set of evidence-based guidelines for improving collaboration and the expected performance of those involved in the process.

This research began with a systematic literature review, following Barbara Kitchenham's protocol, to identify existing information related to the problem of this study, highlighting the main obstacles, gaps, and recommendations for dealing with application support in the banking sector.

This was followed by the application of the research methodology supported by a Survey, which was conducted through semi-structured interviews with 9 (nine) experienced banking professionals operating in different locations in the banking sector distributed around the world.

The interviewees were selected on the basis of their experience and the relevant positions they hold in each of their banking institutions, offering a rich and diverse perspective on the processes, efficiency, quality, and impact of team collaboration.

In this context, this study aims to contribute to the existing literature on IT management in the banking sector. It provides insights and practical guidelines that banking organizations can adopt to improve operational efficiency, service quality, and customer satisfaction.

The extraction and analysis of data from the 9 interviewees, supported by the nVivo application, revealed that the applicability of these results can be considered significant for IT managers, software developers, and application support professionals who want to optimize workflow and collaboration while facing the challenges of the developed banking environment as it currently stands.

Keywords: *Banking Application Support Management, Application Support, Software Development, Banking Industry, Banking*

Resumo

No sector bancário, um ambiente altamente competitivo e regulado, a colaboração efetiva entre as equipas de desenvolvimento e de suporte aplicacional surge como um fator crítico para manter a qualidade do serviço, a satisfação do cliente e a eficiência operacional.

Neste contexto, o presente estudo visa aprofundar esta interação, explorando em detalhe os principais desafios enfrentados por estas equipas e propondo um conjunto abrangente de orientações baseadas em evidências para melhorar a colaboração e o desempenho esperado dos envolvidos no processo.

Esta investigação iniciou-se com uma revisão sistemática da literatura, seguindo o protocolo de Barbara Kitchenham, para identificar a informação, existente relacionada com o problema deste estudo, destacando os principais obstáculos, lacunas e recomendações para o tratamento do apoio a aplicações no sector bancário.

Seguiu-se a aplicação da metodologia de investigação suportada por um Survey que foi conduzida através de entrevistas semiestruturadas a 9 (nove) profissionais experientes do sector bancário que operam em diferentes locais do setor bancário distribuídos pelo mundo.

Os entrevistados foram selecionados com base na sua experiência e no cargo relevante que ocupam em cada uma das suas instituições bancárias, oferecendo uma perspetiva rica e diversificada sobre os processos, a eficiência, a qualidade e o impacto da colaboração em equipa.

Neste contexto, este estudo pretende contribuir para a literatura existente sobre a gestão das TI no sector bancário e fornece perspetivas e orientações práticas que as organizações bancárias podem adotar para melhorar a eficiência operacional, a qualidade dos serviços e a satisfação dos clientes.

A extração e análise de dados aos 9 entrevistados, suportada pela aplicação nVivo, revelou que a aplicabilidade destes resultados pode considerar-se significativa para gestores de TI, programadores de software e profissionais de apoio a aplicações que pretendam otimizar o fluxo de trabalho e a colaboração, enquanto enfrentam os desafios do ambiente bancário desenvolvido, tal como se apresenta atualmente.

Palavras-chave: Gestão de Suporte a Aplicações Bancárias, Suporte a Aplicações, Desenvolvimento de Software, Indústria Bancária, Banca

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List of acronyms, acronyms, and abbreviations

RQ	Research Question
SLR	Systematic Literature Review
SLA	Service Level Agreement
IT	Information Technology
KPI	Key Performance Indicators
ITIL	Information Technology Infrastructure Library
PAM	Product Area Manager
IS	Information System
SA	Service Assurance
BP	Business Process
R&D	Research and Development
ML	Machine Learning
AI	Artificial Intelligence

Chapter 1

Introduction

Chapter 1 - Introduction

In the banking sector, with its high-level competition and rapid technological development, collaboration between the development and application support teams is one of the key aspects to ensure high-quality service, customer satisfaction, and operational efficiency.

Successful integration of these units directly influences the bank's ability to respond promptly and adequately to the demand from the market and the customers. Nonetheless, despite the importance of the matter, numerous studies have brought to light the existence of significant challenges, such as communication obstacles, process integration gaps, and knowledge management deficiencies that reduce the effectiveness of interaction. Consequentially, such conditions may result in delays, inefficiency, and low quality of delivered service.

Acknowledging the relevance of the matter and a considerable gap in both academic and practical knowledge, the current research has been aimed at the thorough investigation of the collaboration between the development and application support teams in the banking sector. This dissertation aims to give a clear and detailed view of how to integrate application support with development teams in the banking sector.

The analysis of the alliance between development and application support teams in the banking system distinguishes this study.

This further contributes to the body of knowledge and offers a practical approach that helps overcome various communication, process integration, and knowledge management challenges. The study not only helps to identify gaps in the current practice but is also important in guiding the team even in the future in terms of operation efficiency and customer satisfaction in the banking sector.

This study aims to analyze current practices and propose a set of guidelines to aid in the decision-making processes of application support teams for banking applications. To this end, it was identified the following research questions:

RQ1: What do information system architectures look like in the banking industry?

RQ2: What are the banking industry practices and systems architectures used by application support team management?

RQ3: How can the best strategy for application support in large banking industry systems be defined?

To answer the proposed questions, we conducted an SLR and a survey-type study. The SLR aimed to identify current practices, while the survey sought to gather responses directly from experienced professionals in the field of expertise. As illustrated in *Figure 1- Methodological structure*, the Investigation Process includes several important steps.

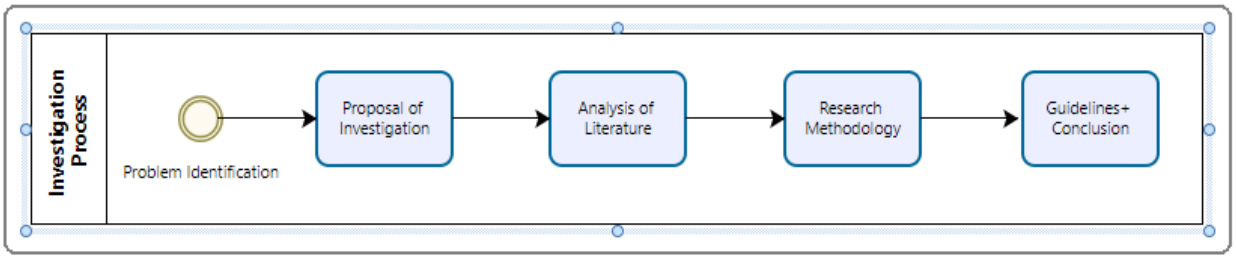


Figure 1- Methodological structure

The survey was based on H. Freitas, M. Oliveira, A. Z. Saccol, and J. Moscarola's protocol and aligned for surveying semi-structured interviews with experienced professionals in the IT banking sector.

"The survey method by interview allows the researcher to collect not only quantitative data but also qualitative data, providing a more complete and richer understanding of the investigated topic, in addition to enabling the clarification of doubts and obtaining more elaborate responses."[26]

The interviews followed a carefully prepared script in advance, allowing for a detailed discussion among the participants about the integration of application support and software development.

The survey technique was selected for its capacity to generate far more specific and detailed qualitative data, allowing for an appreciation of subtle elements of current processes and pinpointing areas that need improvement. The sample included experts from regions with varying cultures and very different points of view. The interviews were analyzed, which allowed us to identify the challenges and practices.

Nvivo software was used for qualitative data, which is a powerful tool for organizing and analyzing large textual data. Coding of the data made the identification of trends and the comparison of the interviews possible. Nvivo turned out to be a fine and accurate tool for the study, as it allowed us to have a complete and standardized review of the data. The application of software was instrumental in identifying word frequencies, creating word clouds, and performing thematic analysis, which refined the guidelines that were subsequently suggested in this study.

The SLR and interview findings were utilized to develop practical guidelines for integrating application support within the banking sector. These principles were designed to assist managers in making informed decisions regarding the structure and operations of support and development teams.

The guidelines cover areas including the automation of mundane jobs, extending the knowledge of the organization, facilitative leadership, continuous improvement, and autonomy with responsibility, as well as including quality practices from the start of the project and evaluating the organization's impact. The main purpose of these recommendations is to increase performance, meeting demands, and give customers the best possible service quality in the sector.

This document is organized into **six** chapters, which include:

In the **first chapter**, the introduction, objectives, and framing of the identified problem will be presented, in addition to the description of the document's structure and the Research Questions of this study.

In **chapter two**, a study of contemporary market practices used in decision-making processes and a literature review are presented, addressing their central ideas and meanings, highlighting the advantages found, and providing an evaluation of how this decision affects the application's performance. Also included are relevant studies in the scientific field for this study.

Chapter three focuses on the Survey that will be used to achieve the established objectives and to answer the research questions.

In the **fourth chapter**, the collection and interpretation of data acquired through the survey will be presented using the nVivo software.

In the **fifth chapter**, a proposal is presented that includes the presentation of guidelines related to the topic under study.

In the **sixth chapter**, the final considerations, limitations, and a proposal for future work are presented.

Chapter 2

Systematic Literature Review

Chapter 2 - Systematic Literature Review

2.1. Introduction

Financial sector software architectures are developed to work in an integrated way that can guarantee the highest availability in their applications.

Companies in the banking sector, despite being large, having many resources, and having excellent professionals, face difficulties in defining which powers the application support team can have or how the application support team should be allocated.

The challenge is whether this team should be allocated with the development team (and code maintenance) or separately, consequently optimizing the system operation and maintenance costs.

An application requires daily support and updates. This support is provided by a team of application analysts who identify and investigate problems that can be simple or complex, depending on the levels of support.

After the first analysis of the problem, if the support team does not solve it, the situation is sent to the application development teams, who will do the analysis and then make the necessary changes to the code to solve the problem. The solution should be tested in an isolated environment and then delivered to the production environment. V. Marković and Z. Konjović mention this in:

"A software service suffers unexpected degradation of quality (e.g., more bugs, more production fixes, non-compliant SLA, etc.), higher development and/or maintenance costs and risks, and if similar incidents repeat in the same or other parts of the system, then this would normally need to be escalated as an issue."[1].

At a time of digital transformation, globalization, and internationalization, deciding how to deploy an application support and systems development team is a complex task for information and systems management. Decision-making is a decisive factor and seriously impacts companies' revenues, especially when discussing a comprehensive and important sector for all citizens, like the banking sector, where applications are created in modules.

"As the integration of software projects, the bank application system has the characteristics of multiple sub-projects, strong inter-project correlation, short development cycle, and numerous projects participating teams. Thus, IT project managers in the bank have generally faced the problem of improving program management efficiency." [2].

Every application or system suffers from entropy. As time goes by, the application's evolution and the technology's obsolescence force companies to define teams that support a certain system to keep it operational and updated. In the scope of banking systems, it is possible to verify that in this area, due to incorporations and acquisitions, this becomes much more complex.

2.2. SLR - Research Methods

This section aims to introduce the systematic literature review (SLR) methodology applied in this report, which serves as the foundation for this research report. The Barbara Kitchenham model was utilized for this study's SLR approach.

A SLR is a process that seeks to analyze and describe the content of knowledge to answer a specific question. Literature refers to all relevant material already written on the subject, such as books, scientific journals, articles, and reports.

A systematic review is a type of narrative developed in a scientific investigation. These studies can be observations. The objective is to test hypotheses to raise, unite, and evaluate a survey and synthesize its results. The research question must be established. The methods should retrieve, select, and evaluate the results of primary studies.

Some criteria that should be the basis for an SLR

Identify the topic or research question.

Elaborate inclusion or exclusion criteria.

Define the objectives to be extracted from the content (studies, pre-selected articles)

Evaluate the selected contents.

Interpreting results

Presentation of the review/knowledge synthesis

The effectiveness of the SLR process is based on the quality of the method established during the research. This quality method should support collecting rich and variable content in the research output.

This report will be based on the Kitchenham Protocol guidelines, which detail the importance and advantages of the procedure that should be presented in an SLR process.

This process will be developed in three stages:

- ➔ *Planning*
- ➔ *Conduction*
- ➔ *Communication*

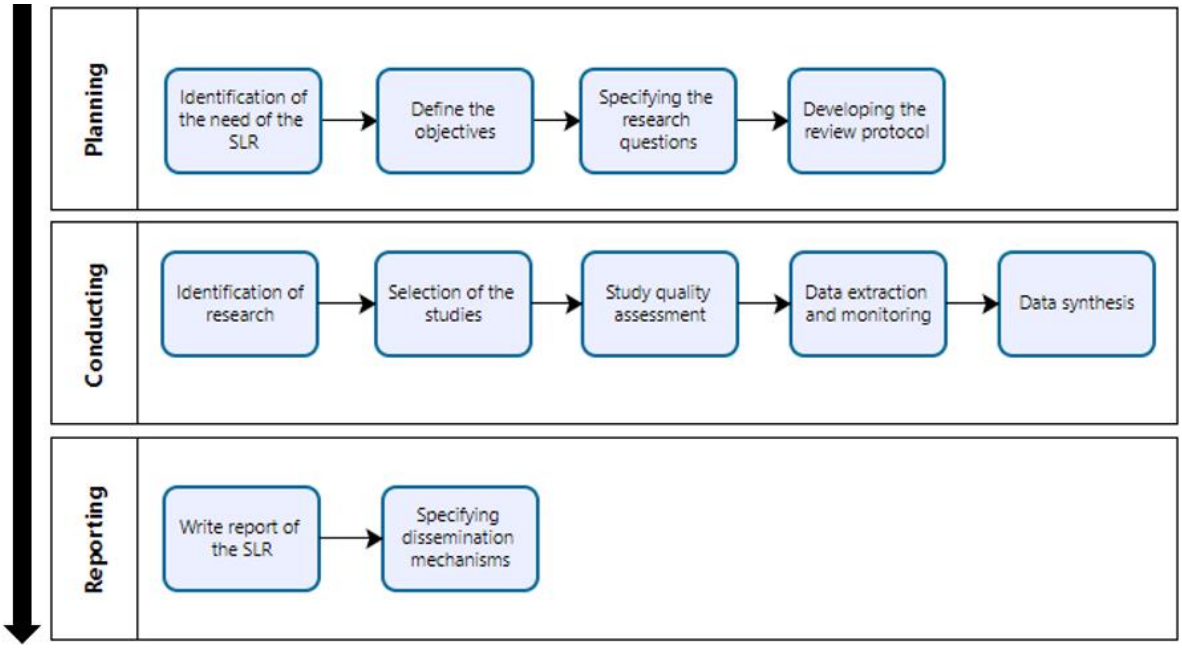


Figure 2- Phases and tasks for SRL (adapted from [3])

Figure 2- Phases and tasks for SRL (adapted from [3]), shows the Investigation Process, which includes several key phases and tasks for systematic review and literature (SRL). The process begins with Problem Identification, followed by the Proposal of Investigation, Analysis of Literature, and Survey, and concludes with Guidelines and Conclusion.

2.3. State of the Art

In this chapter, we will present a general concept of the issues addressed in the report, such as banking application support management, application support, and software development. Its challenges and methods are currently used.

The banking sector, characterized by high competition and rapid technological advancements, demands a seamless collaboration between development and application support teams to ensure service quality and operational efficiency. Despite significant investments in resources and expertise, banks continue to face challenges in defining the optimal structure and integration of these teams. The complexity of financial software architectures, the necessity for

continuous updates and support, and the imperative of maintaining high availability pose significant hurdles.

This section delves into the current state of knowledge regarding the integration of development and support teams in the banking sector. It reviews existing literature on the methodologies, tools, and practices employed to enhance collaboration and operational efficiency. By examining theoretical frameworks, empirical studies, and practical examples, this review aims to highlight best practices and identify gaps that this research seeks to address. The goal is to provide a comprehensive understanding of how effective integration can mitigate common challenges and improve overall service delivery in banking applications.

2.3.1. Banking Application Support Management

Effective management of banking application support is crucial for ensuring the reliability and performance of financial systems. The reviewed literature highlights several key challenges, including complexity, high operational costs, and the critical need for rapid response to technical issues. Successful strategies emphasize the integration of support and development teams, the adoption of agile methodologies, and the implementation of robust IT governance frameworks.

"As organizations develop and expand their businesses, the interdependencies between their processes and information systems increase rapidly. To address this, organizations modify the technology that supports their business. As a result of such developments, organizations face substantial problems. One of the first and most significant problems is complexity, which impedes decision-making and leads to excessively high and often hidden costs. There has been much interest in complexity research from both academia and industry. The term complexity has received much attention in different fields" [4]. "Organizations, through expanding their activities at all levels of information technology, can use IT capabilities to improve the innovation performance" [5].

The costs and benefits can be budgeted in advance. However, there are also more complex benefits, such as avoiding potential regulatory fines, avoiding security breaches, or leveraging new functionality to expand a business. Time is an essential part of the cost-benefit analysis. The life cycle of existing software has a finite time, marked by its end-of-life date. The risk of a regulatory fine has a definite point when the regulation begins to apply. An overall business plan will have a date when the new business aims to launch. These factors can be used to understand when a project should be completed.

"The structural view seeks to identify and explain the banking system's performance by classifying its business model from a regulatory standpoint, which ultimately is concerned with its

strength and ensuring its stability for survival. Quantitative and reductionist studies with retrospective data clustering methods fall into this category of banking business model studies"[8]

"Managers expand the activities of innovation at the level of human resource processes, through applying a strategic plan and attempting to utilize new technologies such as big data and the Internet of Things at the operational level " [5]. "differentiating between such task dimensions as creative, adaptive, interactive (routine), analytical (evaluation, standardization), system supervision, routine cognitive, information processing, information exchange (data stream)" [4].

"A project manager must balance all these factors as commitments are made and ensure resourcing is appropriate" [6].

The integration of development and support teams fosters better communication and collaboration, leading to quicker resolution of issues and continuous improvement. Agile practices, such as Scrum and DevOps, enhance flexibility and responsiveness, enabling teams to adapt to changing market demands and technological advancements. Furthermore, comprehensive IT governance ensures that processes are standardized, risks are managed effectively, and compliance with regulatory requirements is maintained.

"The unique value that the facilitator model proposes is the appropriate response to 'pain' in the daily lives of individuals and businesses to make it easier. Banks need IT infrastructure, innovative IT knowledge, and mature processes to run a facilitator business model"[8]

In conclusion, managing application support in the banking sector requires a multifaceted approach that balances technical, organizational, and strategic considerations. By leveraging integrated teams, agile methodologies, and strong governance, banks can improve their operational efficiency, reduce downtime, and enhance customer satisfaction. This holistic approach not only addresses current challenges but also positions banks to handle future technological and market shifts better.

2.3.2. Application Support

Engaged employees feel connected to the organization, are more productive and dedicated to their work, and commit to innovative behavior in the workplace. The organization should pay attention to employees' innovative abilities and convert employees' ideas into innovative products or services. Employees who feel a strong sense of organizational commitment work towards achieving the company's goals. This will increase productivity, commitment, engagement, and morale, resulting in innovations and ideas that improve organizational performance. In addition, "managers must recognize that positive and innovative behaviour promotes employees' abilities to address challenges in the workplace and so creates an enabling environment for them.

Employees' innovative work behaviour could be increased if they are emotionally invested in the company" [7].

The role of application support within the banking sector is indispensable for maintaining the stability and performance of critical financial systems. The literature underscores the importance of having skilled teams equipped to handle diverse and complex technical issues efficiently. Key strategies for effective application support include continuous monitoring, proactive maintenance, and the implementation of advanced troubleshooting techniques.

"A professional IT team is considered a valuable key resource in the banking industry" [8]. "Programmers are primarily responsible for developing the software product and are co-responsible for other parts of the software development life cycle, including design and testing" [6]. "The project manager focuses on the business case, costs, benefits, and schedule" [6].

"The facilitator business model works with innovation partners, various industries, government, legal assistants, insurance consultants, etc., as key partners to innovate or meet their needs. These partnerships allow facilitator banks to go beyond banking services and provide various insurance, legal, investment, and wealth management services to their clients"[8].

Effective application support involves multiple layers of problem-solving, from immediate response to incidents to deeper analysis and resolution by development teams when necessary. This tiered approach ensures that issues are addressed promptly, minimizing downtime and maintaining high levels of service availability. Additionally, the use of modern tools and automation can streamline support processes, allowing teams to focus on more complex tasks that require human intervention.

"Organizations can grow and gain competitive advantage through the development of knowledge practices in all parts of the organization" [5]. "Necessary training should be provided to keep employees abreast of the necessary knowledge in the organization. Organizations, through training, can develop their people's skills toward exploiting external knowledge. It is also recommended that the managers attempt to enhance the exploration skills of employees at the operational level of their organization to facilitate this process" [5].

Training and knowledge management are also critical components. Ensuring that support teams are well-trained and have access to a comprehensive knowledge base enhances their ability to resolve issues quickly and accurately. Moreover, fostering a culture of continuous improvement through regular feedback loops and performance evaluations helps identify areas for enhancement and implement best practices.

In conclusion, robust application support is a cornerstone of operational excellence in the banking sector. By prioritizing continuous monitoring, leveraging automation, and investing in team training and knowledge management, banks can effectively manage application support, thereby ensuring the reliability and efficiency of their financial systems. This proactive and strategic approach not only mitigates risks but also contributes to sustained customer satisfaction and operational success.

2.3.3. Software development

Considering the expansion of IT functions in various aspects of the organization, new technologies such as the Internet of Things could be expected to evolve dramatically in all human resource processes, including performance management. The Internet of Things offers new opportunities for the promotion of employee activities, including knowledge activities. It allows the "organization to interact with the external environment as an open ecosystem toward taking advantage of the easier analysis of environmental opportunities and threats which hopefully could lead to the growth and enhancement of its dynamic capabilities" [5].

Software development in the banking sector is crucial for maintaining operational efficiency and competitiveness. Key strategies include adopting agile methodologies, modular system architectures, and continuous integration and deployment practices.

"To develop the annual capacity planning, three key performance indicators (KPI) must be identified: resource input, total output, and implementation efficiency. The IT center of the bank will distribute the KPI to various departments and continuously monitor and evaluate throughout the year to ensure the achievement of the goals. The monitoring and evaluation process emphasizes continuous monitoring of the decomposition objectives of various departments throughout the year, assessing the risks for achieving the overall objectives and adjusting them in time. " [2].

"In the cognitive view, the business model indicates the cognitive structures of a firm's boundaries, how to configure and orchestrate, how to create value, and how to become an operational recipe for managers. The business model as a cognitive tool in banking can be used to guide managers in obtaining the cognitive structure of the organization, the structure and internal governance of the bank, and most importantly to create value in the bank"[8].

Agile methodologies, such as Scrum and Kanban, enhance flexibility and responsiveness, enabling teams to adapt to market and regulatory changes quickly. Modular architectures, like microservices, support scalability and maintainability, allowing for independent development and deployment of components.

"The necessity of having technical solutions supporting agile practices has been proposed in previous studies, particularly for frequent delivery in agile projects. To this end, there is a need to adopt a modular system architecture that enables teams to work independently. Furthermore, such an architecture is required if teams take ownership of the release management process" [9].

Containerization technologies ensure consistent environments and seamless updates, reducing errors and enhancing software quality. Effective communication and collaboration between development and support teams are essential for prompt issue resolution and continuous improvement. A comprehensive approach incorporating agile practices and modular architectures is vital for successful software development in the banking sector. This approach enhances performance, scalability, and customer satisfaction, positioning banks to navigate future technological and market changes effectively.

2.4.Evaluating the Existing Literature by SLR

This section refers to the process of SLR done with its results in each phase of this review method. It demands a critical, comprehensive, and systematic analysis of general studies.

2.4.1. Planning

This is the beginning of the SLR, and it should establish why this method will be performed, what the objectives of the results are, and what conclusions can be drawn. The questions must be created impartially and congruent with the research objective.

This phase of SLR reviews how the research was organized, which criteria were used to include or exclude an article or study for this research, the research string used to do the research, and the questions to be answered. In order to use the banking ecosystem to resolve the questions, the research included several topics, such as architectures, development lifecycle, and development methodologies.

The research questions were elaborated to identify and resolve the main problem to be studied in this research, which are:

RQ1: What do information system architectures look like in the banking industry?

RQ2: What are the banking industry practices and systems architectures used by application support team management?

RQ3: How can the best strategy for application support in large banking industry systems be defined?

To research to answer the questions above in this lecture review, the following search string was used:

("banking application support management" OR "application support" OR "ITIL" OR "software development") AND ("banking industry" OR "banking")

Based on this research, the term "*banking application support management*" was used as one of the strings to find articles on application support in banking areas, which could be core information to this research. However, the term "application support" alone was also included to increase the number of results.

The "Software development" string is crucial to this research since an application's support is related to the software development life cycle.

The clause "AND" is the string banking and banking industry used to assert the content of research focusing on the banking area. When the research was done globally, various types of returns were included, but they were not eligible for this study despite the complexity of software development in banking.

After searching using the provided string, a refinement step was performed to narrow down the results due to the high number of articles on the topic. Firstly, duplicate articles were removed. Then, articles unrelated to the research objective based on their keywords and titles were excluded. The same search was applied to two different sources of information to gather as much relevant information as possible for the research.

2.4.2. Conducting

This phase deals in detail with how the obtained results were properly filtered to arrive at a collection of articles that are truly related to the research. Additionally, the results will be characterized according to the research needs in this stage.

This step starts with the literature search; from the definition of the research string, the goal is to obtain the largest amount of data related to the subject and answer the string's questions.

The research string used to obtain the data is mentioned below:

("*banking application support management" OR "application support" OR "ITIL" OR "software development") AND ("banking industry" OR "banking")*

This string was used to query the B-On and SCOPUS digital libraries, using the 'advanced search' to include the inclusion and exclusion criteria (mentioned in table 1).

The use of two digital libraries in the research was justified by the need to obtain a sufficient number of relevant references for the study. Initially, the B-On digital library was used, and strict inclusion and exclusion criteria were applied. Although this library returned a large initial volume of articles, after applying specific filters for the IT field, language, publication year, and thematic relevance, only nine articles were deemed suitable. Given the limited number of references obtained, it was decided to complement the research with the Scopus digital library, which, after applying the same selection criteria, resulted in an additional fifteen articles. This approach ensured a broader and more robust coverage of relevant data, allowing for a more comprehensive and meaningful analysis of the investigated topics.

After entering the string research, the inclusion and exclusion criteria will be included to filter the relevant papers. The inclusion and exclusion criteria are presented in table 1.

Then, with the first set of papers selected, the abstracts will be read for a second filter to decide their relevance in the SLR.

In the semi-final step, the introduction and conclusion will be read to remove articles that have no research relevance.

Finally, the papers will be read to obtain the final selection results for the performance review. This protocol is mentioned in Table 1.

Inclusion Criteria	**Exclusion Criteria**
Articles from the IT area	Articles from other areas
Publication year after 2020 (B-On)	Publication year before 2020 (B-On)
Publication year after 2017 (SCOPUS)	Publication year before 2020 (SCOPUS)
Peer reviewed	Not peer-reviewed
Language English	Other Languages
Subject: Banking Industry	Subjects not related to the Banking Industry
Subject: Information-Technology	Subjects not related to Information Technology.
Subject: Management	Subject not related to Management.

Table 1- Inclusion and Exclusion criteria

The flowchart bellow illustrates the research process in a dataset, which starts with "Search by string in Dataset". The process involves setting inclusion and exclusion criteria, reading abstracts, and analyzing full documents as intermediate steps.

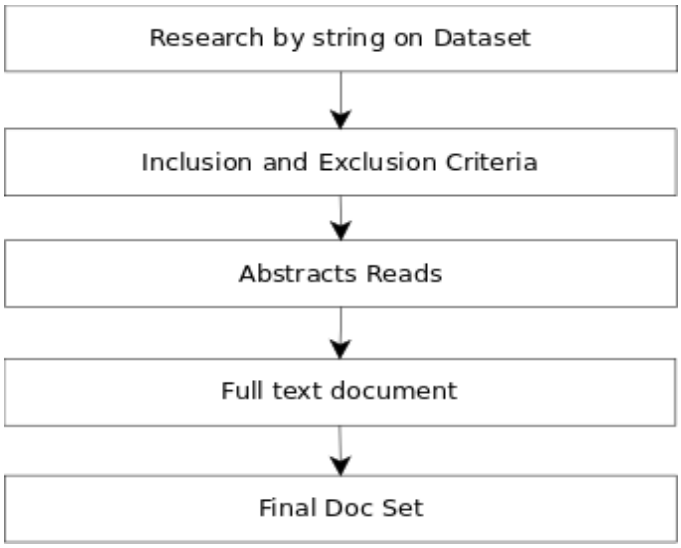


Figure 3- Review Protocol

Figure 3 depicts the Review Protocol, which outlines the sequential steps involved in conducting an SLR.

2.4.2.1.B-On Digital Library

Following the previously mentioned search criteria in the B-On digital library, the following steps were followed:

Applying the search string, the result of 74,384 articles was obtained. Next, we applied the following criteria: Only papers in the IT area, only papers in the English language, only papers published after the year 2020, only peer-reviewed papers, only papers that contained the subject Banking Industry, only papers that contained the subject Information-Technology, only papers that contained the subject Management. And then 359 results were obtained.

The abstracts of these 359 articles were read to determine the relevance of the information, and then 31 articles were obtained. These 31 articles were read from the introduction and conclusion, and 9 articles were excluded due to their lack of relevance to the investigation, resulting in 22 articles deemed suitable for this investigation.

All 09 articles were read to determine their added value to this research. We concluded that 9 articles have value and quality of information corresponding to the expected inclusion level in this report.

2.4.2.2. Scopus Digital Library

The previously mentioned search criteria were also applied to the Scopus digital library, following these steps: The hazing publish or perish application was used to search this database. After applying the search string, 99 articles were obtained.

Then we applied the following criteria: Only papers in the IT field, only papers in the English language, only papers published after the year 2017, only peer-reviewed papers, only papers that contained the subject Banking Industry, only papers that contained the subject Information-Technology, only papers that contained the subject Management. And then 80 results were obtained.

The abstracts of these 80 articles were read to determine the relevance of the information, and then 15 articles were obtained. These 15 articles were read to determine their added value to this research. Attention was paid to introducing these articles to facilitate the validation of aggregation.

2.4.2.3. Refinement of results found in libraries

Figure 4- Representation of the search in digital libraries - illustrates the selection process of research papers from Scopus and B-ON databases. Starting with 463 papers, duplicates were removed, reducing the count to 457. Further exclusions based on titles, abstracts, and content relevance resulted in a final selection of 24 papers.

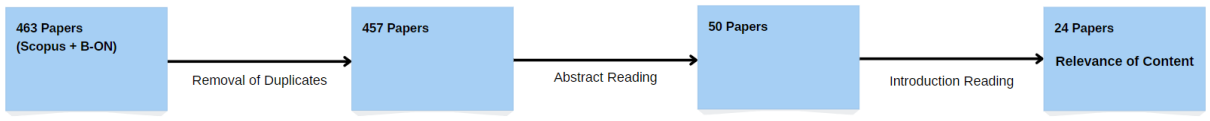


Figure 4- Representation of the search in digital libraries

We can see in Chart 1- Comparison between digital libraries that 9 of the selected articles were taken from the B-On digital library, and another 15 were obtained from the Scopus digital library.

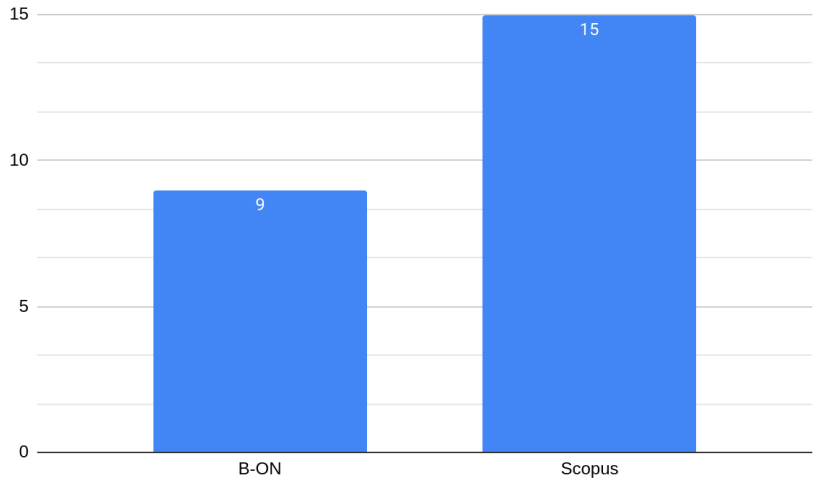


Chart 1- Comparison between digital libraries

The result comprises 15 articles, 62.5 percent of the research, and 9 conference papers, 37.5 percent.

We can identify that in Table 2- Year x Number of published articles x Representative percentage referring to the year and quantity of published articles.

Year	Articles	%
2017	4	16,66
2018	2	8,33
2019	1	4,16
2020	5	20,83
2021	8	33,33
2022	4	16,66
2023	0	0

Table 2- Year x Number of published articles x Representative percentage

It is possible to see in Table 2- Year x Number of published articles x Representative percentage that between 2020 and 2021, the number of articles with content considered of quality was higher than the other years considered in the inclusion and exclusion criteria.

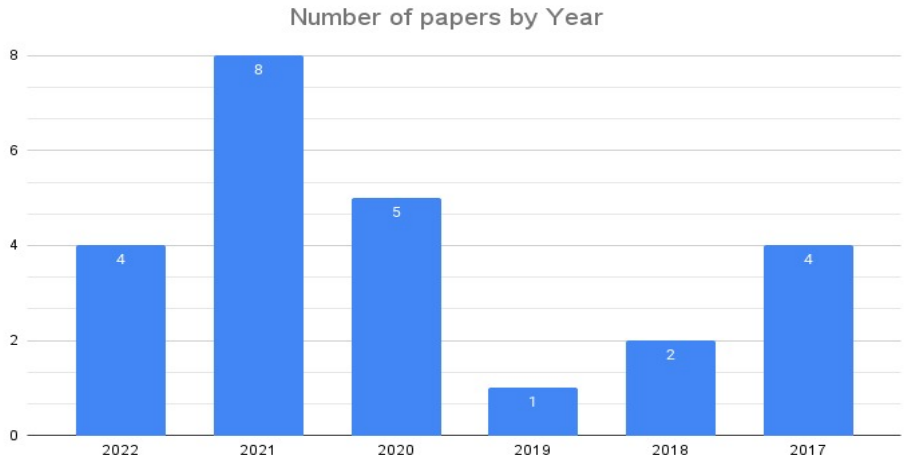


Chart 2- Number of papers by year

Chart 2 above illustrates a bar chart titled "Number of papers by Year", which displays the annual number of papers published from 2017 to 2022. In 2021, there was the highest number with 8 publications, compared to just 1 in 2019.

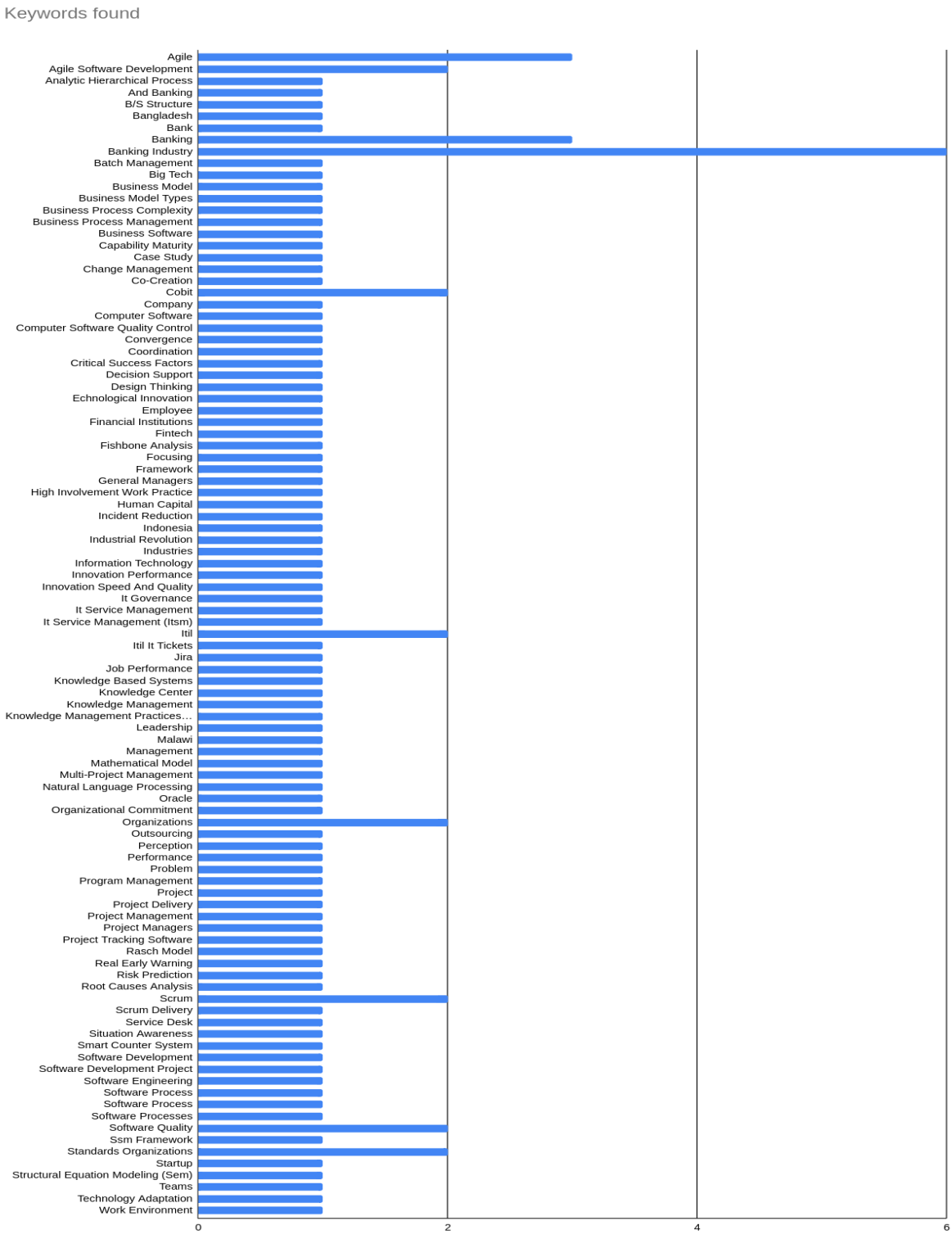


Chart 3 - Keyword occurrences

The bar Chart 3 - Keyword occurrences in the image show the frequency of keywords in research. Each bar represents a different keyword, such as "Agile", "Banking Industry", and "Change Management". This chart was generated using the abstract and keywords from the selected articles.

2.4.3. Reporting

This stage refers to the final stage of the **report,** in which the data extracted in the previous stage will be structured and summarized in a predefined format to meet the previously established research questions. As illustrated in Figure 5- Presentation of SLR report plan steps, the SLR Plan includes several important steps.

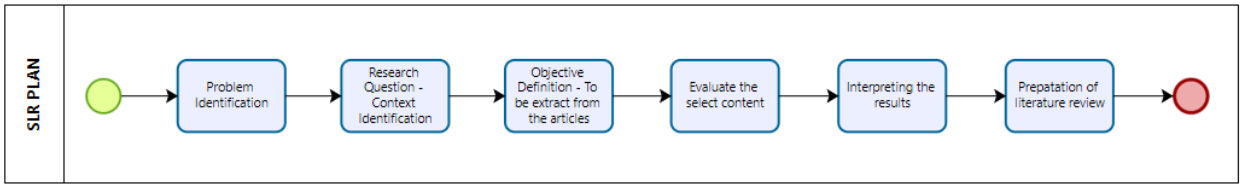


Figure 5- Presentation of SLR report plan steps

RQ1: What do information system architectures look like in the banking industry?

While reading the selected articles, it was found that the architectures of a banking application or system must consider several factors and cannot be considered a simple task. The most notable points were the human factor involved in this task and the complexity of system integrations.. We can consider the following examples:

"One of the first and most significant problems is complexity, which impedes decision-making and leads to excessively high and often hidden costs. There has been much interest in complexity research from both academia and industry. The term complexity has received much attention in different fields" [4]

"Sharing and use of data resources: This system is used by customers to handle banking business and is an integral part of the bank's peripheral system. The data interaction interface of the system should be unified with different business systems to ensure that customers can be accurately obtained in the process of business processing. Identity information, electronic business credentials, transaction data statistics, and other business information." [10].

"The modularization abstractions rely on the sharing of resources of the same machine (memory, databases, or files), and the components are, therefore, not independently executable" [11].

"In a contemporary business environment, intellectual capital is acknowledged as a valuable contribution to performance. Among other benefits, organizations that disclose high-quality intellectual capital have a better chance for innovations and R&D improvements. One of the major aspects of intellectual capital is human capital, which could be presented as an organization's entire available knowledge stock. Bearing in mind that we live in an information society where people are the main resource of organizations, it would not be possible to achieve significant improvements in business or performance without experts. This research aims to determine how CEOs and general managers of different departments perceive the association between human capital and performance, with a specific focus on the banking industry"[13].

"Developers are primarily responsible for developing the software product itself and jointly responsible for other parts of the software development life cycle, including design and testing." [6].

"The project manager focuses on the business case, the costs and benefits, and the timing and scheduling." [6]

"A software project is undertaken to reduce the cost of executing a process, and this can be used to estimate the benefit. For example, suppose an organization does not upgrade to the latest version of a third-party software package. In that case, its supplier will charge an additional cost to extend support for the old version. The costs and benefits can be quoted in advance. However, there are also more complex benefits, such as avoiding potential regulatory fines, preventing security breaches, or leveraging new features to expand a business.

Time is an essential part of cost-benefit analysis. The service life cycle for the existing software has a finite time, marked by its end-of-service-life date. The risk of a regulatory fine has a defined time when the regulation starts to be enforced. An overall business plan will have a date when the new business is aiming to launch. All these factors can be used to understand when a project must be completed. A project manager must balance all these factors as commitments are made and ensure appropriate resourcing." [6].

"From the second rank perspective (process perspective), we identified that the project type and simplicity have a big influence on a successful project tracking software implementation. The project needs to be defined as clearly as possible so the team can propose a simple solution to achieve the goal." [12].

"The company needs to create a great bond between the development team and the project. The development teams that perform well need to be rewarded by management. This will increase the team's motivation to deliver the project successfully." [12].

"Innovation quality can be analyzed through a product/service domain, a process domain, and an enterprise domain. Concerning products or services, innovation quality may be defined through variables like amount, effectiveness, features, reliability, timing, and costs" [13].

"They were focused on fixing defects and production bugs for the whole sprint. Furthermore, the squads were not marked as they did not deliver." [14].

"Companies and organizations have invested much money to develop, improve, and maintain information technology (IT) projects. They become increasingly reliant on their sophisticated and often complicated IT systems. Because their work becomes increasingly automated and computerized." [12].

As the baking area has a complex architecture, it was developed using a modularization concept, as described in the case of the study by S. Sakar:

"In industries such as banking, large software systems support numerous work processes and develop over many years. These systems often evolve into unmanageable monoliths due to repeated debugging and feature enhancements. To address this, practitioners sometimes rewrite the entire application or invest considerable time in documenting the code and training new engineers. This case study describes a modularization approach adopted to reengineer a monolithic banking application, highlighting the benefits of modularization in improving maintainability and scalability"[15]

Management needs to consider the changing and evolving market to avoid becoming obsolete:

"IT governance frameworks assist organizations with evaluating and addressing business operation issues instead of placing focus on how to develop specific technologies to address those issues." [16].

"The ability to react fast to a recognized need for a change of the functionality or performance of an existing software service, or an emerging business need for a new software service running in production, is becoming increasingly important." [1].

"Organizational commitment is directly influenced by organizational factors such as values and organizational behavior. It is also a critical tool for evaluating and improving organizational performance." [7].

"Project management tools and techniques can help organizations manage and handle projects efficiently and effectively." [12].

Information technology is regarded as a crucial factor in determining a company's success and its ability to undergo transformative upgrades:

"Information Technology (IT) grows very rapidly and affects the business life of a large number of organizations. IT role, not just a provider and service support now has become a strategic partner and structurally supporting business operations in facing their business challenge." [17].

"Each development team developed several products, interacted with different product owners, and faced prioritization conflicts that had to be escalated to the management board. The organization was restructured around the products. To this end, the list of products was reviewed, rearranged, and organized into four product areas: clients and channels, investment products, financing products, and payment products. A new role heads each product area, the product area manager (PAM), who is fully responsible for their products. Within each product area, there are product owners." [9].

"Different types of projects necessitate different procedural models to be completed successfully. A procedural model organizes project management methodologies and technologies into defined project phases or procedures." [18].

Based on the articles, we can answer RQ1 as follows:

In the banking sector, information system architectures are designed to handle complex, high-volume transactions, ensuring seamless integration across various subsystems. These systems must consider several critical factors, including human involvement, system integration complexity, and regulatory compliance.

Complexity and integration are essential characteristics of banking systems, requiring support for data sharing and interaction among different business units to ensure precise handling of customer information and transaction processes. Modularization is a common approach, where systems are divided into independent modules that share resources such as memory and databases, facilitating system maintenance and updates.

The effectiveness of banking system architecture heavily relies on professional IT teams who develop and maintain these systems, managing the entire software development lifecycle, including design, testing, and continuous support. Project managers play a crucial role in overseeing business cases, costs, benefits, and project timelines, balancing resources, and ensuring that projects are completed on time to meet regulatory requirements and business objectives.

RQ2: What are the banking industry practices and systems architectures used by application support team management?

The team designated to support the application must be prepared to act quickly in unforeseen situations, avoiding performance and financial losses. So, it is important to choose competent professionals and prepare them properly to act in the necessary support. In "Exploring banking business model types: A cognitive view," [8] mentions that:

"IT governance is an expensive solution, which is difficult to understand and control. Consequently, top executives must have deepened knowledge with more understanding to implement IT governance. Top management must be aware of all impacts and factors. At the same time, they must act as technical leaders with a broad set of skills and competencies to effectively support their operations in managing complex technical organizations." [19].

"Human capital is part of intellectual capital, although there is no consensus upon the components of intellectual capital in terms of theory and research. It can be defined as employees' collective knowledge, skills, and abilities."[13].

"It is proved that intellectual capital contributes to the profitability, efficiency, and earnings per share of organizations." [13].

"Traditional financial institutions have to compete in a constantly changing environment, serve their existing customers, and expand and develop their service portfolios." [20].

" Financial management is an important part of the bank management throughout the whole process of the banking business activities and is a comprehensive reflection of the bank management. It is not only the symbol of whether the banking business is good or bad, but it also indicates whether the reflects the bank operation effect." [21].

"The cc should also be updated and developed based on its existing knowledge and competencies." [5].

"The introduction of new IT and information system (IS) investments in an organization can affect the processes, structures, work environments, and strategies. Investigations have shown that the effects of new IT/IS connected to people system transitions are known as 'soft issues.' This will contribute to employee resistance and might lead to the IT/IS project failure if the organization cannot handle the sense of need and urgency for change." [12].

"Organic growth of the system means the creation and integration of complete, accurate, and usable supporting documents with prompt updates to the existing environment in production for the use of end users, operations and support staff, and business management. If required, adequate training must be provided to the related people, including business end users, IT operators, support and IT application development teams, and service providers to learn how to use the new and continuously changing system." [22].

Application support works with levels of problems to be solved. To guarantee that a professional with the necessary experience will perform the necessary tasks to solve the incident/problem. This relationship must be balanced so that the professional can perform the correct procedure at the correct time:

"The term "skilled team" refers to a group of people who are competent in general but have the relevant knowledge to complete all of the project's tasks." [12].

"The person's perception and comprehension of the relevant elements in the environment set the foundation for the SA and determine further BP decisions and actions. Hence, the SA is formed based on a comprehensive understanding of the current situation, i.e., the professional contextual experience of the BP worker (SA Level 1), business emotions, and quality of the written text, i.e., professionalism, expertise, and stress level of the text author (SA Level 2). Further, it allows for predicting the required BP worker's efforts (cognitive, attention, and reading comprehension) while preparing to execute the process/ task at hand. It also contributes to the BP complexity identification on the SA Level 3. A typical BP scenario of IT ticket processing is used as an illustrative application. Processing IT tickets is common for most businesses today. It has a clear start, steps, and end. This process records customer requests, problems, and complaints as IT tickets. Afterward, further steps are taken to process the ticket. As a rule, such a process is carried out by IT service desks. It starts when a customer submits a request and ends with the resolution of that request. It seems to be straightforward with many existing software solutions. However, the recent literature evidences various challenges in Service Management automation in general and unsolved problems in reporting and processing customer requests in particular." [4].

"In a contemporary business environment, intellectual capital is acknowledged as a valuable contribution to performance. Among other benefits, organizations that disclose high-quality intellectual capital have a better chance for innovations and R&D improvements." [13].

"IT governance frameworks assist organizations with evaluating and addressing business operation issues instead of placing focus on how to develop specific technologies to address those issues." [16].

"Information Technology (IT) grows very rapidly and affects the business life of a large number of organizations. IT role, not just a provider and service support now has become a strategic partner and structurally supporting business operations in facing their business challenge." [17].

"Each microservice is expected to implement a single business capability which brings benefits in terms of service scalability. Since each microservice represents a single business capability, discovering bugs or adding minor improvements does not impact other services and their releases. A single team can develop and manage a single microservice, enhancing the modularity and reducing inter-team dependencies"[11].

"The development of digital banking platforms encourages the adoption of agile software development processes, including user requirements captured as user stories and epics combined with non-technical requirements such as risk compliance and security. These requirements are managed in the product backlog, and the development features are prioritized based on team discussions"[18].

"Banks work with key partners in a way that creates synergies, and they can take advantage of each other's capabilities, resources, and activities" [8].

"Service operation includes functions like application management, which encompasses event management, incident management, and problem management" [6].

"An integrated method for solving complex IT multi-project issues in large banks is the batch-based agile program management model, which enhances coordination of multi-project management" [2].

"Banks collaborate with IT infrastructure partners to ensure the seamless functioning and support of banking applications"[8].

"To address the challenge of quickly launching new financial services, banks must adopt a modular system architecture and microservices. This approach facilitates the application of agile practices and improves the efficiency of application development and support"[9].

"Using agile methodologies such as Scrum and Kanban allows IT development and support teams to quickly adapt to changing market needs and enhances collaboration between teams"[18].

"Adopting a framework based on Spring+SpringMVC+MyBatis facilitates modular development and system scalability, meeting the support needs of multiple IT teams"[10].

"DevOps practices and test automation are essential for continuous maintenance and support of banking systems, ensuring operational quality and efficiency"[9].

"The migration from a monolithic to a microservice architecture at Danske Bank demonstrated significant improvements in scalability, as each microservice implements a single business capability, allowing for independent deployment and updates"[11].

"During the transformation of Turkiye Finans IT to agile models, integrating Scrum with COBIT v4.1 was crucial. This included restructuring teams and processes to comply with regulatory requirements while adopting agile methodologies"[22].

"Danske Bank's new FX Core system leverages Docker Swarm for orchestration, enabling automated continuous integration and deployment, which simplifies the management of services and enhances reliability through self-healing and load balancing capabilities"[11].

"In a COBIT-compliant environment, documentation and approval processes must be maintained rigorously, even when adopting agile methodologies. This includes iterative and incremental development of design documents with formal approvals from relevant stakeholders"[22].

Based on the articles, we can answer RQ2 as follows:

In the banking sector, the application support team plays a crucial role in managing systems and ensuring effective practices to maintain service quality. They regularly monitor servers to identify and resolve issues, prioritizing the core component of the system and guarantee its availability. This ensures that the system or application operates with quality, meeting the business needs.

The application support team is responsible for ensuring the availability of users and their services. They correct errors, manage unavailability, and handle integration issues between applications. This work is essential to maintain service continuity and minimize disruptions that could affect the business unit.

Support also encompasses performance testing and necessary upgrades. The team must ensure that applications function optimally and are updated as required. This involves conducting performance tests to identify potential improvements and ensuring the implementation of essential upgrades.

Additionally, the support team must be prepared to act quickly in unforeseen situations to avoid performance and financial losses. This requires selecting competent professionals and preparing them adequately to provide the necessary support. The ability to respond quickly is vital to minimizing negative impacts in case of unexpected issues, thereby ensuring operational efficiency and customer satisfaction.

Therefore, managing application support in the banking sector involves a set of well-defined practices, including continuous monitoring, maintaining service availability, performing performance tests and upgrades, and preparing to handle unforeseen situations effectively.

RQ3: How can the best strategy for application support in large banking industry systems be defined?

Banking application support management is responsible for how the application support will be performed for the product (application). At this point, we intend to demonstrate how the strategy for application support for banking systems is performed. Although this paper focuses on the banking area, application support covers the whole industry and commerce.

Its concepts are related to increasing the possibility of profitability and cost reduction, in addition to the proper functioning of the systems and their interconnection, ensuring their availability to customers and processes that need to be run in parallel.

"For decades, software engineering circles have debated how to structure software development to offer faster, better, and lower-cost solutions." [18].

"An organization should manage its projects because a project is an investment. Some issues, challenges, or problems may lead to a project failure. There are four main reasons for project failure: people, processes, technology, and organization." [23].

"Companies and organizations have invested much money to develop, improve, and maintain information technology (IT) projects. They become increasingly reliant on their sophisticated and often complicated IT systems. Because their work becomes increasingly automated and computerized." [12].

N. Rizun, A. Revina, and V. G. Meister [4] define Support Management as:

"As organizations develop and expand their businesses, interdependencies between their processes and information systems increase rapidly. To address this problem, organizations modify the technology supporting their businesses. As a result of such developments, organizations face substantial problems. One of the first and most significant problems is complexity, which impedes

decision-making and leads to excessively high and often hidden costs. There has been much interest in complexity research from both academia and industry. The term complexity has received much attention in different fields." [4].

The software allows the user to create and perform specific tasks. Some analysts ensure the quality of the software, and these professionals perform tests to identify problems and propose corrections. This process assures users of the quality of their systems and applications.

"Technology adoption focuses on the choice to acquire an innovation, while technology adaptation refers to the use of technology being changed or adapted by people in the organization. In this paper, we examine the notion of technology adaptation. We argue that technology choice is not merely a matter of implementing the latest innovation (technology adoption); rather, an organization must have the ability to adapt the technology (technology adaptation) to connect and meet the needs of their customers." [24].

In "Becoming a Successful Software Manager - ProQuest." [6] it is clarified that:

"For a software project to succeed, the manager must exemplify and drive a quality culture in everything the manager and the team do. Making the developer-to-manager transition is difficult, and there will be many highs and lows along the way." [6].

In a banking system, the software is prepared to work individually but connects to other applications and synchronizes data between operations. In other words, they define a software system as a car project that has individual processes working simultaneously:

"Each project, just like a private car, project planning, organization, and controlling (e.g., performance assessment and writing monitoring report) are executed separately for each project. For example, we must implement project configuration management, schedule, and risk management for each project separately. The development, testing, and commissioning environments will be prepared for each project at each stage. We must arrange and put the training tasks into production for each project separately. Project performance assessment and monitoring reports will be executed for various projects. The traditional individual project management method leads to problems such as poor project coordination, frequent system shutdowns, huge resource waste, and quality problems. Due to the limited resources in software development, multiple projects can be arranged in overlapping or parallel, in which the resource, environment, technology, and process are similar and interdependent. These interdependencies represent a rationale for the multi-project operation, involving the synergy of common technologies and other capabilities." [2].

"Providers in many markets show great interest in reference models that describe generally accepted practices for effective IT service delivery. These good practices typically cover the design of service processes, roles, and functions" [25].

"allows for automated service restart and provides self-healing capabilities. It also enables service discovery and load balancing, which are essential for maintaining service reliability and performance"[11].

Centralized logging and monitoring through services "allow for the aggregation of logs and metrics from all services. This centralized system status overview enables proactive action on suspicious and faulty behavior, enhancing the overall reliability and efficiency of the application support system"[11].

"We have placed the Sprint Zero step in order to identify and remove possible uncertainties around project scope, cost schedule, and technical strategy. There, adequate grooming is conducted, which is required for launching Sprint 1. Apart from getting the big picture in design, this step has fortunately reduced the documentation overhead to a level"[34].

"Program management is needed to coordinate the program's projects as well as related teams and activities to deliver the strategic change for the organization"[2].

"There is an integral focus on the total cost of ownership of services over their entire service life cycle, which includes constant improvements after the service's initial development" [6].

"A good project manager is risk-aware at all times and meticulously records, tracks, and ensures the risks are addressed properly by the right team member or stakeholder" [6].

"Although agile software development methods can improve the efficiency of individual projects significantly, they still lack effective control for programs to reduce management complexity" [2].

"Successful agile transformation in financial institutions requires the agile mindset to permeate the entire organization, not just the development teams" [9].

"Training in agile methodologies is crucial for organizations to implement agile practices effectively, enabling them to develop knowledge and be better prepared for the implementation of these methodologies"[9].

"Implementing agile practices fully rather than partially is essential. Selective application of agile practices within a traditional development process can limit the benefits of agile methodologies" [9].

"Using dynamic and collaborative roadmaps between product managers and development teams helps align goals and prioritize tasks effectively, improving support and system delivery" [9].

"Turkiye Finans achieved significant success by transforming all production and project teams to agile models. The strategy involved extensive training and restructuring to ensure compliance with COBIT while adopting Scrum, leading to improved efficiency and project management"[22].

"Implementing continuous training for all levels, including C-level executives, relevant business units, and outsourcing resources, was crucial in supporting the agile transformation at Turkiye Finans. This approach ensured that all stakeholders were aligned with the new agile processes"[22].

"The migration process at Danske Bank was business-driven and outside-in, focusing on implementing one business functionality at a time based on priority. This strategy helped avoid the pitfalls of reimplementing a distributed monolith and ensured that each new service added value independently"[11].

"Adopting containerization and automated continuous integration and continuous deployment pipelines were key strategies in improving the deployment process at Danske Bank. This approach enabled consistent environments across development, testing, and production, facilitating smoother updates and maintenance"[11].

Based on the articles, we can answer RQ3 as follows:

To define the best strategy for application support in large banking industry systems, it is essential to consider several aspects that ensure the system's availability, performance, and reliability. Based on the provided document and additional text, here are the key components for defining an effective strategy:

Integrating development and support teams is fundamental. Establishing clear communication channels between these teams ensures that issues can be resolved quickly and efficiently, leveraging the expertise from both sides. Regular meetings to discuss ongoing issues, upcoming changes, and feedback from both teams help maintain a continuous improvement loop.

The use of automation and knowledge management is also crucial. Implementing automation tools for routine tasks frees up time for more valuable activities focused on system and application improvement.

Creating an accessible and comprehensive knowledge base, along with proper documentation, allows frequent issues to be resolved faster and promotes information sharing among team members. Encouraging individuals to contribute to this repository as part of their daily routines leads to the growth and maturity of knowledge management processes.

Developing facilitative leadership is another essential component. Team leaders should act as facilitators, removing barriers immediately and prioritizing support for the team with essential resources. They should adopt a servant leadership approach.

Promoting continuous improvement is vital. Establishing a continuous feedback loop that ensures development teams are aligned with the support crew ensures that leadership values are in place, resulting in continuous process improvement and product quality assurance. Encouraging autonomy with responsibility is also important.

Teams should be encouraged to find alternative solutions and new ways of solving problems while taking responsibility for their actions. Regular meetings to review processes and conduct retrospectives help build a culture where making mistakes, learning, and adapting are part of the decision-making maturation process.

Incorporating quality practices from the project's inception is essential to avoid existing problems and build a solid foundation for quality. Developing a partnership-based relationship between development and support units is fundamental. Information can be passed to the development team to enhance product quality based on customer feedback.

Finally, regularly assessing the impacts of the organizational structure on efficiency and customer satisfaction is crucial. Conducting a weakness analysis and eliminating these weaknesses to make the product more cost-efficient is a recommended practice.

These combined components ensure a robust strategic approach to application support in large banking industry systems, promoting continuous improvements and long-term success.

2.5. Conclusion SLR

It was possible to identify some relevant discussions from the SLR based on the selected documents or articles, such as:

In banking applications or systems, which are characterized by their high complexity and the seasonality of some applications, quality and service level management of certain applications, the management of quality and service levels faces significant challenges.

These challenges include making informed decisions regarding the establishment of a support team adjacent to the development team, especially considering the unique importance of each application.

Decision-making for management becomes increasingly complex when considering factors such as costs, human resources, and operational capacity. Additionally, there are difficulties in assessing scenarios and the potential risks associated with system inaccessibility or diminished quality in application support.

It is challenging for managers to make decisions on how to analyze the human factor and the knowledge levels of professionals. This complexity underscores the necessity for an approach to evaluating aspects affecting the operational efficiency and efficacy of support and development teams.

The product solutions also present a better form of economy in complex systems while maintaining the entire internal IT structure of the bank, allowing for optimal product management. Regarding application support, IT governance incurs high costs.

It is often difficult to understand and control, but it is indispensable for managing the service level of the product, whose importance must be clarified to management.

Additionally, the fact of application modularization in the banking environment can be highlighted here, with the diversification of methods and technologies to meet business needs, further increasing the complexity of available applications.

The Systematic Literature Review showed the main obstacles and recommendations for handling app support in banking. The complexity and system architecture interconnectivity of banking services systems should be managed effectively to provide stable and qualitative service. In addition, it was stressed that the methods and practices of management should be introduced to increase the effectiveness and quality of support.

The decision to either integrate or separate the development and support teams is also seen as another crucial issue since it all depends on the frequency or the complexity of issues experienced alongside the business impact. Teams with integration can help in highly complex environments; separation, meanwhile, will be more applicable in situations where recurring problems often happen. It is necessary to maximize collaboration and ensure that people receive assistance of the highest quality and efficiency.

Furthermore, the results are taken as a basis for designing an evidence-based set of guidelines that are aimed at enhancing cooperation between the development and support teams.

The findings of this critical study have far-reaching implications and significance. It was accepted at CENTERIS - International Conference on Enterprise Information Systems 2023 and at CISTI - Iberian Conference on Information Systems and Technologies.

It was decided to proceed with the publication of an in-depth position paper at CISTI, as the systematic literature review (SLR) was already completed.

This praise is the outcome of the best of both worlds. Displaying this article at the CISTI'2024 conference will, in turn, provide this implementation with an opportunity to cover a large number of researchers and industry representatives with the aim of helping them make better deals.

Chapter 3

Survey

Chapter 3 - Survey

Based on the findings from the Systematic Literature Review (SLR), the survey was developed to gain a deeper understanding of the current practices and challenges in the integration of application support in the banking sector. The SLR identified gaps and recommendations that required further practical validation and detailed exploration.

Semi-structured interviews were conducted with experienced banking professionals to address this exploration. This chapter will describe the methodology used for collecting and analyzing qualitative data from these interviews, providing additional practical information and supporting the conclusions drawn from the SLR.

The second phase involved semi-structured interviews with experienced banking sector professionals as a means of obtaining an in-depth understanding of the current practices and challenges of the industry. This chapter will illustrate how qualitative data from the interviews are collected and analyzed, giving additional practical information and supporting the SLR findings.

This chapter describes the method used to achieve the goal of this project.

Based on the identification of the problem and the analysis of the research questions (RQs) outlined in the systematic literature review, the survey was designed as a survey conducted through interviews, following the framework established by H. Freitas, M. Oliveira, A. Z. Saccol, and J. Moscarola in their work "O Método de Pesquisa Survey".

"A survey is appropriate as a research method when you want to answer questions like 'what?', 'why?', 'how?' and 'how much?', that is, when the focus of interest is on 'what is happening' or 'how and why is this happening" [26].

"The interview, especially the structured one, is a data collection technique that allows the researcher to obtain detailed and contextualized information directly from the interviewees, which can increase the accuracy and depth of the responses obtained" [26].

The semi-structured interview research method was defined as the tool for this study. This determination was the foundation that directed the next phases of the study: preparation, definition, implementation, and analysis of the data obtained through the interviews. As represented in Figure 6 - Methodological structure, the Investigation Process includes several important steps.

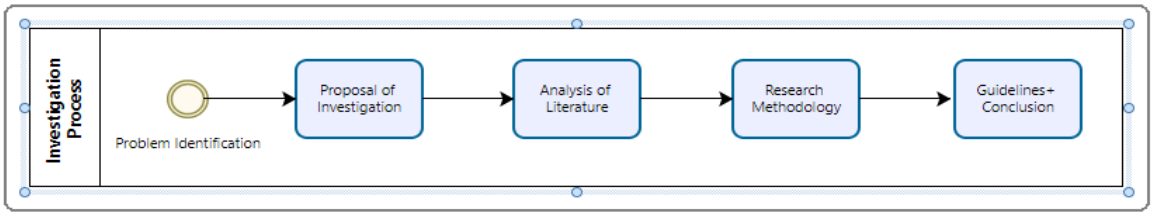


Figure 6 - Methodological structure

The methodological structure of the study is organized as follows:

- Proposal of Investigation:
  - Objectives, Investigation Questions, and Methodology - Define the study's objectives, questions to be answered, and the data gathering and analysis methods used to build the case.

- Analysis of Literature:
  - State of the Art - Up-to-date capabilities and the existing plans of the banking sector when it comes to application management and support.
  - Systematic Analysis of Literature - Critical analysis of the literature review and synthesis of the work of scholars to know deficit areas and best approaches.

- Survey:
  - Research Problem - The focus of the research is on the problem that is contained in the integrative application support.
  - Selection of the Survey Methodology - Research technique to investigate the issue with specialists supported by interviews.
  - Development of the Survey and design for interviews - Develop the questions and structure the interview to collect the most assertive data.
  - Execution of the Survey - realization of interviews - Carrying out interviews of some selected banking professionals to collect the information that can help.
  - Analysis and Extraction of Interview Data - Analyze the results obtained from interviews and perform the analysis of collected data to get a sustainable conclusion.

- Conclusion:
  - Guidelines - Evaluate strengths and lessons learned extracted by the interviews and the RSL and deliver them as guidelines.
  - Limitations - Discuss the constraints and limitations encountered during the study.
  - Future Work - Identify possible areas for future study that could be suggested to build upon the basis of results and deduce the remaining inquiries.

An interview protocol was elaborated, containing six questions directed at the study participants. After the interviews, the collected data were organized, extracted, and analyzed.

Based on this analysis, a set of guidelines was formulated to assist in making decisions related to operational support teams for applications in the banking sector to discuss and propose a solution to the research problem identified in this study.

3.1. Interview

This section demonstrates the survey methodology and explains the interview method for application in this project. The Survey based on interviews is qualitative research based on questions that the researcher prepares for the collection of deep and detailed data from its invited participants.

It consists of communication between two or more people, one being the interviewer who conducts the interview and the other(s) the participant(s) who provided their points of view on each question. The invited participants (nine in total) are chosen based on their experience or comprehensive knowledge of the topic of interest.

3.2.Types of Interviews

The interviews can be classified into three main categories:

- *Structured*: This type of interview is prepared with high accuracy, and the questions follow a fixed list to ask all responders. Such an interview allows an easy way to analyze data and is primarily used when the scientist is aware of the need.
- *Semi-structured*: Even though there is a predefined script of specific questions, the responder and the interviewer can develop a topic further inside the conversation and ask more questions.
- *Unstructured:* This is a model completely developed from one of the previous ones. It is very flexible, and although it has one theme, the entire conversation is left to develop naturally. As exemplified in Figure 7- Data collection workflow, the Investigation Process includes a few steps to take into consideration.

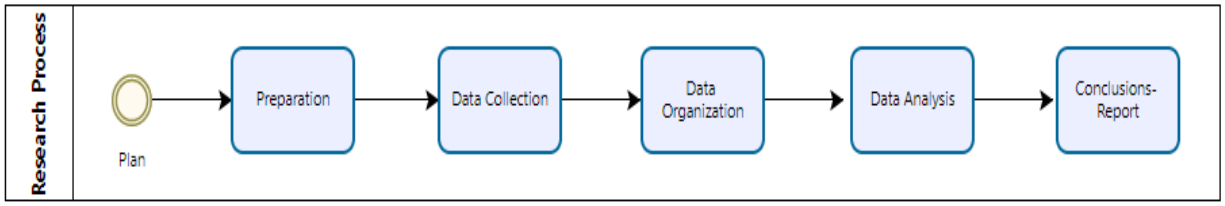


Figure 7- Data collection workflow

3.3. Interview Script

A script with questions was developed based on the findings from the Systematic Literature Review (SLR), which sought to identify key themes and gaps in current practices.

The interviews were designed to be semi-structured, allowing for maximum flexibility while encouraging participants to elaborate on their opinions and experiences beyond simple answers.

This approach aimed to delve deeper into specific areas that could inform the development of comprehensive guidelines. Participants were encouraged to share their insights freely, ensuring that the data collected would be rich and detailed, providing a robust foundation for the proposed decision support guidelines.

We invited **nine experts** in the relevant field for entrance on a professional basis. Regardless of their employment at different banks in four countries, all of them were chosen because they were experts in their fields, thereby adding cultural diversity and unique insights to the topic.

The nine participants in this study were selected based on their remarkable success stories and recognized expertise in the banking sector.

Each of them holds strategic positions such as Project Manager, Systems Analyst, and Vice President, bringing extensive experience ranging from 13 to 32 years in their respective fields.

These professionals were chosen not only for their qualifications but also for their significant contributions and in-depth knowledge of the challenges and dynamics of application support and development in the banking industry.

The selected professionals are distinguished by their advanced and practical experience, and specialization skills in their field were considered when selecting participants – Managers, developers, and application support analysts at the development and production levels.

The table below (Table 3 - Interviewers information) details the relationship of participants, their respective roles, years of experience, and location.

Participant	Field	Position	File Name	Experience	Location
Interview 1	Development	Systems Analyst - Programmer	3 - EGH	13 Years	Portugal
Interview 2	Support	Systems Analyst - Application Support	8 – VKM	17 Years	Chennai
Interview 3	Development	Systems Analyst - Programmer	4 – LCA	29 Years	Chennai
Interview 4	Management	Project Manager	5 – LCN	14 Years	Luxembourg
Interview 5	Management	Project Manager	9 – ZMN	21 Years	Luxembourg
Interview 6	Management	Vice President	1 – ANT	24 Years	Brazil
Interview 7	Management	Project Manager	2 – EDR	24 Years	Brazil
Interview 8	Support	Systems Analyst - Application Support	7 – TCR	15 Years	Brazil
Interview 9	Management	Project Manager	6 – PSC	32 Years	Luxembourg

Table 3 - Interviewers information

The following table (Table 4 – Questions raised in the interview with the RQs) represents the interviews and their objectives. The questions were formulated to gather general insights and experiences not specifically tied to the participants' current workplaces. This approach ensured a broader perspective on the topics discussed, allowing for more universally applicable findings:

Nº	RQ	Interview Question	Reason/Objective
1	RQ1	How would you describe the interaction between the application support team and development, and what are the main challenges or problematic points that you identify in this dynamic?	The question is formulated to receive information about the current state of the interaction between application support and development teams and determine any problems and difficulties that affect the quality of interaction work.

2	RQ2 RQ3	What are the processes between application support and development teams that directly affect the application's service level?	The information from the answer provides data on which communication enterprises there are. The tasks to increase the level of service on this application should be subject to integration.
3	RQ3	What criteria or performance indicators would you consider relevant for assessing the effectiveness of the process of allocating the application support team to development or keeping them separate?	This question aims to identify the criteria and indicators that will be relevant to use objectively and in a data-based decision-making process.
4	RQ2 RQ1	In your opinion, what are the main benefits of keeping the application support team separate from development? And what would be the main benefits of integrating these teams?	This question should reveal the 'respondent's perception regarding the benefits of separation or integration. Their answers can give other insights into the analysis of the benefits and disadvantages.
5	RQ2 RQ3	How does the interaction between the application support team and development affect the efficiency and quality of the services provided?	Define potential fields of improvement, correct the processes, and outline the strategies that will lead to more fruitful and collaborative interaction of the specialists involved.
6	RQ3	What are the impacts of separating or integrating the application support team with development?	Evaluate the effects of different organizational and collaboration approaches between the application support team and development.

Table 4 – Questions raised in the interview with the RQs

The interviews were recorded and securely stored in a private folder that is not publicly shared, ensuring that only authorized individuals can access the data. Each file was labeled based on the participant and the interview date to facilitate organization and access during the analysis phase. Additionally, a consent form was sent to and signed by each participant, ensuring that they were fully informed about the purpose of the study and the handling of their data.

The NVivo software was chosen due to its advanced analytical tools and easy way to demonstrate the gathered data with a commitment to the integrity and accuracy of the processed information, providing a robust platform for categorizing and thematically analyzing the collected data. Utilizing NVivo allows for efficient organization, categorization, and visualization of data. This powerful tool enables researchers to systematically manage qualitative data systematically, facilitating deeper analysis and clearer insights through its robust features. Gathered during the

interview is maintained at the highest level, respecting the privacy of the participants and ensuring the validity and reliability of the research results.

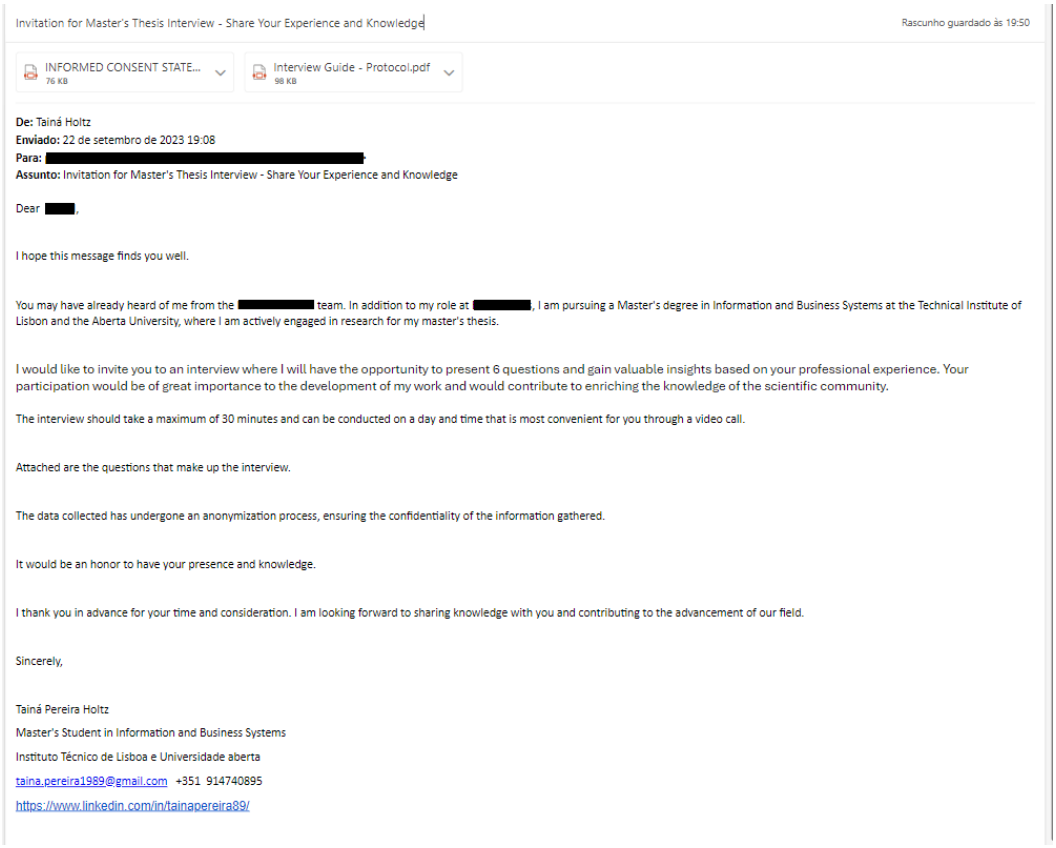
The interviews conducted for this research had their contents securely stored using a structured digital folder system. The files were named and categorized according to the order of the interviews and the participants to ensure the integrity and confidentiality of the data. The Table 5 - Files organization illustrates the organization of the files:

Participant	**File Name**	**Format**	**Size**	**Date**	**Time**
Interview 1	3 - EGH	Documento do Microsoft Word (.docx)	23 KB	25/09/2023	09:00 PM CET
Interview 2	8 – VKM	Documento do Microsoft Word (.docx)	19 KB	26/09/2023	01:00 PM CET
Interview 3	4 – LCA	Documento do Microsoft Word (.docx)	27 KB	29/09/2023	05:30 PM CET
Interview 4	5 – LCN	Documento do Microsoft Word (.docx)	26 KB	29/09/2024	10:00 PM CET
Interview 5	9 – ZMN	Documento do Microsoft Word (.docx)	28 KB	30/09/2024	01:30 PM CET
Interview 6	1 – ANT	Documento do Microsoft Word (.docx)	22 KB	03/10/2023	08:00 PM CET
Interview 7	2 – EDR	Documento do Microsoft Word (.docx)	27 KB	05/10/2023	02:30 PM CET
Interview 8	7 – TCR	Documento do Microsoft Word (.docx)	28 KB	09/10/2023	11:00 AM CET
Interview 9	6 – PSC	Documento do Microsoft Word (.docx)	17 KB	12/10/2023	02:00 PM CET

Table 5 - Files organization

The information collected during the interviews was transcribed into Word documents to use as input on the NVivo software. Each file received an abbreviation and guaranteed the anonymity of the interviewees.

The interview participants were provided with a detailed explanation of the purpose of the research, the expected duration, the interview structure, and the questions that would be discussed and addressed one day before the interview. Therefore, in this document, the disclosure of the answer was also stressed.



Invitation for Master's Thesis Interview - Share Your Experience and Knowledge

Rascunho guardado às 19:50

INFORMED CONSENT STATE... 76 KB

Interview Guide - Protocol.pdf 98 KB

De: Tainá Holtz
Enviado: 22 de setembro de 2023 19:08
Para: [redacted]
Assunto: Invitation for Master's Thesis Interview - Share Your Experience and Knowledge

Dear [redacted],

I hope this message finds you well.

You may have already heard of me from the [redacted] team. In addition to my role at [redacted], I am pursuing a Master's degree in Information and Business Systems at the Technical Institute of Lisbon and the Aberta University, where I am actively engaged in research for my master's thesis.

I would like to invite you to an interview where I will have the opportunity to present 6 questions and gain valuable insights based on your professional experience. Your participation would be of great importance to the development of my work and would contribute to enriching the knowledge of the scientific community.

The interview should take a maximum of 30 minutes and can be conducted on a day and time that is most convenient for you through a video call.

Attached are the questions that make up the interview.

The data collected has undergone an anonymization process, ensuring the confidentiality of the information gathered.

It would be an honor to have your presence and knowledge.

I thank you in advance for your time and consideration. I am looking forward to sharing knowledge with you and contributing to the advancement of our field.

Sincerely,

Tainá Pereira Holtz
Master's Student in Information and Business Systems
Instituto Técnico de Lisboa e Universidade aberta
taina.pereira1989@gmail.com +351 914740895
https://www.linkedin.com/in/tainapereira89/

Figure 8 - Invitation for interview

A formal consent form was also attached to this email, As shown in Figure 8 - Invitation for interview.

This document provided a well-detailed purpose that informed the participants that all the data collected would be used solely for academic purposes. It also stated that it would take the confidentiality and anonymity of the responses as “it is this way that it is guaranteed that all the data would be treated with the highest care and protection.”

Informed consent was requested to clearly understand that participants have all the right to know the details of the work and the information that will be given during the interview, as demonstrated in Figure 9 - Consent Statement model.

INFORMED CONSENT STATEMENT

I, the undersigned, hereby agree to participate in an interview with the purpose of contributing to the understanding of the needs of online higher education teachers to support self-regulation and co-regulation of learning, in the context of Tainá Pereira Holtz's master's dissertation in Information and Business Systems, a joint program of Universidade Aberta (UAb) and Instituto Superior Técnico.

The research objective is to comprehend the perspective, understanding, experience, and opinions of the interviewees regarding relevant aspects of decision-making support for the integration of application support in the banking sector.

I acknowledge that the provided data will remain confidential and will only be used for academic purposes. I have also been informed that my participation is voluntary, and I may discontinue it at any time.

I consent to participate in the study and authorize the recording of the interview in video format.

Date 26 of September of 2023

Interviewee's Signature

_____

Figure 9 - Consent Statement model

In this email, a detailed interview script was also included as an attachment. The script contained the topic, objectives, methodology, structure, and questions that would be addressed (as outlined in Table 4, presented earlier). This information was provided to help participants adequately prepare for the interview.

Chapter 4

Data Extraction and Analysis

Chapter 4 - Data Extraction and Analysis

The data collected from the interviews were processed using the software 'NVIVO 14'. "The choice and use of this software add quality and lend more credibility to the investigation" [27].

Before the interviews, participants received (via email) a detailed guide about the interview. This document included crucial information about the topic addressed, the purpose of the interview, the estimated duration, the objective, the structure of the interview, the questions that would be discussed, and the purpose of each question.

Aiming to facilitate the participation of global experts and enrich the dataset with a wide variety of perspectives, the interviews were conducted online through the Microsoft Teams application. This approach not only enabled the inclusion of professionals from different parts of the world but also added diversity to the collected responses.

Each session was recorded to ensure the accuracy of the collected data. Subsequently, the recordings were transcribed and converted into Word documents. This process facilitated the organization, analysis, and extraction of relevant information, ensuring the integrity and quality of the obtained data.

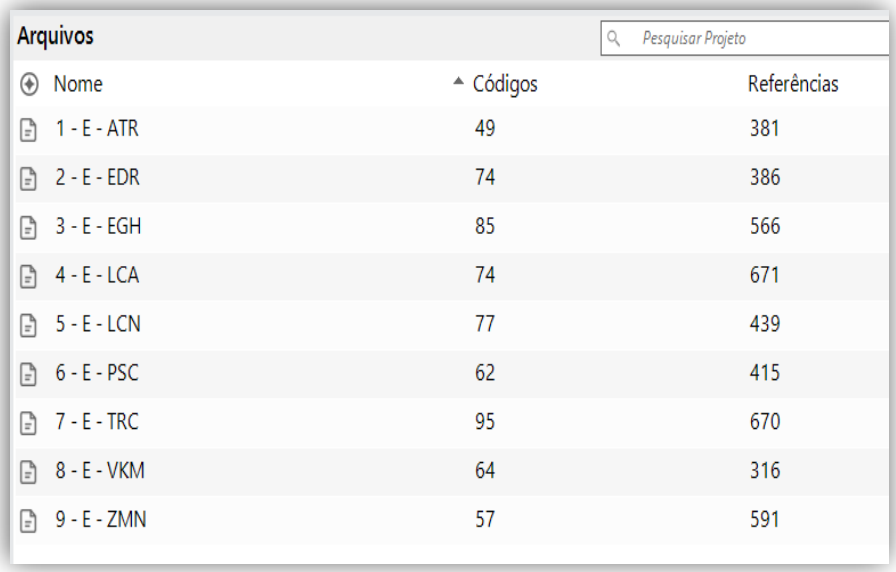
4.1. Data Processing

The project's scope seeks to understand the perspectives and viewpoints of the interviewees and identify common points among the **nine (9) conducted interviews**. The shared information was deeply analyzed, and relevant points present and regular among the interviews were highlighted. This data analysis procedure ensured a perspective on the experiences shared by the participants and facilitated the organization of the collected data.

This chapter presents a detailed analysis of the qualitative data collected during the research period. Using a combination of word clouds, frequency analysis, and automated thematic coding, key themes that emerged from the data were identified.

This multifaceted approach allows a comprehensive understanding of the concepts and ideas expressed by the participants. The methodology employed in this research involved conducting interviews, whose data were imported into the NVivo program for analysis and classification.

The texts were organized, and some excerpts were chosen and marked with codes, as highlighted in Figure 10 - Files (Interviews submitted to NVivo).



Arquivos

Pesquisar Projeto

Nome	Códigos	Referências
1 - E - ATR	49	381
2 - E - EDR	74	386
3 - E - EGH	85	566
4 - E - LCA	74	671
5 - E - LCN	77	439
6 - E - PSC	62	415
7 - E - TRC	95	670
8 - E - VKM	64	316
9 - E - ZMN	57	591

Figure 10 - Files (Interviews submitted to NVivo)

Codes are like labels for themes that demonstrate the data categories.

These categories can be created beforehand using a specific vocabulary or can emerge organically as the data is analyzed. In this study, codes were established based on the research questions (RQs), ensuring that each code represented an important aspect of the study. Subcategories were defined based on the theme that each question covered.

Analysis of qualitative data was first categorized by 'theme.' First, codes were established in the NVivo tool, and then a grouping by larger themes was performed. These themes were adapted for a more appropriate presentation of the data.

The analysis result of these themes is visible through word clouds and frequency comparison charts, showing the frequency of themes intuitively and more explicatively.

4.1.1. Word Cloud Analysis

The word clouds provide a visual representation of the most frequent terms within the dataset.

Figure 11 - Frequent Word Cloud in the files

From the word clouds, Figure 11 - Frequent Word Cloud in the files, it is evident that terms like "development," "project," "team," "quality," "production," "interaction," "communication," and "support" are highlighted, suggesting a focus on team dynamics and project development in the operation context (production environment).

4.1.2. Comparative Analysis

Figure 12 - Compared by the number of references, files, and codes, shows the themes that appeared most frequently in different interviews. The chart allows us to intuitively identify which words and themes were most repeated by the participants.

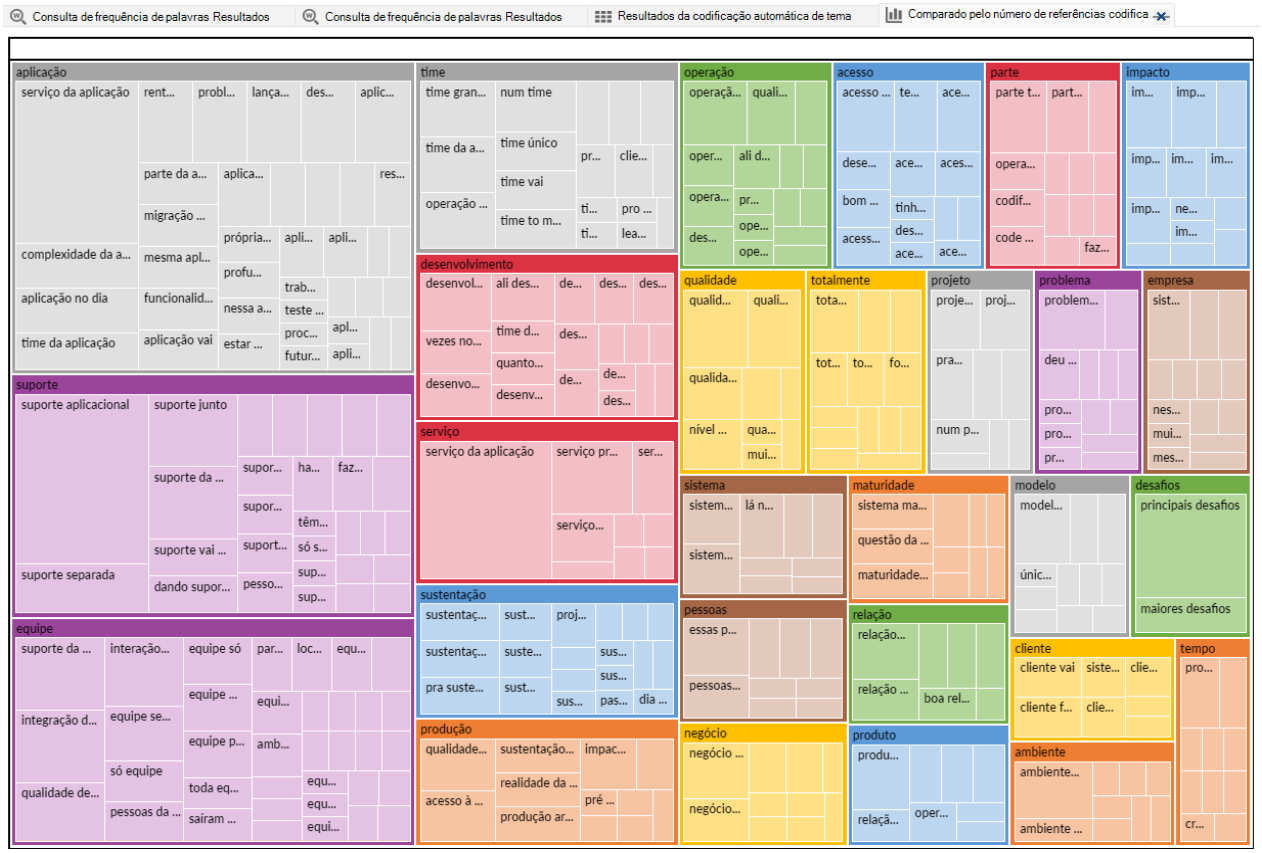


Figure 12 - Compared by the number of references, files, and codes

For example, it can be highlighted that the themes were repeated, emphasizing that the participants value teamwork and collaboration and that they were predominant themes in different files (interviews).

4.1.3. Key Words Analysis

The codes were organized into three main categories, subdivided into seven subcategories each, enriched with specific keywords that will be detailed below, providing a clear and structured view of the themes addressed, as demonstrated in Figure 13 - Generated Codes.

Nome	Arquivos	Referências
(RQ1) Arquiteturas de Sistema	9	28
Q1 - Desafios - Interação	9	9
Q6 - Eficiencia e qualidade	9	10
Q7 - Impactos	9	9
(RQ2) Praticas de Gestão Atuais	9	18
Q2 - Processos e nivel de Serviços	9	9
Q4 - Beneficios Integrar - Separar	9	9
(RQ3) Definição de Plano de Ação - Melhores Praticas	9	18
Q3 - Indicador de desempenho	9	9
Q5 - Critérios de decisão	9	9

Figure 13 - Generated Codes

The code "RQ1: System Architectures" covers subcategories that encompass topics from interview questions 1, 6, and 7, aiming to elucidate the structures of information system architectures specific to the banking sector.

As shown in Figure 14 - Word Cloud – Code RQ1: System Architectures, the NVivo tool indicates that the most used keywords were:

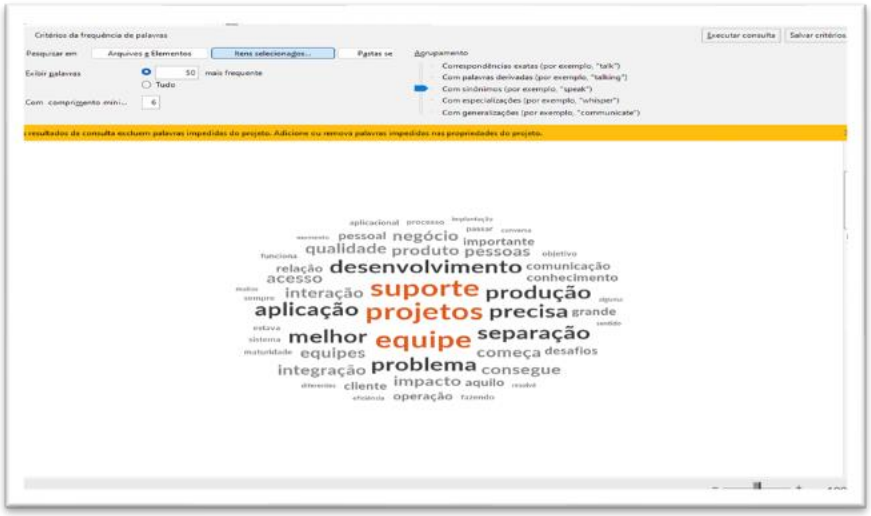


Figure 14 - Word Cloud – Code RQ1: System Architectures

This category aims to detail and understand the technological and strategic configurations adopted in the banking industry for the management and operation of their information systems.

Palavra	Extensã	Contage	Percentual ponderado	Palavras similares
projetos	8	172	1,78	desenha, desenho, empresa, planos, programa, projeto, projetos, trabalha, trabalham, trabalhamos, trabalhando, trabalhar, trabalhava, trabalhavam, trabalhei, trabalhem, trabalho
suporte	7	154	1,60	baseados, suporta, suporte, sustenta, sustentação, sustentando, sustentar
equipe	6	130	1,34	brigando, brigas, equipa, equipe
desenvolvimen	15	110	1,14	desenvolve, desenvolvem, desenvolvendo, desenvolver, desenvolveu, desenvolvimento, desenvolvimentos, evolução
problema	8	64	0,66	aperto, dificuldade, dificuldades, problema, problemas
separação	9	62	0,64	separação, separada, separadas, separado, separados, separar, separaria
aplicação	9	55	0,57	aplicação, aplicações, aplicativos, implementação, realizado
precisa	7	53	0,55	precisa, precisam, precisamos, precisar, precisarmos, preciso, precisou
produção	8	50	0,52	produção
melhor	6	40	0,41	melhor, melhorada, melhorando, melhorar, melhore, melhores, melhoria, melhorias, melhorou
interação	9	38	0,39	interação, interativa
produto	7	38	0,39	produtiva, produtividade, produtivo, produtivos, produto, produtos
começa	6	37	0,38	começa, começam, começar, começasse, começava, comecei, começo, começou, início
equipes	7	37	0,38	equipes
impacto	7	34	0,35	impacto
pessoas	7	33	0,34	pessoais, pessoas
qualidade	9	33	0,34	características, propriedade, qualidade, qualidades
acesso	6	32	0,33	acesso
negócio	7	29	0,30	negócio, negócios
consegue	8	28	0,29	consegue, conseguem, conseguia, conseguir, conseguiu
integração	10	28	0,29	integração, totalmente
conhecimento	12	27	0,28	conheçam, conhece, conhecem, conhecendo, conhecia, conhecimento, conhecimentos, conheço, sabendo
importante	10	26	0,27	importante
comunicação	11	25	0,26	comunicação, comunicar, comunicarem, comunicativas
relação	7	24	0,25	listei, relação, relacionado, relacionamento
desafios	8	23	0,24	desafio, desafios, partir
aquilo	6	22	0,23	aquilo
diente	7	22	0,23	diente, dientes
grande	6	22	0,23	grande, grandes
operação	8	22	0,23	operação, operações
pessoal	7	22	0,23	galera, pessoal, pessoalmente
estava	6	21	0,22	estava
sempre	6	21	0,22	sempre
sistema	7	21	0,22	sistema, sistemas
maturidade	10	20	0,21	maduro, maduros, maturidade, maturidades
objetivo	8	20	0,21	objetivo, objetivos
passar	6	20	0,21	passado, passam, passando, passar, passaram, passavam, passei, passou
processo	8	23	0,20	formas, maneira, processo, processos
funciona	8	19	0,20	funciona, funcionam, funcionando, funcionar, funcionava, funcionou
fazendo	7	18	0,19	fazemos, fazendo, fazíam
aplicacional	12	18	0,19	aplicacional
muitas	6	17	0,18	muitas, muitos
conversa	8	17	0,18	conversa, conversam, conversamos, conversando, conversar, conversava, conversem, conversou
resolvê	7	16	0,17	resolve, resolvê, resolver, resolveu, resolvia
momento	7	16	0,17	momento, momentos
sentido	7	16	0,17	sentido, sentou
diferentes	10	16	0,17	diferente, diferentes
alguma	6	15	0,16	alguma
eficiência	10	15	0,16	eficácia, eficiência, eficiente
implantação	11	15	0,16	implantação, implantações

Table 6 - Frequent Words RQ1: System Architectures

The code "RQ2: Current Management Practices" has subcategories derived from the answers to questions 2 and 4 with the goal of clarifying the current practices in the banking industry as well as the system architectures employed in the management of application support teams.

As shown in Figure 15 - Word Cloud – Code RQ2: Current Management Practices, the NVivo software identified the following keywords as the most recurrent:

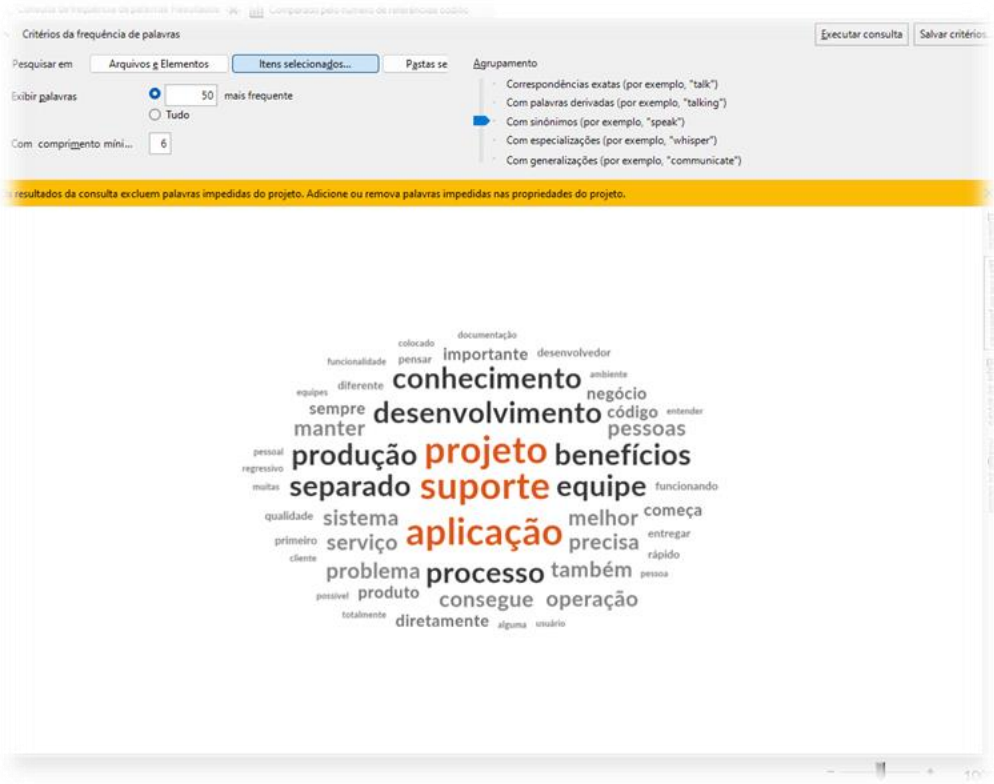


Figure 15 - Word Cloud – Code RQ2: Current Management Practices

This code seeks to detail and analyze the methodologies and technological structures adopted by support teams, highlighting how these practices and architectures contribute to operational efficiency and effectiveness in the banking sector.

Palavra	Extensã	Contage	Percentual ponderado	Palavras similares
suporte	7	104	1,80	suporta, suportando, suportar, suporte, sustenta, sustentação, sustentações, sustentar
projeto	7	84	1,46	desenhar, desenho, desenhos, empresa, programação, programas, projeto, projeto', projetos, trabalha, trabalham, trabalhando, trabalhar, trabalharem, trabalhava, trabalhe, trabalhei, trabalho
aplicação	9	83	1,44	aplicação, aplicações, aplicativo, aplicativos, implementação, realizadas, realizado
desenvolvimen	15	76	1,32	crescimento, desenvolve, desenvolvem, desenvolvendo, desenvolver, desenvolveram, desenvolveu, desenvolvido, desenvolvimento, desenvolvimentos, evolução
equipe	6	53	0,92	equipa, equipe
processo	8	44	0,72	maneira, maneiras, procedimento, procedimentos, processamentos, processo, processos
separado	8	34	0,59	separação, separada, separadas, separado, separados, separar
benefícios	10	33	0,57	benefício, benefícios
conhecimento	12	33	0,57	conheça, conhece, conhecem, conhecer, conhecida, conhecimento, sabemos
produção	8	30	0,52	produção
melhor	6	29	0,50	melhor, melhorar, melhorar', melhorarem, melhores, melhoria, melhorias
sistema	7	29	0,50	sistema, sistemas
precisa	7	28	0,49	precisa, precisam, precisamos, precisar, precisem, preciso
serviço	7	26	0,45	service, serviço, serviços
consegue	8	25	0,43	consegue, conseguem, consegui, conseguia, conseguiam, conseguir, conseguiu
problema	8	25	0,43	problema, problemas
também	6	25	0,43	também
manter	6	24	0,42	mantendo, manter
pessoas	7	22	0,38	pessoas
operação	8	20	0,35	operação, operações
código	6	19	0,33	código, códigos
importante	10	18	0,31	importante
sempre	6	18	0,31	sempre
negócio	7	15	0,26	negócio, negócios, transação
produto	7	15	0,26	produtivo, produto
começa	6	14	0,24	começa, começam, começaram, comecei, começo, começou, início
funcionando	11	13	0,23	funciona, funcionam, funcionando, funcionar, funcionava
diferente	9	12	0,21	diferente, diferentes
entregar	8	12	0,21	entregar
qualidade	9	12	0,21	qualidade
desenvolvedor	13	12	0,21	desenvolvedor, desenvolvedores
pensar	6	12	0,21	pensado, pensam, pensando, pensar, pensou
primeiro	8	12	0,21	primeira, primeiro
rápido	6	11	0,19	rápida, rápidas, rápido
alguma	6	11	0,19	alguma
ambiente	8	11	0,19	ambiente
documentação	12	11	0,19	documentação, documentações, documento, documentos
funcionalidade	14	11	0,19	funcional, funcionalidade, funcionalidades, funcionalmente
pessoa	6	11	0,19	pessoa
regressivo	10	11	0,19	regressivo, regressivos, retorna, retornar, voltado, voltando, voltar
muitas	6	10	0,17	muitas, muitos
diente	7	10	0,17	diente, dientes
usuário	7	10	0,17	usuário
colocado	8	9	0,16	colocada, colocado, colocando, colocar, função, posicionar
entender	8	9	0,16	entender
equipes	7	9	0,16	equipes
pessoal	7	9	0,16	galera, pessoal, pessoalmente
possível	8	9	0,16	possível
totalmente	10	9	0,16	integração, integrações, totalmente
diretamente	11	8	0,14	diretamente, direto

Table 7 - Frequent Words - RQ2: Current Management Practices

The code "RQ3: Action Plan Definition - Best Practices" includes subcategories based on the answers to questions 3 and 5, focusing on outlining the optimal strategy for application support in large-scale systems in the banking industry.

As highlighted in Figure 16 - Word Cloud – Code RQ3: Action Plan Definition - Best Practices, the analysis conducted by the NVivo software revealed that the most frequent keywords include:

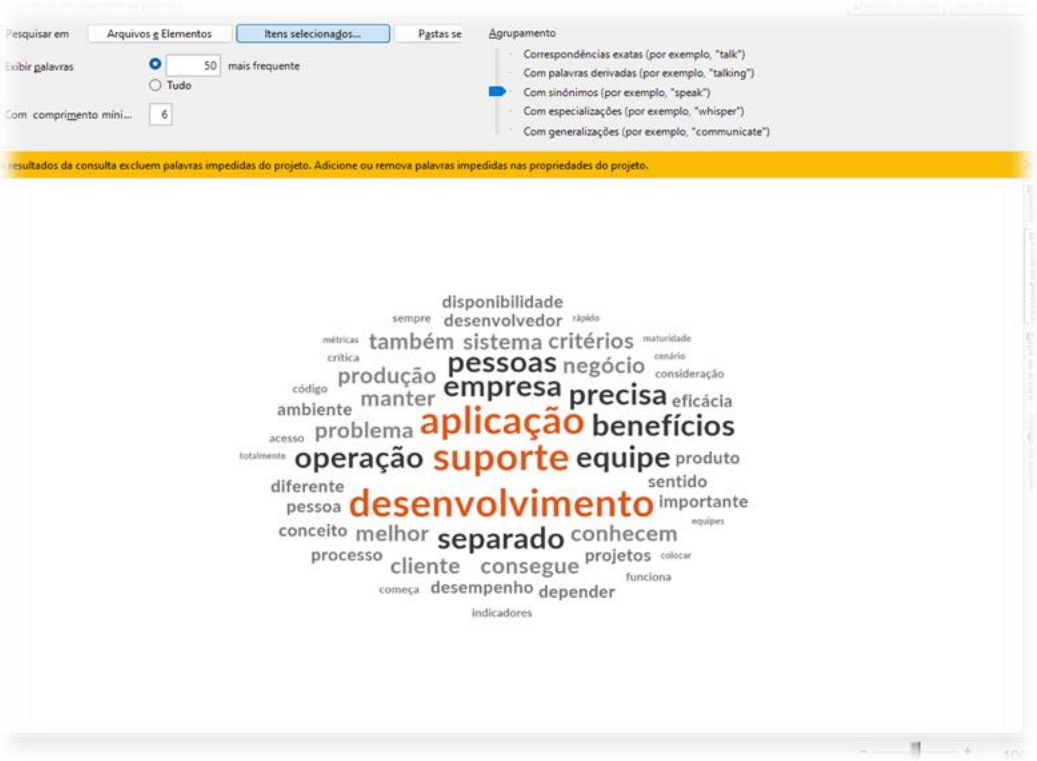


Figure 16 - Word Cloud – Code RQ3: Action Plan Definition - Best Practices

This segment aims to uncover the most effective approaches for defining action plans, emphasizing exemplary practices that guide the management and operationalization of support in complex technological contexts of the banking sector.

Palavra	Extensã	Contage	Percentual ponderado	Palavras similares
suporte	7	109	1,76	baseou, suporta, suporte, sustenta, sustentação, sustentando, sustentar
aplicação	9	90	1,45	aplicação, aplicações, aplicativo, aplicativos, implementação
desenvolvime	15	82	1,31	crescimento, desenvolve, desenvolvendo, desenvolver, desenvolveram, desenvolveu, desenvolvido, desenvolvimento, desenvolvimentos, evolução
empresa	7	80	1,01	empresa, projeto, projeto', projetos, trabalha, trabalham, trabalhamos, trabalhando, trabalhar, trabalhávamos, trabalhe, trabalhei, trabalho
separado	8	59	0,95	separação, separada, separadas, separado, separados, separar
equipe	6	58	0,93	equipa, equipe
operação	8	45	0,73	operação, operações, operadora
pessoas	7	37	0,60	pessoas
benefícios	10	33	0,53	benefício, benefícios
precisa	7	33	0,53	precisa, precisam, precisamos, precise, precisem, preciso, precisou
problema	8	30	0,48	problema, problemas
manter	6	29	0,47	mantendo, manter, manteria
conhecem	8	28	0,45	conheça, conheçam, conhece, conhecem, conhecer, conhecimento, sabemos, sabendo
produção	8	28	0,45	produção
melhor	6	26	0,42	melhor, melhorar, melhorar', melhorarem, melhores, melhoria, melhorias
consegue	8	23	0,37	consegue, conseguem, conseguia, conseguiam, conseguindo, conseguir, conseguiu
negócio	7	22	0,35	negócio, negócios, transação
sistema	7	22	0,35	sistema, sistemas
cliente	7	19	0,31	cliente, clientes
critérios	9	19	0,31	critério, critérios
também	6	19	0,31	também
projetos	8	36	0,30	programação, projeto, projeto', projetos
desempenho	10	17	0,27	desempenho, performance
sentido	7	17	0,27	sentar, sentido
ambiente	8	16	0,26	ambiente
diferente	9	16	0,26	diferente, diferentes
produto	7	16	0,26	produtivo, produto
desenvolvedo	13	15	0,24	desenvolvedor, desenvolvedores
importante	10	15	0,24	importante
pessoa	6	15	0,24	pessoa
processo	8	19	0,24	maneira, maneiras, procedimento, procedimentos, processar, processo, processos
consideração	12	15	0,24	consideração, considerada, considerando, considerar, consideraria
crítica	7	14	0,23	crítica, críticas, crítico
código	6	14	0,23	código, códigos
acesso	6	13	0,21	acesso
começa	6	13	0,21	começa, começam, começar, começo, começou, início
indicadores	11	13	0,21	indicador, indicadores
sempre	6	13	0,21	sempre
funciona	8	13	0,21	funciona, funcionando, funcionar, funcionava
equipes	7	12	0,19	equipes
cenário	7	11	0,18	cenário, cenários
rápido	6	11	0,18	rápida, rápidas, rápido
totalmente	10	11	0,17	integração, integrações, totalmente, unidade
colocar	7	10	0,16	coloca, colocando, colocar, colocaria, função
maturidade	10	10	0,16	maturidade
métricas	8	10	0,16	métrica, métricas
conceito	8	9	0,15	conceito, conceitos, opinião, parecem, parecidas
depender	8	9	0,15	depende, dependendo, depender
disponibilidad	15	9	0,15	disponibilidade
eficácia	8	9	0,15	eficácia, eficiência, eficiente

Table 8 - Frequent Words - RQ3: Action Plan Definition - Best Practices

Table 8 - Frequent Words - RQ3: Action Plan Definition - Best Practices presents the frequently used words associated with RQ3.

4.2. Discussion on the analyzed qualitative data from the interviews

This chapter demonstrates the effectiveness of the chosen methodology, providing a clear and detailed view of the points of convergence among the interviews that served as the basis for the recommendations presented in this study.

Conducting online interviews added multicultural value, as participants were from Brazil, Luxembourg, Portugal, and India. Despite diverse cultural backgrounds, the results, keywords, and viewpoints were similar, enhancing the value of the collected data.

The use of the nVivo 14 tool facilitated the organization, reading, and understanding of the data, enabling thematic analysis and visualization through word clouds and comparative charts.

In general, the interviewees shared several common points, with various keywords standing out in the data analysis. It was evident that all interviewees saw an advantage in a cautious and considered analysis before deciding on application support for a product. Factors such as team maturity, communication, collaboration between project and support teams, and product performance quality were emphasized. The combination of these factors ensures customer satisfaction.

The primary objectives identified through the interviews and data analysis are customer satisfaction and operational efficiency. Interviewees emphasized the importance of careful analysis before making decisions related to application support. Ensuring that all factors, such as team maturity, communication, and collaboration between project and support teams, are considered crucial to achieving customer satisfaction.

The key aspects highlighted include systematically defined and executed processes and the importance of removing obstacles and optimizing processes. Knowledge consolidation through adequate documentation and operational efficiency were recurring themes in the interviews.

These aspects are fundamental to ensure that teams are well-informed and prepared to handle challenges, promoting a collaborative environment focused on customer satisfaction and product quality.

The keywords that stood out the most were: "support," "team," "development," "sustainment," "quality," "operation," "communication," "production," and "client."

Problems related to communication and reduced efficiency in team interaction were the most frequently mentioned during the interviews. Effective communication between teams is vital for the success of any project, and its absence can lead to misunderstandings, delays, and a negative impact on support quality and product performance.

Additionally, efficient team interaction is essential to ensure that activities are carried out in a coordinated manner without obstacles.

Operational challenges also include delays in project activities due to poor communication, a negative impact on business support, and performance issues arising from communication gaps. There is an urgent need for knowledge consolidation through adequate documentation, removing obstacles in the coordinated execution of activities, and optimizing operational processes.

The lack of a proper collaborative environment affects customer satisfaction and product quality, highlighting the need for management practices that promote effective communication and collaboration between development and support teams.

Chapter 5

Decision Support Guidelines

Chapter 5 - Decision Support Guidelines

In order to achieve a high level of service quality, customer satisfaction, and operational efficiency in the banking sphere, you need to integrate development and application functions. In the supporting application area, we have created a set of Decision Support Guidelines for the Integration of Application Support in the Banking Area.

Initially, the exhaustive literature review did not uncover any gaps, but it highlighted the inadequacy of post-delivery care practices (after the project phase, when a product is already in production). The Systematic Literature Review (SLR) emphasized the complexities of banking systems, paving the way for a structured, evidence-based strategy to enhance teamwork between development and support teams.

Additionally, semi-structured interviews with experienced banking professionals highlighted significant existing problems, as outlined in section 4.2. These include:

- *Communication issues between teams;*
- *Reduced efficiency in team interaction;*
- *Delays in project activities;*
- *Negative impact on business support;*
- *Performance issues due to communication gaps;*
- *Need for knowledge consolidation through adequate documentation;*
- *Obstacles in the coordinated execution of activities;*
- *Lack of optimization in operational processes;*
- *Insufficient collaborative environment affecting customer satisfaction and product quality*.

These interviews also revealed practical business habits that contribute to these challenges.

Through the Nvivo software application for the qualitative data assessment, we concluded recurrent patterns and themes directly related to the development of guidelines.

The key issues identified that could hinder the formation of high-quality team interactions include communication problems, process integration failures, and knowledge management gaps. These challenges are likely to reduce the efficiency of team collaboration.

Hence, the designed regulation is targeted to solve such problems by delivering technology for routine actions, maintaining organizational learning, providing for leadership, ongoing improvement, and value-added responsibility.

The guidelines have been organized into **four main aspects: Consequences, Quality, Productivity, and Production**. The practice and application that leads to the increase in effectiveness, service quality, and client satisfaction in the banking sector are explained in detail to achieve its growth.

The recommendations are based on literature review findings, as well as shared experiences of the interviewed professionals, which provide a fair and well-reasoned view of the problems and solutions for addressing the challenges in bank application support.

The decision to allocate the application support team together with or separately from the development team should consider several **key factors**:

- ***Problem Frequency:*** *The number of reported problems that require support.*
- ***Solution Complexity:*** *The degree of difficulty in solving reported problems.*
- ***Business Impact:*** *How delays in problem resolution affect operations and customer satisfaction.*

Applications of high criticality that receive requests of high complexity require a specialized and well-trained support team capable of handling complex requests.

However, if the frequency of these requests is low, the cost of maintaining a dedicated team can be prohibitive.

In such cases, it may be more viable to keep the support integrated with the development team, allowing for a more cost-effective approach.

For situations not covered by this scenario (as indicated in Figure 15), and especially where the frequency of requests is high, it is beneficial to maintain an independent support team.

This team can act quickly and focused, ensuring the stability of the production environment, while the development team remains concentrated on developing new features or fixing identified problems.

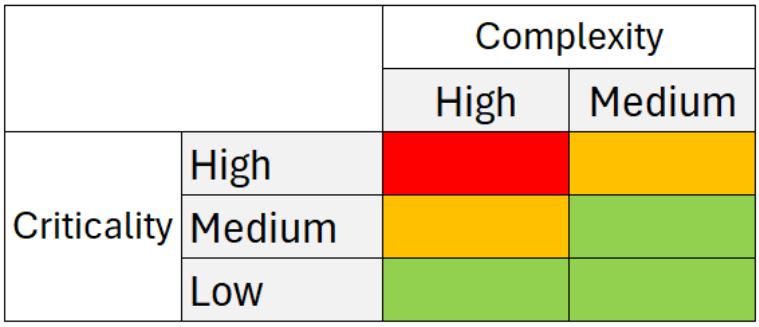


Figure 17 – Complexity x Criticality

Figure 17 – Complexity x Criticality illustrates a matrix showing the relationship between Criticality and Complexity. High criticality combined with high complexity is marked in red, medium in yellow, and low in green, indicating varying levels of risk.

First, it is necessary to assess the fundamental needs of the system/application. Based on this assessment, three distinct approaches can be defined, each suitable for different levels of criticality, complexity, and frequency of requests.

In the first situation, "High criticality and complexity," a specialized support team is needed to handle complex and critical issues. This approach ensures that problems are resolved by professionals with deep knowledge and experience, minimizing the impact on the company's operations.

In the second situation, "Low frequency of requests," support is integrated with the development team, facilitating direct and efficient communication. This is ideal for environments where problems are less frequent, allowing developers to handle support requests swiftly and effectively.

In the third situation, "High frequency of requests," an independent support team is implemented to manage the high volume of requests. This approach allows the development team to focus on their core tasks while the independent support team ensures a quick and specialized response to user requests.

Figure 18 - Request Frequency Levels with Support Team Allocation visually illustrates the text above.

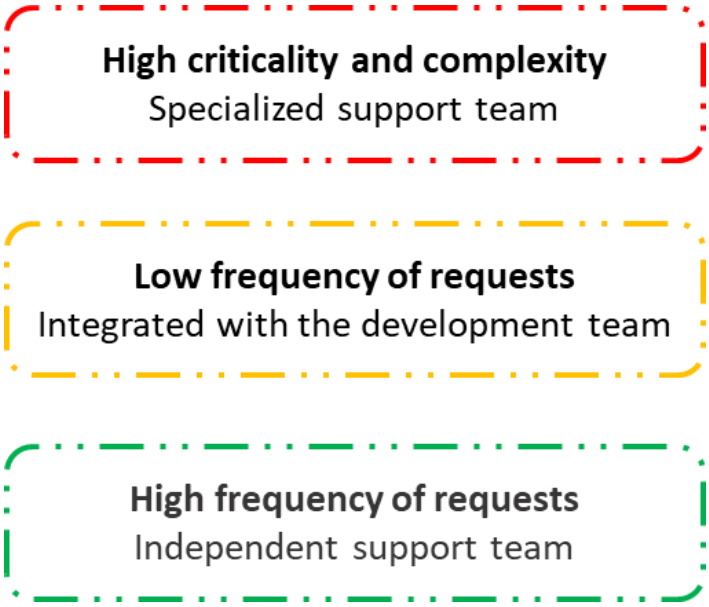


Figure 18 - Request Frequency Levels with Support Team Allocation

Guidelines are directions, a path, a way forward. They are instructions that act as a guide or advice to orient. Perhaps the best definition for guidelines is a set of recommendations that help us know what to do in certain situations, especially when we need to decide how to act during the execution or implementation of a task.

The guidelines were developed through a combined analysis of interviews conducted with banking sector professionals and the results of the Systematic Literature Review (SLR), which identified current practices, gaps, and challenges in application support management in the banking sector. The main obstacles found included communication issues, process integration gaps, and deficiencies in knowledge management. Subsequently, the survey was further developed with semi-structured interviews with nine experienced professionals, providing rich and diverse perspectives on the efficiency, quality, and impact of team collaboration.

The qualitative analysis of these data was conducted using NVivo software, which helped identify trends, create word clouds, and perform thematic analysis. Based on this solid empirical and theoretical foundation, it was possible to develop a comprehensive set of evidence-based guidelines designed to improve collaboration between support and development teams, enhance operational efficiency, and increase customer satisfaction, thus significantly contributing to IT management in the banking sector.

Based on the analysis of data collected in the interviews (presented in the chapter 'data extraction and analysis'), It is proposed a set of guidelines, presented in the section below, 'Decision support guidelines for application support in the banking sector.'

This study organized the distribution of the guidelines into **4 main aspects**, which are ***Processes, Efficiency, Quality, and Impact.*** These aspects are defined in Table 9 - Aspects to define the guideline:

Key	Description
Process	The set of defined and executed activities.
Efficiency	The optimization and automation of processes by the development and product support teams (system/application).
Quality	The practices that seek to reduce defects, imperfections, and product problems.
Impact	The assessment of the effect and/or result on the efficiency and performance of the system/application.

Table 9 - Aspects to define the guideline

This section presents a set of guidelines to assist decision-making related to the application support of a system or application, including a detailed description of each item to facilitate understanding.

Process

1. **Automate repetitive tasks:** Implementation of automation tools to enable development and support teams to rid themselves of repetitive tasks will free up more time, which can be spent instead of significantly more valuable for the system/application improvement activities.

2. **Increase knowledge:** Create and ensure an easily accessible complete knowledge base and full documentation that will allow the more frequent issues to be resolved in less time in the meantime, as well as promote information sharing between team members. Encourage individuals to contribute to the repository as a part of their daily routines, and this will lead to the growth and maturity of their knowledge management processes.

3. **Develop facilitative leadership:** Develop team leaders who act as facilitators, remove barriers immediately, and make it their priority to support the team with essential resources. Team leaders should act as servant leaders.

Efficiency

4. **Promote continuous improvement:** Establish a continuous feedback loop that ensures that development teams are in line with the support crew to ensure that leadership values are in place, which in turn results in continuous process improvement and product quality assurance.

5. **Promote autonomy with responsibility:** Encourage the teams to find alternative solutions and new ways, though they should be able to take responsibility for responsibilities. Establish regular meetings (monthly at least) to review processes and retrospectives to hold people accountable and build a culture where making mistakes, learning, and adapting is a part of the maturation of decision-making.

Quality

6. **Integrated quality practices from the very beginning:** Define the project to avoid existing or future problems and build the basis for quality at its initial stages.

7. **Developing a partnership-based relationship:** The way the development and support units are combining forces is through partnerships. The information can then be passed to the development team so it can enhance the quality of a product, as this is consistent with customer feedback.

Impact

8. **Integrated the effects of organizational structure:** Regularly assess the impacts of combining or separating development and support teams on two axes of side efficiency and customer satisfaction.

9. **Perform weakness analysis:** pinpoint and eliminate the weaknesses of current development and support processes so that the product will become more cost-efficient.

Key	Guideline
Process	Automate repetitive tasks
	Increase knowledge
	Develop facilitative leadership
Efficiency	Promote continuous improvement
	Promote autonomy with responsibility
Quality	Integrated quality practices from the very beginning
	Developing a partnership-based relationship
Impact	Integrated the effects of organizational structure
	Perform weakness analysis

Table 10 - Key guidelines for organizational improvement

These advantages show that points may have different contributions. Therefore, it is through these that organizations are able to achieve continuous improvement and long-term success, as presented in Table 10 - Key guidelines for organizational improvement**.**

Chapter 6

Conclusion

Chapter 6 - Conclusion

In the systematic literature review, it was possible to understand the main contributions to the management and application support area of banking systems and the most used arguments. It allowed for the mitigation of approaches and the comprehension of other interesting viewpoints on the subject.

This study broadly addressed the integration of application support in the banking sector, standing out for conducting a systematic literature review and qualitative interviews with experienced professionals in the field.

This work relied on an SLR as its foundation, enabling the identification of knowledge gaps and the consolidation of a relevant body of information that supported the proposed decision support guidelines.

Various aspects of application support in the banking context were illuminated by this rigorous SLR process, addressing information system architectures, management practices, and the optimization of this support.

In this research, it was possible to understand the main contributions to the field of management and support for the application of banking systems and the most used arguments.

The study allowed for the mitigation of approaches and the understanding of other interesting viewpoints on the subject, as well as the difficulties and advantages of each argument.

From the systematic review of the literature, a research gap directly related to the products (applications) after delivery and how their maintenance is conducted while they are in use and with high added value for companies was identified. This is a complex topic that can contribute to more assertive decision-making.

This study undertook a comprehensive investigation of the integration of application support in the banking sector, standing out for conducting an SLR and qualitative interviews with highly experienced professionals in the field.

The SLR served as the foundation for this work, allowing the identification of knowledge gaps and the consolidation of a relevant body of knowledge that underpinned the proposal of decision-support guidelines.

This thorough process of SLR illuminated various facets of application support in the banking context, covering information system architectures, application support management practices, and approaches for optimizing this support.

The insights gained from the interviews, along with the evidence collected in the SLR, were crucial for the development of a set of practical guidelines aimed at guiding banking organizations in the effective setup of their application support teams.

These guidelines not only reflect the best practices identified in the literature but are also enriched by the real experiences of the interviewed professionals, offering a balanced and deeply informed view of the challenges and solutions in application support in the banking sector.

This study has been recognized for its depth and significance through its acceptance as a position paper at the CENTERIS - International Conference on Enterprise Information Systems 2023 and its publication at the CISTI 2024 - 19th Iberian Conference on Information Systems and Technologies. We decided to move forward with publishing a comprehensive position paper at CISTI, as the systematic literature review (SLR) was already completed. This recognition represents the best of both worlds. Showcasing this article at the CISTI'2024 conference will provide an opportunity to engage a wide audience of researchers and industry professionals, ultimately helping them make more informed decisions.

Clearly highlighting the key findings from both the systematic literature review and in-depth interviews, this study thoroughly explores the topic and field. It elucidates the primary results from both methodologies, offering a comprehensive understanding of the subject matter.

This publication will not only serve to validate the quality and significance of the work, but it will also contribute to the conversation around providing support for the applications and the operational efficiency level.

6.1. Limitations

This study contributes significantly to the existing academic corpus, providing a detailed analysis grounded in both theory and practice.

Moreover, the proposed guidelines represent a valuable practical contribution to managers and IT professionals in the banking sector, providing a reliable guide for optimizing collaboration between development and application support teams.

However, it is recognized that this work, like all academic studies, has limitations, particularly regarding the generalization of the results to all banking contexts. Therefore, future research is suggested to explore specific case studies that implement and evaluate the proposed guidelines in different organizational and cultural contexts.

This would not only validate the recommendations of this study across a broader spectrum of banking environments but could also reveal necessary adjustments or extensions to the guidelines to accommodate the specific nuances of different organizations.

Although this research has the great merit of enveloping the existing knowledge base with solid theoretical and practical reasons, it also has some restrictions.

Because each of the participating institutions has its own cultural and organizational particularities, the generalization of the results to all banking cases can be problematic.

Diversity of the interviewees, which, in turn, contributes various perspectives but ultimately does not cover all possible types of activities and challenges from different regions.

The fact that the survey utilizes semi-structured interviews and a systematic literature review gives it a good scope. This may overlook the small details and dynamics of banking application support environments. However detailed the interviews are, they are heavily dependent on participants: their willingness and ability to share their experiences and opinions as accurately as possible.

The suggested guidelines have not yet been widely applied to provide first-hand information on practical use.

We urge further research concerning the application and evaluation of these recommendations in different cultural and organizational contexts to ensure the validity of the outcomes of this study on banking operations in various countries. Also, it could show further modifications or expansion.

6.2. Future Considerations

The present study provides a clear guide for the advancement of application support management in the banking field.

The approaches highlighted emphasize the importance of a strategic approach rooted in academic evidence and the empirical experience of professionals in the field.

Moreover, the proposed guidelines indicate a promising start for the future continuous improvement of various critical aspects of the area, including operability, service quality, and customer satisfaction in the banking sector.

In addition to these, which will be previously explained as the fields of research that require more, other approaches should be taken for the purposes of enhancing the application support issues in the banking sector. Other parts persistently focus on Agile and DevOps practices.

The evaluation of the effect that these procedures have on the cooperation between application and development teams could be quite beneficial. It could provide us with information on how to improve collaboration, response time, and issue resolution.

The actual determination and simple application of these practices in banking will help us adjust our techniques, provide us with confidence, and make them effective, which is the goal of the entire operation.

One of the areas in which research continues to expand is the new trending technologies such as artificial intelligence (AI) and machine learning (ML).

The implementation of such technologies redefines the pattern of support services, such as predictive maintenance through deeper analytics, and security measures could become more commonly used features.

The findings from future research must be evaluated to determine how grounded systems can build more effective and reliable machines.

Moreover, displaying real-life examples of these technologies being successfully applied in the banking system will create a visual instruction and be a good example for others.

The boundaries between cultures and organizations are blurring, and depending on whether they are supportive or hindering, the application integrations should be cleared.

Alternatively, other research done on different cultures, leadership styles, and employee engagement approaches can present us with a careful contrast of what facilitates effective collaboration in banking settings.

With an in-depth analysis of critical success factors, the current research should be able to come up with specific recommendations that will help narrow down the challenges and open opportunities and, in the end, create better sustainable support systems.

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