RBAC&CiA
Revista Brasileira de Aviação Civil & Ciências Aeronáuticas
Artigos

FUNDAMENTALS OF SCIENTIFIC RESEARCH IN CIVIL AVIATION

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ABSTRACT

This article explores the fundamental steps of scientific research and their application to the civil aviation sector, emphasizing key methodologies: qualitative, quantitative, and mixed. Based on a theoretical review and an analysis of the characteristics of these approaches, it demonstrates how each method can be employed to investigate technical, operational, and human-related issues. Qualitative research is highlighted for its ability to delve into complex phenomena and interpret organizational and cultural contexts, while the quantitative approach excels in analyzing numerical data and validating large-scale hypotheses. Mixed methodologies combine the strengths of both qualitative and quantitative approaches, proving particularly effective in interdisciplinary studies involving technical and human factors. The article also discusses the importance of triangulation to enhance the validity of analyses and the strategic use of tools such as questionnaires and interviews in future investigations. It concludes that the careful selection and integration of different methodologies can significantly enrich research in the aeronautical sector, aligning academic rigor with practical demands.

Keywords: Scientific Methodology; Civil Aviation; Qualitative Research; Quantitative Research; Mixed Methodology.

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FUNDAMENTOS DA PESQUISA CIENTÍFICA EM AVIAÇÃO CIVIL

RESUMO

O presente artigo explora as etapas fundamentais da pesquisa científica e sua aplicação no setor de aviação civil, destacando alguns tipos de metodologias: qualitativa, quantitativa e mista. Com base em uma revisão teórica e na análise das características dessas abordagens, demonstra-se como cada método pode ser utilizado para investigar problemas técnicos, operacionais e humanos. A pesquisa qualitativa é reconhecida por sua capacidade de explorar fenômenos complexos e interpretar contextos organizacionais e culturais, enquanto a abordagem quantitativa se destaca na análise de dados numéricos e na validação de hipóteses em larga escala. A metodologia mista combina os pontos fortes das abordagens qualitativa e quantitativa, sendo especialmente aplicada em estudos interdisciplinares e que envolvem fatores técnicos e humanos. O artigo discute ainda a importância da triangulação, da sistematicidade, da replicabilidade e da objetividade para ampliar a validade das análises e a possibilidade de uso estratégico de instrumentos como questionários e entrevistas em investigações futuras.

Palavras-chave: *Metodologia Científica; Aviação Civil; Pesquisa Qualitativa; Pesquisa Quantitativa; Metodologia Mista.*

1 INTRODUCTION

Civil aviation is a sector highly dependent on solutions grounded in technical and scientific knowledge, with academic research serving as a key foundation for its sustainable development (Boff, 2021, p. 104). However, many professionals and scholars face difficulties in understanding and applying scientific methodologies, which compromises the relevance and validity of their

investigations. This gap is particularly significant when experienced professionals attempt to base their publications solely on personal experiences without aligning them with the fundamental principles of scientific research, thereby limiting the broader applicability of their findings (Gallaway, 2007, p. 224).

Scientific methodology provides the essential foundations for conducting rigorous investigations, connecting logic and practice. According to Gower (1996, p. 3), it not only structures the production of knowledge but also guides the resolution of complex problems in a reproducible and reliable manner. In the civil aviation sector, such a methodological approach is indispensable for addressing issues such as operational efficiency, safety, and sustainability. Nevertheless, the lack of familiarity with methodological fundamentals often results in research that does not meet academic standards nor the practical needs of the sector (Gallaway, 2007, p. 226).

Given this context, the main objective of this article is to present the fundamental stages of scientific research as applied to civil aviation. As secondary objectives, it aims to (1) introduce some types of scientific methodology, such as qualitative, quantitative, and mixed methods; and (2) explore how these methodologies can be used to structure investigations within the sector.

The working hypothesis of this study is that introducing the fundamentals of scientific research and methodological types can help professionals and scholars overcome reliance on isolated empirical approaches, promoting more structured studies with greater practical impact. Furthermore, it is believed that by understanding these foundations, even professionals who wish to focus on personal experiences will be able to align such practices with the methodological standards required for scientific development, thereby enhancing the relevance of their contributions (Boff, 2021, p. 108).

This article is structured to present the essential concepts of scientific research, the characteristics of scientific methods, and practical examples of application within the sector. In conclusion, it will be evaluated whether the objectives have been met and whether the proposed hypotheses have been confirmed, highlighting the importance of scientific methodology for the advancement of civil aviation.

2 THEORETICAL REVIEW

Scientific research can be defined as a set of systematic and rigorous procedures aimed at producing new knowledge or validating previously established hypotheses. Lakatos and Marconi (2017, p. 21) highlight that the scientific method is based on principles such as systematization, replicability, and objectivity – characteristics that ensure the reliability and practical applicability of results. These principles structure scientific advancement by enabling problems to be investigated consistently, leading to precise and universally applicable answers.

Kuhn (2013, p. 10) argues that science develops through paradigms that guide the formulation of problems and methods of solution. When a paradigm becomes incapable of explaining new phenomena, what he terms “scientific revolutions” occur, leading to its replacement by new theoretical models. This dynamic underscores the importance of scientific research as a tool for the continuous renewal and adaptation of knowledge in the face of emerging challenges.

Creswell (2018, p. 32) complements this view by emphasizing that scientific research must not only answer fundamental questions but also be guided by clear and well-defined objectives. The choice of method – whether qualitative, quantitative, or mixed – should align with the nature of the problem under investigation, thereby maximizing the validity and relevance of the results obtained.

2.1 CORE CHARACTERISTICS OF SCIENTIFIC RESEARCH

Scientific methodology plays a fundamental role in organizing the research process by establishing techniques and stages that ensure the production of reliable and verifiable results. In this regard, Silva and Paiva (2022, p. 3) emphasize that the method should be understood as an indispensable tool for interpreting the object of study, allowing for the validation of the steps followed by the researcher. Moreover, methodology fosters critical and reflective thinking – essential skills for building solid knowledge and for analyzing the reality under investigation (Silva & Paiva, 2022, p. 5).

Complementing this perspective, Popper (1985, p. 44) introduces the criterion of falsifiability as a distinctive element of the scientific method. According to the author, only theories that can be refuted by experimentation or observation are considered scientific. This characteristic ensures that the advancement of knowledge is guided by a continuous cycle of hypothesis formulation, rigorous testing, and revisions, thereby promoting the evolution of scientific theories.

This idea of continuous progress is also highlighted by Bachelard (1996, p. 17), who emphasizes the overcoming of epistemological obstacles as a central mechanism in the advancement of science. According to him, the construction of knowledge requires not only a critical stance but also the constant revision of previously accepted concepts. Thus, scientific methods must adhere to the highest standards of accuracy and objectivity to ensure the robustness of the results obtained.

Another key aspect is triangulation, defined by Creswell (2018, p. 65) as the use of multiple methods, data sources, or theoretical perspectives to analyze a phenomenon, thereby strengthening the validity and reliability of the results. As shown in Table 1, triangulation combines three main elements:

1. Data Sources (such as documents, interviews, and observations), allowing evidence from different contexts to be compared to validate interpretations;
2. Analysis Methods (for example, qualitative and quantitative), integrating different approaches to achieve a more comprehensive understanding of the phenomenon;
3. Theoretical perspectives, which include diverse viewpoints and schools of thought to avoid one-sided interpretations.

This strategy is widely used in research addressing complex issues, as it reduces bias, broadens scope, and improves the reliability of conclusions, enriching the analysis with multiple dimensions (Creswell, 2018, p. 65).

Chart 1 – Exemplos da Triangulação na Pesquisa Científica em Aviação Civil

Element	Examples of Application
Data Source	Combination of interviews with pilots, analysis of operational records, and institutional documents.
Method of Analysis	Use of statistical analysis of questionnaire data and content analysis of interview transcripts.
Theoretical Perspective	Application of behavioral and constructivist theories to analyze communication patterns and interaction within flight crews.

Source: Prepared by the authors.

Additionally, Lakatos and Marconi (2017, p. 56) highlight replicability as an essential attribute of scientific research. This feature ensures that other researchers can verify the results obtained, further expanding and deepening investigations based on initial findings. In this way, replicability not only reinforces the reliability of research but also promotes transparency, allowing knowledge to grow in a collaborative and continuous manner.

By articulating these elements – methodological organization, falsifiability, overcoming of epistemological obstacles, triangulation, and replicability – scientific research is configured as a powerful tool for building reliable and progressive knowledge. These characteristics assert that the methods employed are increasingly aligned with contemporary demands for rigor and adaptability, thereby contributing to the ongoing advancement of science across various fields.

2.2 IMPACTS OF RESEARCH ON THE DEVELOPMENT OF KNOWLEDGE

The impacts of scientific research go beyond technological or practical advancements, encompassing the continuous evolution of human thought and knowledge structures. In this regard, Kuhn (2013, p. 22) emphasizes that scientific revolutions not only replace obsolete paradigms but also establish new ways of understanding the world. According to the author, these transformations have a direct influence on other disciplines and areas of study, broadening the reach and applicability of scientific discoveries.

Complementing this view, Bachelard (1996, p. 163) argues that science is inherently dynamic, characterized by a constant process of construction and reconstruction. For him, the advancement of knowledge occurs through the reformulation of questions and the overcoming of conceptual challenges, which allows science to remain relevant in the face of new intellectual and practical demands. Thus, scientific progress is not limited to the mere accumulation of facts but involves a continuous adaptation to contemporary needs.

Contributing to this perspective, Popper (1985, p. 209) reinforces that science is a collective and cumulative endeavor, in which critique and refutation play central roles. The interaction between different ideas and the systematic contestation of pre-existing theories result in the construction of more robust and comprehensive models. This aspect highlights the role of scientific research as a promoter of the integration of ideas, fostering the advancement, validity, and applicability of knowledge across various fields.

3 METHODOLOGY

This section details the methods and procedures adopted for conducting this study, emphasizing how the methodological approach was structured to meet the defined objectives and produce results relevant to scientific research in the civil aviation sector.

3.1 DEFINITION OF THE RESEARCH METHOD

This study employs a qualitative and descriptive approach, complemented by exploratory methods. According to Lakatos and Marconi (2017, p. 61), qualitative research allows for in-depth understanding of phenomena, while descriptive research organizes information systematically, supporting the comprehension of complex topics. This methodological combination was selected to provide a solid foundation for detailing the fundamental stages of scientific research and analyzing the types of methodologies applicable to the aviation sector.

Additionally, the study aims to offer theoretical outputs, such as a mapping of the types of scientific research, identifying their potentialities and limitations. The theoretical foundations provided by Kuhn (2013, p. 10) and Silva and Paiva (2022, p. 3) were used to structure and validate these stages, ensuring that the results are aligned with both scientific rigor and the practical demands of the aviation sector.

3.2 DATA SOURCES AND COLLECTION PROCEDURES

Data was collected exclusively through bibliographic review, using well-established academic sources in the field of scientific methodology and works related to the aviation sector. According to Creswell (2018, p. 65), literature review is essential in theoretical studies as it provides the necessary foundation for critical analysis and the identification of gaps in the existing body of knowledge.

Among the consulted sources, the following stand out:

- Classic works, such as *The Logic of Scientific Discovery* by Popper (1985) and *The Structure of Scientific Revolutions* by Kuhn (2013), to understand methodological foundations.
- Contemporary texts that explore the application of scientific methods in complex contexts, such as Wiggins' (1999, p. 33) studies on social sciences and aviation.

Data triangulation, as recommended by Creswell (2018, p. 65), was employed to validate the information, ensuring that the sources were analyzed in

an integrated and multidimensional manner, allowing the identification of relevant patterns and trends.

3.3 METHODS USED TO ACHIEVE THE OBJECTIVES

To meet the defined objectives, the following methods were used:

1. Theoretical Analysis: The identification and systematization of the core characteristics of scientific methodology were carried out through in-depth theoretical analyses, grounded in authors such as Silva and Paiva (2022, p. 5) and Bachelard (1996, p. 17). This step provided the conceptual framework necessary for detailing the fundamental stages of scientific research.
2. Practical Exemplification: The study used theoretical simulations to explore how different methodologies – qualitative, quantitative, and mixed – can be applied to specific issues in the civil aviation sector. According to Wiggins (1999, p. 33), practical examples are essential to connect theoretical principles to real-world needs, thus promoting a more applicable understanding of scientific methodologies.
3. Mapping of Research Types: As part of the exploratory approach, a mapping of the most common scientific methods found in academic literature was conducted, highlighting their advantages and limitations in the aviation context. This process was guided by contributions from Kuhn (2013, p. 10) and Popper (1985, p. 44), who discuss how different paradigms and approaches influence the progress of scientific knowledge.

These methods were integrated to ensure that the intended outcomes – such as the detailing of methodological steps and the mapping of scientific research techniques applicable to the aviation sector – would be achieved with rigor and clarity.

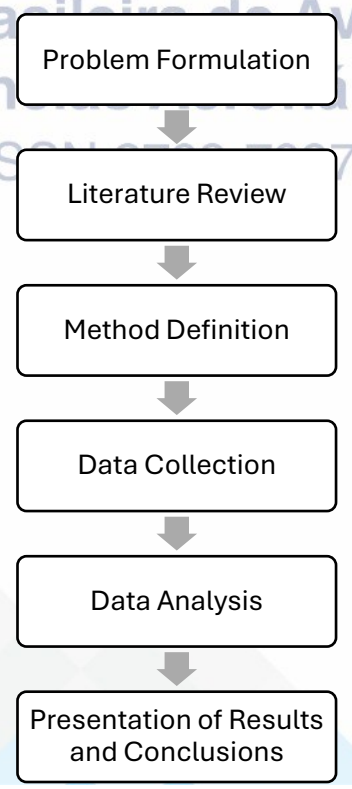
4 DEVELOPMENT

Methodological rigor is an essential element of scientific research and, within the civil aviation sector, assumes a strategic role in the identification and resolution of problems. This chapter presents the fundamental stages of scientific research, details the types of applicable methodologies, and discusses how these approaches can be integrated into the civil aviation context, highlighting their relevance to both theoretical investigations and practical applications.

4.1 STAGES OF SCIENTIFIC RESEARCH

The stages of scientific research structure the investigation process and ensure the reproducibility of results. According to Lakatos and Marconi (2017, p. 72), these stages include problem formulation, literature review, method definition, data collection and analysis, and presentation of results. Each of these stages, as illustrated in Figure 1, plays a specific role in the development of reliable and objective research.

Figure 1 – Overview of the Investigative Process



Source: Prepared by the authors.

In this sense, the organization of a new research project can be summarized as follows: initially, the central problem is defined by identifying relevant issues within the context of civil aviation. Next, a literature review is conducted, which involves examining existing knowledge and identifying the gaps the investigation aims to address. The choice of method – whether qualitative, quantitative, or mixed – follows, adapting the approach to the nature of the problem. Subsequently, data collection is carried out using various sources such as specialized literature, interviews, questionnaires, and operational records. The analysis stage applies statistical and/or interpretive techniques to extract patterns and validate the information. Finally, the results and conclusions are organized and discussed, emphasizing their practical implications for the sector and contributing to the advancement of scientific knowledge.

In the civil aviation sector, these stages allow complex issues to be addressed in a structured manner. For example, when investigating factors contributing to incidents related to air traffic management, a researcher may begin with a review of existing studies, define specific variables, and collect both qualitative and quantitative data for analysis (Wiggins, 1999, p. 33).

Triangulation is a technique frequently employed in this context, as it combines different methods and sources to increase the validity of the results. Creswell (2018, p. 65) emphasizes that triangulation enables a broader view of the problem by reducing bias and enhancing the reliability of conclusions. In civil aviation, it can be applied through the simultaneous analysis of flight records, interviews with crew members, and operational data.

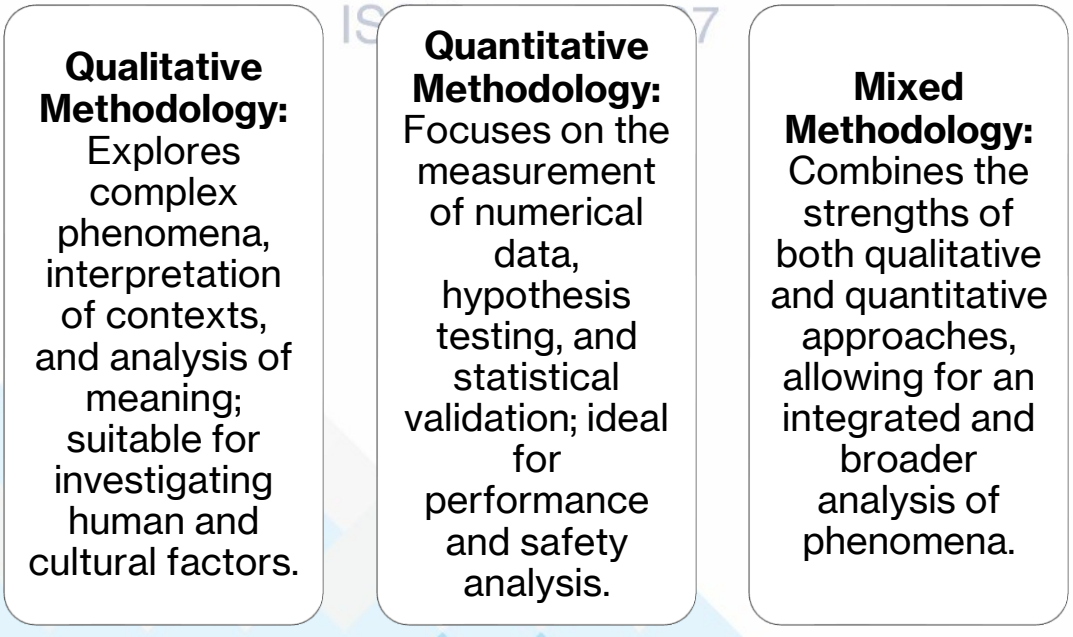
4.2 TYPES OF METHODOLOGY

The choice of research methodology is directly influenced by the nature of the problem under investigation and the objectives of the study. According to Kuhn (2013, p. 10), science progresses through paradigms that guide not only the problems to be solved but also the methods considered appropriate for addressing them.

In the aeronautical sector, research has traditionally favored quantitative approaches due to the need for objective and verifiable metrics, especially in studies focused on safety systems and human performance (FERROFF *et al.,* 2012, p. 2). This preference reflects a positivist bias, driven by regulatory requirements for numerical metrics and the perception that objective results are more suitable to support organizational policies and operational decision-making (FERROFF *et al.,* 2012, p. 3).

However, FERROFF *et al.,* (2012, p. 4) argue that despite the relevance of the quantitative approach, the complexity of the aviation environment demands a broader perspective, as many phenomena – such as organizational interactions and human factors – cannot be fully explained by numerical data alone. In this context, social constructionism emerges as a complementary perspective, recognizing that reality in aviation is not solely technical but also a human and organizational construct (FERROFF *et al.,* 2012, p. 5). Thus, combining qualitative and quantitative methodologies through mixed approaches becomes essential to capture both the objective measurement of events and the subjective context of professionals' experiences and decisions within the sector.

Figure 2 – Comparison Between Qualitative, Quantitative and Mixed Methodologies



Source: Prepared by the authors.

Thus, methodological selection should consider not only the need for robust metrics but also the understanding of the social and organizational dynamics that influence safety and efficiency in the aeronautical sector. The use of mixed methodologies allows for the exploration of this intersection, adding value to scientific investigations and promoting a more comprehensive analysis of the challenges faced in civil aviation.

All this dynamic, as illustrated in Figure 2, is reflected in the distinction between qualitative, quantitative, and mixed methodologies commonly employed in research within the civil aviation sector.

4.2.1 Qualitative Methodology

Qualitative research primarily aims to explore complex phenomena, allowing for an interpretative and contextualized analysis of behaviors, processes, and perceptions. According to Creswell (2018, p. 41), this approach is particularly useful when the researcher seeks to understand the meanings that participants assign to their experiences.

In civil aviation, qualitative research is frequently applied to investigate human factors and operational interactions. For instance, Wiggins (1999, p. 58) highlights that interviews and observations are important tools for analyzing how communication among maintenance teams influences operational safety. Furthermore, Marconi and Lakatos (2017, p. 271) point out that qualitative studies can reveal behavioral and emotional patterns that would not be captured by quantitative methods.

Data collection in qualitative research also includes the use of open-ended questionnaires. These instruments allow participants to express their opinions and experiences in detail, providing the researcher with deeper insights into the phenomena being investigated (Marconi; Lakatos, 2017, p. 275).

4.2.2 Quantitative Methodology

Quantitative research uses numerical data to test hypotheses and identify patterns. Popper (1985, p. 44) argues that this approach is grounded in statistical rigor, allowing theories to be tested in a replicable manner. This characteristic is essential for studies aiming to measure performance or evaluate the effectiveness of specific interventions.

In the civil aviation sector, quantitative research is widely employed to monitor operational indicators, such as incident rates per million operations or route efficiency. According to Creswell (2018, p. 57), structured questionnaires with numerical scales are key tools for quantitative data collection, allowing for consistent comparisons across different samples.

For example, a study analyzed by Wiggins (1999, p. 62) used standardized questionnaires to measure the effectiveness of flight simulator training. This approach enabled researchers to correlate pilots' technical performance with operational variables such as response time in emergency situations.

4.2.3 Mixed Methodology

Mixed methodology combines qualitative and quantitative elements, providing a more integrated and comprehensive view of the issues under investigation. According to Creswell (2018, p. 55), this approach is particularly effective in interdisciplinary contexts where both human and technical dimensions must be analyzed together.

In the civil aviation sector, mixed methodology is widely used in studies that seek to assess the impact of new policies or technologies. For example, Wiggins (1999, p. 70) reports a study that combined interviews with air traffic controllers (qualitative) and statistical analyses of operational data (quantitative) to evaluate the effectiveness of advanced automation systems.

Instruments such as hybrid questionnaires, -including both open- and closed-ended questions – are frequently employed in mixed-method studies.

These tools allow for the collection of numerical data for statistical analysis while also capturing participants' subjective perceptions (Marconi; Lakatos, 2017, p. 278).

5 RESULTS AND DISCUSSION

The results presented demonstrate that scientific methodologies provide a foundational structure for addressing research challenges in civil aviation, encompassing not only technical issues but also human and organizational aspects. The analysis indicates that the choice of methodological approach should be guided by the study's objectives and the complexity of the problem being investigated, with each type of methodology contributing uniquely to the production of knowledge.

Qualitative methodologies stand out for their ability to explore complex phenomena that require contextual and in-depth interpretation. Although often associated with the investigation of human factors – such as organizational practices and communication barriers – their scope goes further. They can be applied to understanding decision-making processes, analyzing cultural dynamics in specific environments, assessing perceptions of new technologies or regulatory changes, and investigating how organizational contexts influence the adoption of innovations. This approach is also effective in exploratory studies, where the goal is to identify key variables for future quantitative analyses, or in research aimed at capturing the meanings participants assign to the phenomena under investigation.

Quantitative methodologies, in turn, remain essential for measuring, monitoring, and analyzing numerical data related to performance, efficiency, and operational safety. Their application allows researchers to identify patterns, test hypotheses, and validate large-scale interventions using tools such as statistical models and predictive analysis. In the aviation sector, possibilities range from studies on route efficiency and incident rates to the evaluation of training effectiveness and automation systems. This analytical rigor is indispensable to ensure that results are replicable and generalizable, providing a more robust basis for strategic decision-making.

The integration of qualitative and quantitative approaches through mixed methodology has proven particularly useful in scenarios that require interdisciplinary analysis or involve both technical and human factors. By combining interpretive data with statistical analysis, studies are able to offer a broader and more well-founded view of multifaceted problems. For example, in projects that assess the impact of innovative technologies on air traffic management, qualitative interviews with operators may reveal cultural barriers and resistance, while quantitative analyses of operational data measure the technical efficiency of implemented changes. This integrated approach enhances both the practical relevance and scientific value of the results.

Triangulation has also been recognized as a valuable tool for strengthening the validity of analyses, as it allows for the combination of different methods and data sources. This practice not only broadens the scope of the studies but also reduces bias and provides a richer, more detailed understanding of the issues under investigation. In the aviation context, it can be employed in the joint analysis of interviews with industry professionals, historical operational data, and incident reports, fostering more robust interpretations aligned with practical demands.

The findings also indicate that the use of questionnaires, interviews, and other data collection tools is a strategic possibility for future investigations in the sector, provided they are aligned with the study's objectives and the characteristics of the problem. Questionnaires, in particular, are versatile and can be structured to capture objective data using quantitative scales or configured as open-ended instruments to collect subjective perceptions. This flexibility is particularly useful for evaluating new policies, technologies, or organizational processes, enriching the analysis with multiple perspectives.

6 FINAL CONSIDERATIONS

This study aimed to understand the foundations of scientific research in the context of civil aviation, highlighting the relevance of methodological approaches for analyzing technical, operational, and human-related issues. The central hypothesis was that the careful integration of different methodologies could

provide a more comprehensive and effective overview of the phenomena investigated, contributing to knowledge advancement and informed decision-making within the sector.

The results confirmed this hypothesis, showing that different methodological strategies offer in-depth analyses and practical applications that enhance the reliability and relevance of research. Systematic approaches, such as data triangulation, proved important by integrating multiple sources and perspectives, thereby increasing the validity and applicability of the findings.

Within the civil aviation sector, it was found that methodological tools can be used to explore human factors – such as the impact of communication practices in operational teams – as well as to analyze technical aspects, such as operational efficiency and flight safety. The ability to adapt these methodologies to the specific characteristics of the sector is essential to address investigative challenges and generate more applicable solutions.

All proposed objectives were achieved. The detailing of the fundamental stages of scientific research and the discussion of its application to the aviation sector demonstrated that a systematic and well-founded approach is essential to understand and solve complex problems in this field.

Despite the progress made, the study has some limitations. The initial analysis prioritized a broad overview of methodologies without addressing in detail their specific applications to operational, regulatory, and technological issues. Furthermore, the practical implementation of these methodologies requires greater adaptation to the unique conditions of the aviation sector, as well as investments in the technical and strategic training of researchers.

As a continuation of this research, it is suggested that future studies take the form of a collection of scientific articles focusing on: Specific Methodologies in Aviation; Systematic Literature Reviews; Case Studies; and Comparative Analyses of Civil Aviation Regulations.

It is concluded that methodological rigor and the integration of different approaches are indispensable for the construction of relevant and applicable knowledge. Continuing this line of research will contribute to strengthening scientific studies in the aeronautical sector, promoting not only scientific

advancement but also safety and efficiency in a multifaceted operational environment.

REFERENCES

BACHELARD, G. **A formação do espírito científico: contribuição para uma psicanálise do conhecimento**. Tradução Estela dos Santos Abreu. Rio de Janeiro: Contraponto, 1996.

BOFF, L. **O método do estudo de caso no campo da gestão da aviação: abordagens, desafios e contribuições**. In: Revista Brasileira de Aviação Civil e Ciências Aeronáuticas, v. 5, n. 1, p. 98-109, 2021.

CRESWELL, J. **Research Design: Qualitative, Quantitative, and Mixed Methods Approaches**. 5th ed. Los Angeles: SAGE Publications, 2018.

FERROFF, C. *et al.* A case for social constructionism in aviation safety and human performance research. **Aeronáutica**, Brisbane, v. 3, 2012. Disponível em: https://www.academia.edu/download/78173205/75372_1.pdf. Acesso em: 15 mar. 2025.

GALLAWAY, T. **Aviation Psychology Research: Extending Scientific Method to Incorporate Value**. Aviation Psychology, v. 6, p. 224-230, 2007.

KUHN, T. **A estrutura das revoluções científicas**. Tradução Beatriz Vianna Boeira e Nelson Boeira. São Paulo: Perspectiva, 2013. (Coleção Debates).

LAKATOS, E.; MARCONI, M. **Fundamentos de metodologia científica**. 8. ed. São Paulo: Atlas, 2017.

POPPER, K. **The Logic of Scientific Discovery**. London: Routledge, 1985.

SILVA, J. G.; PAIVA, M. C. **Metodologia da pesquisa científica no Brasil: natureza da pesquisa, métodos e tendências**. Estudos Interdisciplinares em Educação, v. 9, n. 3, p. 1-20, 2022.

WIGGINS, M.; STEVENS, C. **Aviation Social Science: Research Methods in Practice**. London: Routledge, 1999.