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Impact of Intelligent Systems in Aviation: A Bibliometric Study

Solomiya Rohovets

Master in Business Administration

Supervisor:
PhD, Renato Jorge Lopes da Costa, Assistant Professor with Habilitation
Iscte – Instituto Universitário de Lisboa

Co-Supervisor:
PhD, Rui Alexandre Henriques Gonçalves, Invited Assistant Professor
Iscte – Instituto Universitário de Lisboa

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BUSINESS SCHOOL

Department of Marketing, Operations, and General Management

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To my family, I am heartfully grateful for their unconditional support and encouragement.

To all my friends, I am genuinely thankful for any kind of help provided.

Abstract

This thesis focuses on the impact of intelligent systems in the aviation sector in order to achieve sustainability. By performing a bibliometric analysis using Elsevier Scopus and VOSviewer, the results demonstrate that the exponential increase of intelligent systems application by airline companies and by some of their stakeholders brings benefits and positively influences not only the business development, but also the sustainability. Due to the innovation factor, the implementation of these new technologies enables companies to achieve a competitive advantage and strengthen their market position in the aviation industry. The research concludes that the integration of intelligent systems helps the aviation industry meet its environmental targets and transition to a low-carbon future by improving fuel efficiency, optimising operations, reducing costs, increasing safety, and enabling data-driven decision-making and strategic planning. The findings of this research, derived from a comprehensive review of the literature, provide valuable information and guidance for airlines, airports, AI engineers, policymakers, and the research community.

Keywords: Intelligent Systems; Aviation; Sustainability; Bibliometric Analysis

JEL Classification:

O32 - Management of Technological Innovation and R&D

Q01 – Sustainable Development

Resumo

Esta tese centra-se no impacto dos sistemas inteligentes no setor da aviação para alcançar a sustentabilidade. Ao realizar uma análise bibliométrica com recurso ao Elsevier Scopus e ao VOSviewer, os resultados demonstram que o aumento exponencial da aplicação de sistemas inteligentes por parte das companhias aéreas e de alguns dos seus stakeholders traz benefícios e influencia positivamente não só o desenvolvimento do negócio, como também a sustentabilidade. Devido ao fator de inovação, a implementação destas novas tecnologias permite às empresas obter uma vantagem competitiva e reforçar a sua posição no mercado na indústria da aviação. O estudo conclui que a integração de sistemas inteligentes ajuda a indústria da aviação a alcançar os seus objetivos ambientais e a fazer a transição para um futuro de baixo carbono, melhorando a eficiência do combustível, otimizando as operações, reduzindo custos, aumentando a segurança e permitindo a tomada de decisões e o planeamento estratégico baseados em dados. As conclusões desta investigação, derivadas de uma revisão abrangente da literatura, fornecem informações e orientações valiosas para as companhias aéreas, aeroportos, engenheiros de IA, decisores políticos e a comunidade de investigação.

Palavras-chave: Sistemas Inteligentes; Aviação; Sustentabilidade; Análise Bibliométrica

Classificação JEL:

O32 - Management of Technological Innovation and R&D

Q01 – Sustainable Development

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Index of Acronyms

AI - Artificial Intelligence

ANN - Artificial Neural Network

CBR - Case-Based Reasoning

CO2 - Carbon Dioxide

CRM - Customer Relationship Management

DSS - Decision Support Systems

DL - Deep Learning

GHG - Greenhouse Gas

IoT - Internet of Things

LLCs - Low-Cost Carriers

ML - Machine Learning

RFID - Radio-Frequency Identification

WOM - Word-of-Mouth

CHAPTER 1
Introduction

1.1. Contextualisation

The aviation industry, often considered as a strong reflection of a country's economy, has been experiencing rapid growth due to the significant increase in demand for air travel in recent years (Sharno & Hiloidhari, 2024). With air traffic expected to reach 6.4 billion passengers by 2030, this increase has resulted in higher fossil fuel consumption and a corresponding rise in greenhouse gas emissions (Abubakar et al., 2022).

The aviation sector, known for its difficulty in decarbonization, is confronted with the challenge of addressing the growing demand while simultaneously minimising its ecological effects. The sector also faces strict environmental regulations, strong competition, and the complexity of its systems (Abubakar et al., 2022). Aircraft, which are intended to operate for 30 to 40 years, require substantial financial investments, making it challenging to implement immediate engine adjustments for reducing emissions (Sharno & Hiloidhari, 2024). The aviation industry's impact on climate change is intensified by additional atmospheric effects, that significantly contribute to its overall environmental footprint. Innovative technologies such as AI-driven systems are under development to predict regions where these effects are likely to occur and adjust flight routes to reduce their formation.

The role of Artificial Intelligence (AI) and machine learning will be crucial in addresing these challenges. Fuel efficiency can be improved, processes can be made more efficient, and aviation's ecological footprint can be reduced through AI-driven solutions (Abubakar et al., 2022). AI’s exceptional ability to optimise complex processes and foster scientific innovation positions it as an essential resource in the industry's sustainable transformation. For instance, AI can support pilots by assessing fuel-to-time ratios, allowing for smarter decision-making that reduces emissions and operating expenses (Zaoui et al., 2024).

The aviation sector is transitioning into an era of decarbonization, aiming to identify and implement the most effective clean technologies. With ambitious goals set for significant emission reductions relying on future innovations, AI will be essential in driving progress. Moreover, AI’s potential extends beyond manufacturers, benefiting airlines and other industry stakeholders by improving operational efficiency, reducing emissions, and ensuring long-term sustainability.

1.2. Objectives

The goal of this study is to explore how intelligent systems can impact sustainability in the aviation sector. It aims to assess how different advanced technologies can optimise operational efficiency, minimise greenhouse gas emissions, and reduce expenses. Additionally, the study seeks to evaluate the potential of intelligent systems to facilitate informed decision-making, strategic planning, and to transform and innovate the business models of the airlines, in order to create a competitive advantage through the integration of these technologies. Nonetheless, to have a comprehensive understanding of its potential effects besides the benefits, this research is also focused on addressing challenges and limitations of adopting intelligent systems.

1.3. Research Questions

The research questions guiding this study are as follows:

Q1: What does the bibliographic literature reveal about the impact of intelligent systems in aviation management?

Q2: How do intelligent systems impact business models of airline companies to reduce environmental impact?

Q3: How do intelligent systems influence strategic decision-making within aviation organisations in the context of achieving sustainability?

1.4. Dissertation Structure

In the first chapter, the dissertation introduces the topic, specifies the objectives and the research questions that will guide the research, and defines the structure of the study.

The second chapter, dedicated to methodology, explains the bibliometric analysis approach, and provides criteria for article selection, as well as the criteria used for the research.

In the third chapter, bibliometric analysis results obtained from Elsevier Scopus and correlations identified through the VOSviewer are explored.

The fourth chapter focuses on the discussion of the research findings, which are presented in alignment with the research questions, enabling a detailed analysis of the main insights and essential discoveries from the extensive review.

Finally, the fifth chapter concludes the dissertation by offering a summary of the main research findings and by directly addressing the research questions. Furthermore, the chapter also includes the study's limitations, as well as recommendations and directions regarding future research.

CHAPTER 2
Methodology

2.1. Identification of the Research

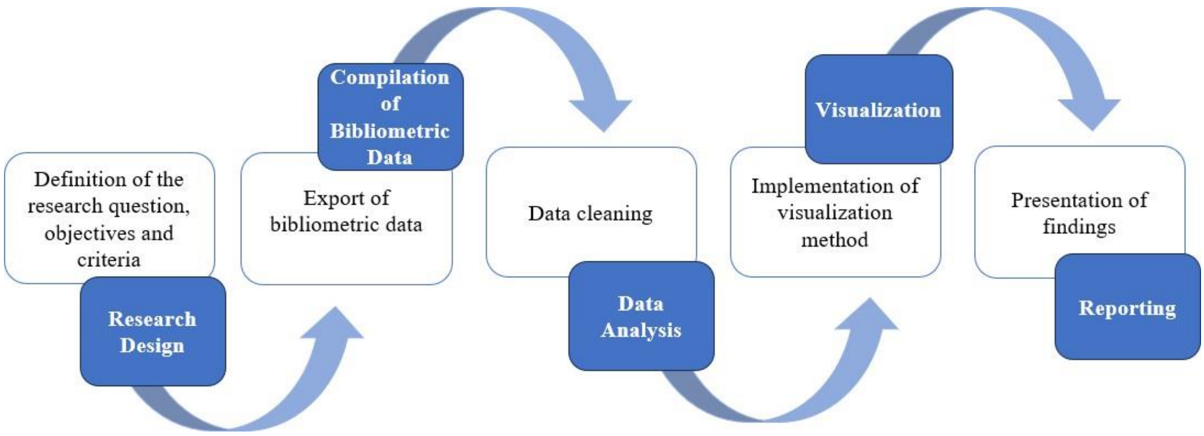
Literature review is defined by Snyder (2019) as a systematic approach that collects and synthesises information from multiple previous research, addressing research questions more comprehensively, ultimately being considered as a method that expands theoretical understanding. As mentioned by Aria and Cuccurullo (2017), bibliometrics provides a systematic, transparent, and replicable review approach, ensuring reliable and unbiased analyses of scientific activity. This method helps to organise extensive data to reveal trends, highlight research areas and changes in academic disciplines, as well as recognise leading researchers and institutions, offering a clear perspective of the existing research.

Zupic and Čater (2014) define in their research a five-step approach for conducting a bibliometric analysis: (i) Defining the research questions and the bibliometric methods; (ii) Compiling bibliometric data; (iii) Analysing results; (iv) Visualising data, and (v) Interpretating results.

According to Shaffril et al. (2020), a procedure of seven steps had been delineated in order to perform a systematic literature review. The steps are the following: (i) Formulating and validating of the review procedure/publication criteria/reporting guidelines; (ii) Defining the research questions; (iii) Applying systematic searching strategies; (iv) Performing quality assessment; (v) Extracting data; (vi) Synthesising data, and (vii) Demonstrating results.

Following the presented approaches, the research method illustrated in Figure 1 will be applied in this study.

Figure 1. Research Method



Source: Self-elaborated

2.2. Articles Selection

The initial step of articles' selection involved compiling an extensive sample of data from Elsevier Scopus using specific filters and keywords. The objective was to collect detailed information pertinent to the research objectives. Following an assessment of the abstracts and full texts, the sample size was adjusted to ensure the inclusion of only the most relevant sources. The process was intended to preserve the quality of the data.

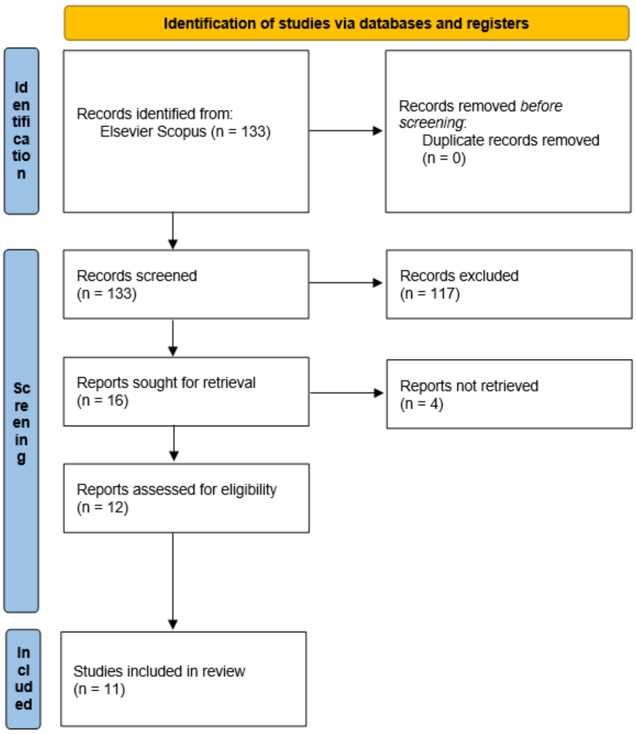
2.3. Data Criteria

The search began with a large set of articles, which was then reduced by applying the selection criteria for more specific results. The data criteria are the following:

1. English academic articles
2. Published between 2020 and 2024
3. Database used Elsevier Scopus
4. Research limited to study areas such as *Business, Management and Accounting, Decision Sciences*, and *Environmental Science*.

2.4. Articles Screening

Figure 2. PRISMA Methodology



CHAPTER 3
Bibliometric Analysis

3.1. Overall Findings

This chapter analyses the connection of topics within the literature over the past five years.

3.1.1. Elsevier Scopus

Through a search on Elsevier Scopus, an extensive academic database, papers were identified by using the keywords Aviation and Artificial Intelligence.

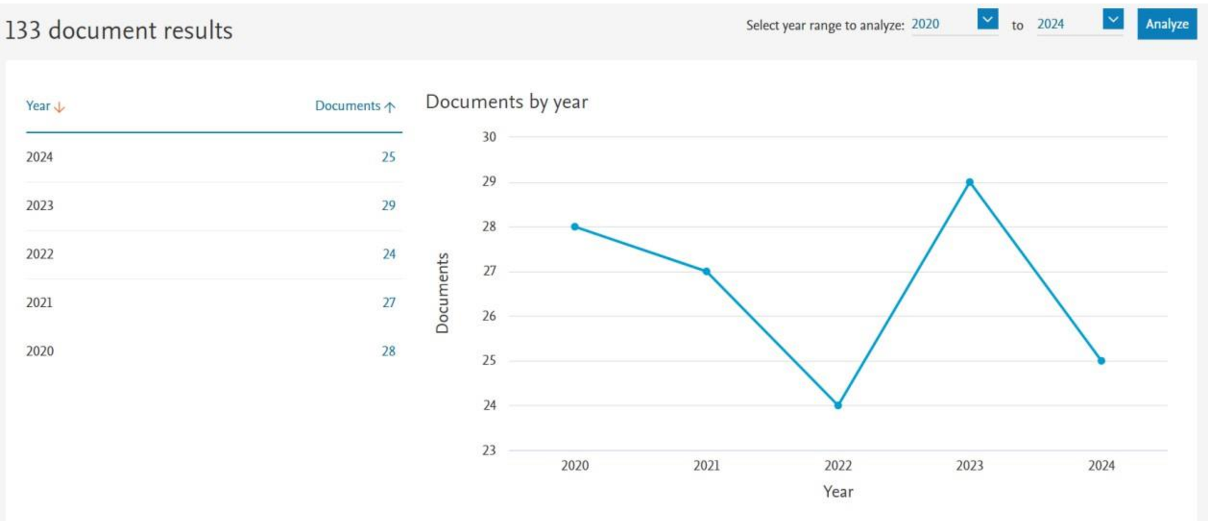
TITLE-ABS-KEY (aviation AND artificial AND intelligence) AND PUBYEAR > 2019 AND PUBYEAR < 2025 AND (LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "DECI") OR LIMIT-TO (SUBJAREA , "BUSI")) AND (LIMIT-TO (LANGUAGE , "English"))

133 document results were obtained using this filter.

3.1.2. Documents by year

The total number of publications between 2020 and 2024 is shown in Figure 3. 2023 was the year with the highest number of publications, while 2022 had the lowest number. Despite a decline in the analysis in the year of 2024, which can be attributed to the fact that the year has not ended, these documents have been growing in popularity since 2022.

Figure 3. Documents by Year

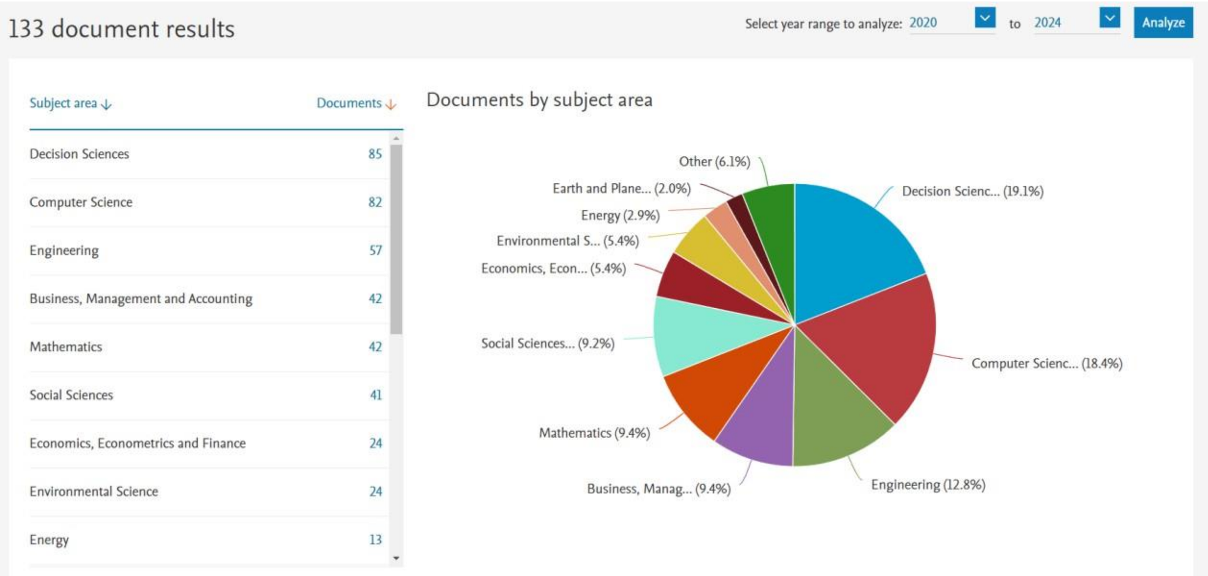


Source: Elsevier Scopus Website

3.1.3. Documents by Subject Area

The search resulted in 133 documents, with 19,1% of them falling under the category of Decision Sciences, 9,4% under the category of Business, Management, and Accounting, and 5,4% under the category of Environmental Science, according to Figure 4. The Computer Science, and Engineering fields, which together account for 18,4% and 12,8% of the results, respectively, were omitted as they included predominantly more technical content.

Figure 4. Documents by Subject Area

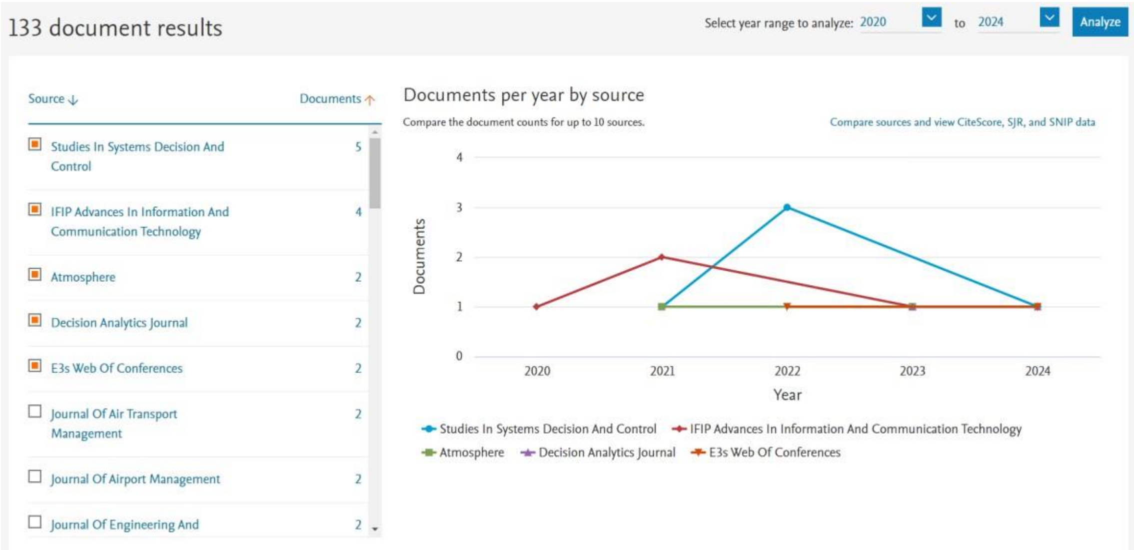


Source: Elsevier Scopus Website

3.1.4. Top Publishing Sources

Figure 5 illustrates that the Studies In Systems Decision And Control is the source that published the most on the subject, which justifies a significant amount of information in the area of Decision Sciences.

Figure 5. Top Publishing Sources

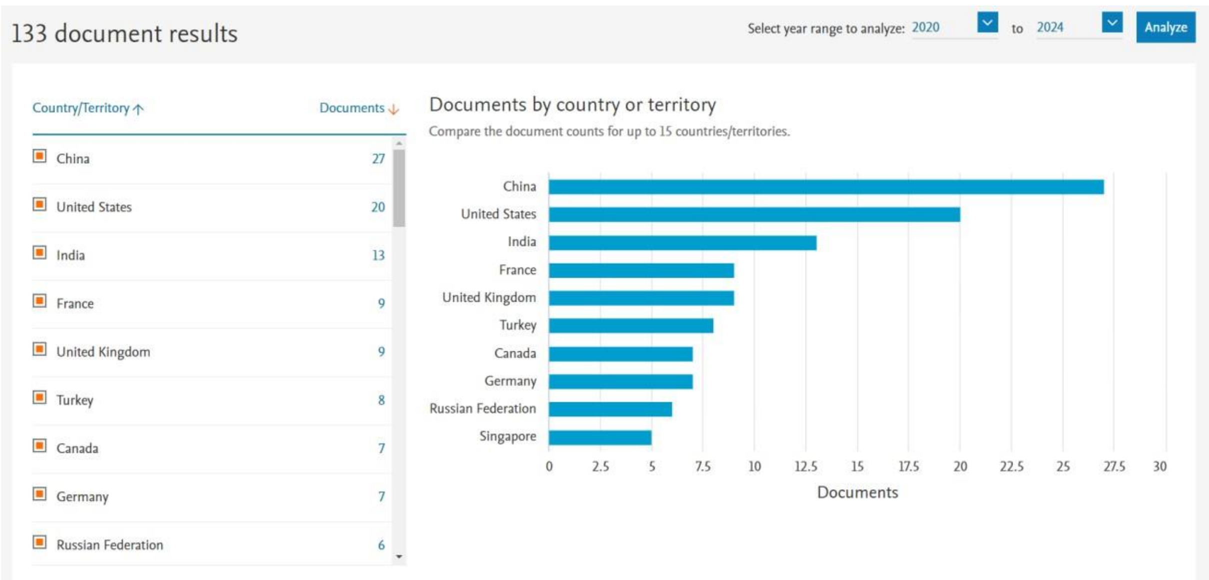


Source: Elsevier Scopus Website

3.1.5. Documents by Country or Territory

The results in Figure 6 indicates that most of the documents retrieved from the search are from China, the United States, and India. Notably, China leads with the highest number of publications, totalling 27 documents.

Figure 6. Documents by Country or Territory

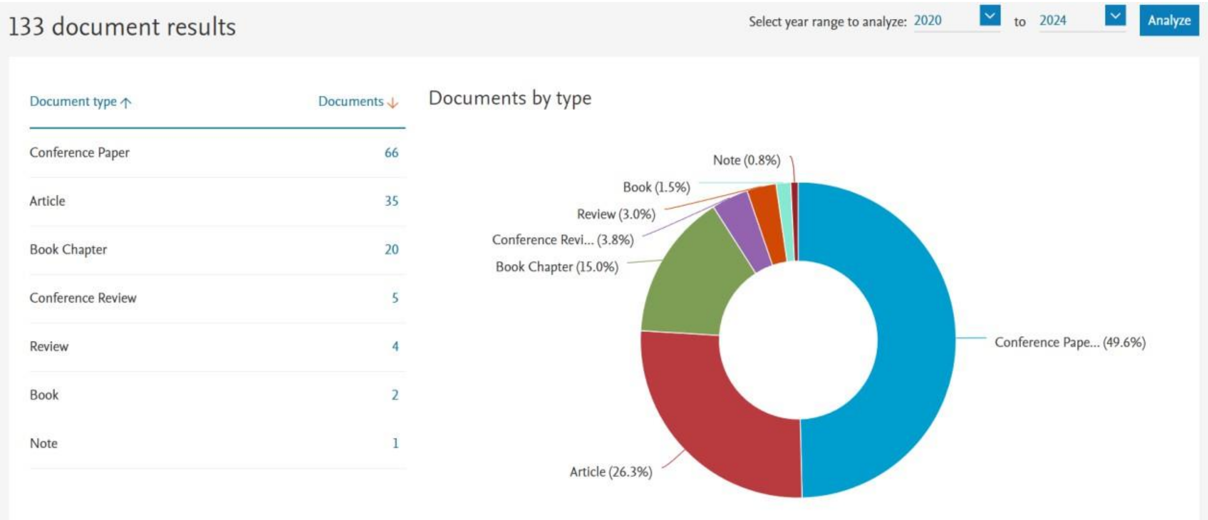


Source: Elsevier Scopus Website

3.1.6. Documents by Type

In Figure 7, conference papers compose 49,6% of the documents obtained by the search, followed by articles (26,3%), book chapters (15%), and conference reviews (3,8%).

Figure 7. Documents by Type

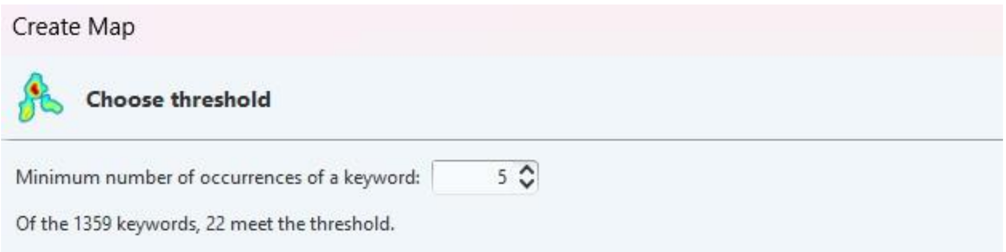


Source: Elsevier Scopus Website

3.1.7. Keywords Selection

Using the dataset of the 133 documents provided by the Elsevier Scopus search, the keyword co-occurrence was mapped using VOSviewer. By clustering the important keywords, their network visualisation is possible, offering details about the connections and trends within a particular field of study. From a total of 1359 keywords, Figure 8 indicates that 22 were selected.

Figure 8. Keyword Selection

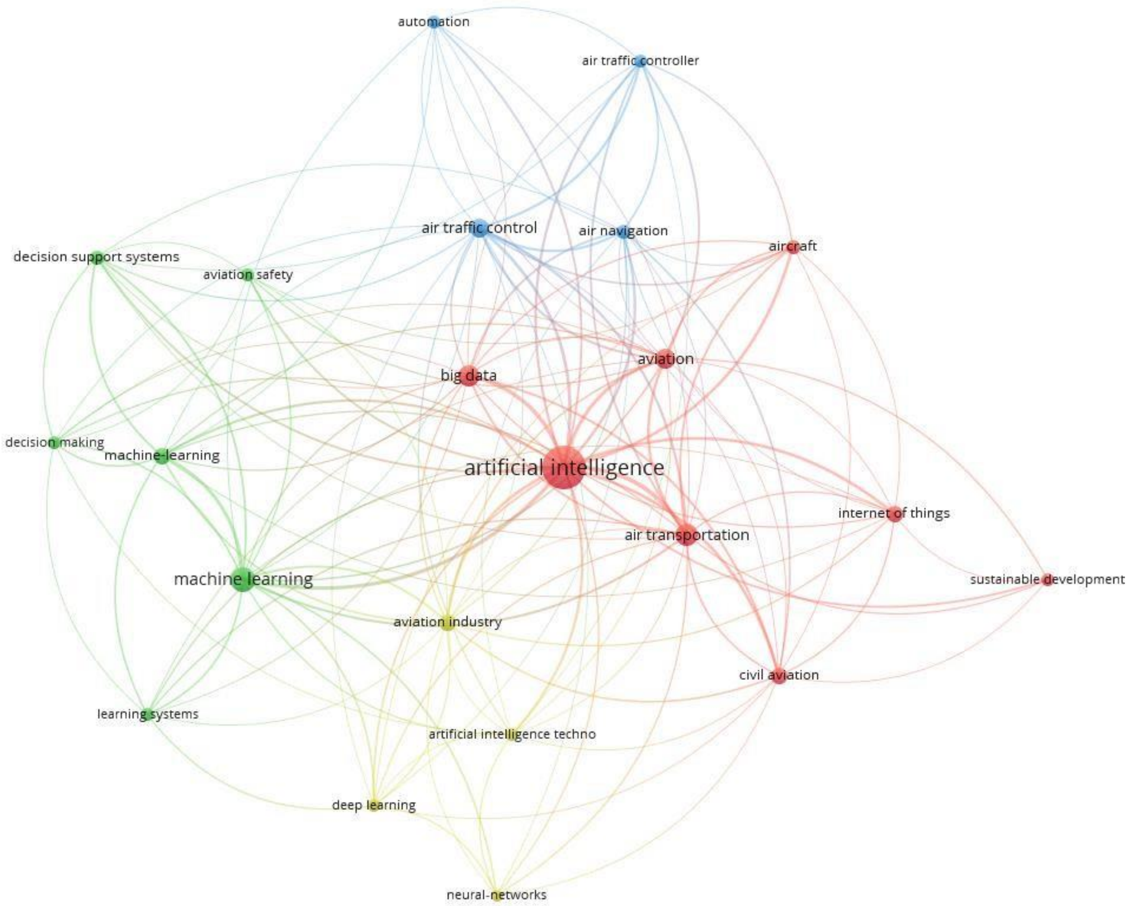


Source: VOSviewer

3.1.8. Keyword Co-occurrence Map

In Figure 9, the co-occurrence map highlights the size of each keyword which reflects its frequency of occurrence. According to Van Eck and Waltman's (2009) interpretation of the results, clusters positioned closely on the map reflect strongly related fields. The clusters are used to provide insight into the structure of keyword networks.

Figure 9. Keyword Co-occurrence Map



Source: VOSviewer

The VOSviewer displayed four clusters, as indicated in Table 1.

Table 1. Keyword Clusters

Cluster 1 Sustainable Air Transport	Cluster 2 Intelligent Safety Systems	Cluster 3 Air Traffic Automation	Cluster 4 AI-Driven Innovation
air transportation, aircraft, artificial intelligence, aviation, big data, civil aviation, internet of things, sustainable development	aviation safety, decision making, decision support systems, learning systems, machine learning, machine-learning	air navigation, air traffic control, air traffic controller, automation	artificial intelligence techno, aviation industry, deep learning, neural-networks

Source: Self-elaborated

3.2. Data Analysis

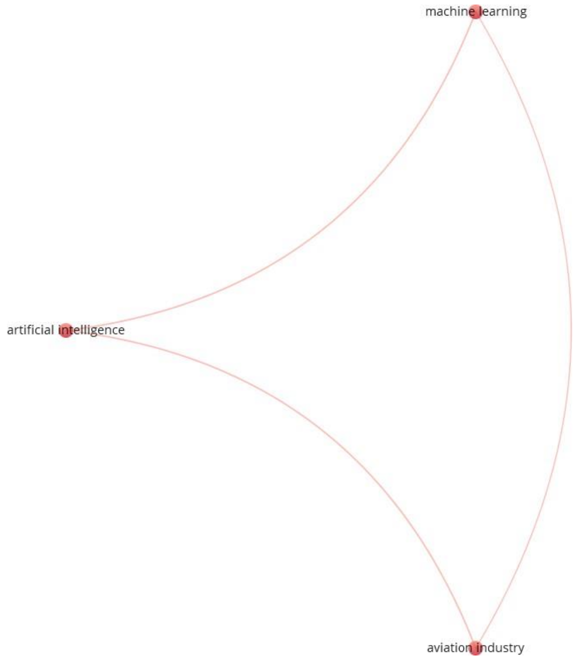
3.2.1. Data Cleaning

Following an initial screening of the 133 articles obtained by the search in Elsevier Scopus, 16 publications were retained after reviewing its titles and abstracts. Subsequently, articles with unavailable full text were removed. After that, articles in full-text stage were reviewed. Finally, after the eligibility review of full texts, 11 articles remained.

3.2.2. Main Articles Keywords

The articles included in review enable an analysis of keywords in accordance with the research questions. The Figure 10 illustrates a map with the most significant keywords from the selected articles.

Figure 10. Main Keywords from the Selected Articles



Source: VOSviewer

The terms *artificial intelligence*, *machine learning*, and *aviation industry* are all part of the same cluster, as defined by the VOSviewer. This can be observed by the representation of these terms in the same colour. As the mentioned keywords are clustered together, it can be determined that there is a strong correlation between them and a frequent presence of all the three terms in the reviewed articles.

CHAPTER 4
Discussion and Findings

4.1. What does the bibliographic literature reveal about the impact of intelligent systems in aviation management?

Intelligent systems, particularly artificial intelligence (AI), machine learning (ML), and the Internet of Things (IoT), have significantly transformed aviation management. These systems optimise aviation operations, contributing to increased efficiency, reduced costs, better safety, and smart decision-making. As noted by Jiang et al. (2023), AI and machine learning facilitate advancements in aircraft design, manufacturing, and maintenance, while mixed reality technologies provide training experiences that increase operational productivity and support sustainability goals. Additionally, Alam et al. (2023) highlight the crucial role of AI in strategic decision-making, emphasising machine learning’s ability to make more accurate predictions related to resource allocation, fleet management, and demand forecasting, leading to more effective long-term business strategies.

Kondinski et al. (2024) emphasise the importance of AI in advancing sustainability, particularly through its integration with decarbonization technologies and sustainable aviation fuels. Intelligent systems enable cross-disciplinary collaboration in the aviation industry, accelerating the development of innovative solutions aimed at reducing environmental impacts. Elhmoud and Kutty (2020) also stress the importance of sustainability, noting that AI-powered Decision Support Systems (DSS) are key to promoting eco-friendly aviation operations and addressing greenhouse gas (GHG) emission challenges.

Moreover, both Zaoui et al. (2024) and Saadi et al. (2020) highlight how AI-driven systems enhance operational performance, addressing rising fuel costs, environmental concerns, and customer demands. These systems improve operational processes, including marketing, logistics, and Customer Relationship Management (CRM). Pillai and Devrakhyani (2020) discuss the contributions of AI and IoT in transforming CRM by providing advanced tools for analysing customer preferences, thereby improving both core and supplementary services offered by airlines.

The adoption of AI has also led to significant progress in predictive maintenance, as noted by Abubakar et al. (2022), improving efficiency and reducing operational costs through the early identification of potential system failures. This use of intelligent systems not only increases safety but also simplifies complex processes, benefiting both customers and aviation companies. Mishra and Choubey (2024) further highlight the impact of AI in automating decision-making and optimising tasks such as route planning and fuel consumption, contributing to sustainability and operational efficiency.

Nevertheless, Holford (2020) raises caution regarding over-reliance on AI, noting that while AI processes vast amounts of data and automates repetitive tasks, it struggles with complex and ambiguous decision-making, which requires human intervention. Therefore, while intelligent systems significantly enhance aviation management, they also pose challenges that necessitate careful consideration of their limitations.

Overall, the bibliographic literature collectively demonstrates that intelligent systems have a major influence on aviation management by optimising operations, fostering sustainability, improving customer engagement, and driving innovation, all while enhancing the efficiency, safety, and profitability of the aviation industry. However, it also highlights the importance of balancing AI's capabilities with human expertise to address complex and ambiguous situations.

4.2. How do intelligent systems impact business models of airline companies to reduce environmental impact?

4.2.1. Operational Efficiency Enhancements

4.2.1.1. Fuel Optimisation

As kerosene prices rise, the need for accurate assessments of aviation fuel use becomes critical, as Abubakar et al. (2022) note. Reducing fuel consumption benefits the business while also positively impacting the environment. Transitioning to fuel-efficient airplanes is essential for the aviation industry to lower carbon emissions and promote greater sustainability for the environment, according to Elhmoud and Kutty (2020). By consuming less fuel, fuel-efficient aircrafts also contribute to the economic sustainability of the industry.

Jiang et al. (2023) explain that machine learning delivers advanced solutions for analysing and optimising the complex challenges in aerospace. When applied to aerodynamics, it ensures that flights consume less fuel, remain stable, and are easier to manage. Automated routing systems that use machine learning help in minimising delays and lowering operational costs. Alam et al. (2023) add that with ANN-based passenger demand forecasting, low-cost carriers (LLCs) can identify high-demand routes, leading to more effective route planning and resource allocation.

Abubakar et al. (2022) further discuss how AI-powered tools reduce fuel use by helping pilots analysing essential flight information, including fuel systems, and weather conditions, which leads to optimised flight routes. In the cockpit, AI significantly contributes to flight path optimization by notifying pilots about important information such as fuel levels and weather conditions.

Zaoui et al. (2024) explain that the use of Deep Learning (DL), which is an advanced AI technology, contributes to the transportation sector, by improving its efficiency, safety, and sustainability, in areas such as predictive maintenance, and route optimization. Operational efficiency is further improved with decision support systems that optimise flight routes. Additionally, by introducing innovative measures such as baggage-free terminals, airports can decrease fuel consumption and carbon emissions, positively affecting energy efficiency and environmental sustainability, as highlighted by Jiang et al. (2023).

4.2.1.2. Predictive Maintenance

The integration of machine learning and predictive analytics is reshaping the way aircraft operate by continuously assessing performance and detecting possible environmental risks, as noted by Jiang et al. (2023). Through the data processing related to flight patterns, fuel consumption, and aircraft performance, algorithms can identify hazards such as environmental or system issues. The transition to machine learning has improved aircraft design, resulting in safer, more efficient planes with better performance optimisation.

Jiang et al. (2023) further explain that the implementation of prediction algorithms and analytical tools have transformed the aircraft design by improving aerodynamics, structures, and control systems. Reliable predictions and optimised aircraft designs are achieved through the application of model-based engineering. In the manufacturing sector, operations are continuously tracked by machine learning systems, which identify real-time defects, and anticipate future abnormalities. As a result, companies have reduced manual labour by adopting AI-based tools for predictive maintenance and performance optimization, making jet engine production processes more efficient.

Predictive maintenance is essential in mitigating challenges related to delays and cancellations due to unplanned maintenance often faced by airlines, as Pillai and Devrakhyani (2020) discuss. Predictive maintenance increases airline reliability by preventing unexpected component failures, thereby reducing both downtime and operational costs. Service data contributes to better digital representations of aircraft, leading to more reliable simulations and more precise predictions for performance and maintenance requirements, according to Jiang et al. (2023).

Jiang et al. (2023) also highlight that machine learning is applied to forecast future traffic flow, which leads to more informed decision-making processes in airport operations. Predictive analytics estimates the number of passengers and flights for particular periods of time. Automated systems for flight scheduling and air traffic control improve the coordination of aircraft and resources. Incident detection systems powered by machine learning and real-time weather updates rapidly detect and resolve potential problems. Additionally, automated systems for ground operations improve aircraft flow and optimise resource management, leading to greater efficiency.

Augmented reality and similar AI technologies are being employed more often to increase the efficiency of assembly and maintenance, as mentioned by Zaoui et al. (2024). AI reduces time consumption and increases operational efficiency by decreasing the workload of maintenance operators, particularly for challenging tasks. Moreover, real-time data-driven digital maintenance systems have allowed decision support systems to operate more efficiently by utilising AI and machine learning, as Elhmoud and Kutty (2020) point out.

4.2.2. Integration of Sustainable Technologies

In heavy transportation sectors, such as shipping and aviation, where electrification faces significant difficulties, sustainable fuels such as ammonia and synthetic hydrocarbons are crucial, as noted by Kondinski et al. (2024). Addressing the urgent challenge of decarbonization demands a broad combination of interconnected technologies, making AI-assisted molecular modelling and data analytics increasingly essential.

Kondinski et al. (2024) suggest an analysis highlighting a future where efficient decarbonisation solutions, with a focus on sustainable fuels for aviation and shipping, and carbon capture and utilisation, play a key role. The development of AI-driven energy management systems aims to optimise energy use across multiple sectors (Mishra & Choubey, 2024). Machine learning algorithms are applied by these systems to assess energy consumption patterns, detect areas for optimisation, and offer suggestions regarding energy-saving strategies.

These technologies unlock the creative potential of scientists and promote world-centric AI, helping to build a sustainable future (Kondinski et al., 2024).

4.2.3. Business Model Adaptation and Innovation

4.2.3.1. Cost Structure Transformation

The aviation industry is being reshaped by intelligent technologies that increase efficiency and productivity, and minimise costs, as noted by Jiang et al. (2023). Many airlines are undergoing a digital transformation, which could result in considerable cost savings, higher productivity, more efficient operations, and lower risks. Machine learning plays a vital role in minimising costs and improving efficiency in processes such as automated baggage handling, enabling airports to conserve time and resources while improving the passenger experience. It also increases the accuracy, sustainability, and cost-efficiency of these operations.

In the aircraft manufacturing industry, Jiang et al. (2023) explain that machine learning drives cost reduction, increases safety and efficiency by allowing automated machines to manufacture aircraft components more accurately and with reduced expenses. AI-driven quality screenings rigorously detect problems on an early stage, helping reduce airline downtime and expenses. The use of AI in quality assurance guarantees optimal performance while decreasing human errors. Additionally, aviation is being transformed by mixed reality, which delivers cost-effective pilot training and enhances maintenance procedures, leading to reduced downtime, and safer and more efficient aircraft maintenance.

Airlines benefit from AI-driven solutions that predict fuel consumption through historical data analysis, achieving 5-10% fuel savings per trip and lowering CO_2 emissions, according to Zaoui et al. (2024). Automated routing systems powered by machine learning help minimise delays and operational costs, and AI-driven single-pilot operations for newer aircraft also contribute to further lowering operating costs. The use of autonomous robots and vehicles offers a cost-efficient solution for managing passenger flow, baggage handling, and terminal transportation (Jiang et al., 2023).

Furthermore, AI integration in fly-by-wire technology has replaced manual hydro-mechanical controls, reducing aircraft weight and fuel expenses, as highlighted by Holford (2020). With the expansion of the aviation industry, Alam et al. (2023) note AI-powered predictions assist airlines in estimating future costs related to passenger demand, capacity growth, fleet purchases, and service development.

Overall, the incorporation of AI and cutting-edge technologies is leading to a transformation in cost structures innovation in business models within aviation, resulting in more sustainable and cost-efficient practices for routine maintenance, fuel use, and operational effectiveness.

4.2.3.2. New Revenue Streams

By strategically applying emerging technologies such as AI and IoT, Customer Relationship Management can be improved, allowing airports to participate in the implementation of advanced CRM systems that promote sustained profitability and long-term revenue increases, as noted by Pillai and Devrakhyani (2020). As a fundamental part of service industries, CRM is described as the practice of managing communications with both current and potential customers based on data derived from their engagements with the organisation. Companies can improve customer relationships, increase retention, and create new revenue streams by analysing this data with specific tools.

Two fundamental components of CRM play a significant role for ensuring sustained revenue growth in the long run. First, Pillai and Devrakhyani (2020) recognise factors causing customer dissatisfaction and business losses, and discuss how AI and IoT can effectively resolve these issues. Second, the authors explore the application of advanced technologies such as facial recognition to identify high-value passengers based on their travel records. These technologies enable airports to develop into smart hubs, improving passenger experiences and also acting as centres for data collection.

Implementing these technologies can significantly alleviate customer dissatisfaction, leading to higher satisfaction and retention rates, thereby ensuring sustained revenues, as noted by Pillai and Devrakhyani (2020). Additionally, CRM tools can enhance resource planning and utilisation, resulting in greater efficiency. Introducing face recognition technology in airports can attract more passengers, thus driving revenue growth. Airports have the opportunity to generate additional revenue by delivering important data to airlines for their CRM activities. Eventually, the strategic use of emerging technologies and CRM tools boosts customer loyalty while creating new revenue streams.

4.2.4. Customer Engagement and Value Proposition

4.2.4.1. Personalisation and Transparency

According to Jiang et al. (2023), with machine learning, passengers are provided with personalized recommendations according to their preferences and location, enabling them to select the most appropriate transportation options, the lowest prices, and the most enjoyable travel experiences. As a result, passengers can make informed decisions, leading to savings in time and expenses. By using machine learning, check-in processes become automated and self-service options are available, creating a more efficient and customised experience. Automating the check-in process helps airlines to reduce labour costs while collecting data to analyse passenger preferences, thereby improving service quality and customer loyalty.

In a study led by Jiang et al. (2023), the authors identified that airlines analyse passenger travel history, behavioural patterns, and purchase records to develop customised travel packages and boarding experiences. Machine learning processes data from various sources, including in-flight systems, social media, and web searches, to develop detailed passenger profiles that can be used to deliver personalised services. For instance, in-flight entertainment options are adjusted to match passengers' preferences, resulting in a better travel experience (Pillai and Devrakhyani, 2020).

As noted by Pillai and Devrakhyani (2020), another important aspect where personalisation is essential is the onboard food selection. A significant number of passengers do not communicate their food preferences before travelling, causing food waste and shortages. Based on traveller data, AI algorithms can determine food preferences, minimising waste and ensuring passengers receive their preferred meals, which helps lower catering costs and boost customer satisfaction.

Additionally, Pillai and Devrakhyani (2020) claim that delivering a personalised travel experience with specific entertainment and meal choices, plays a key role in customer satisfaction and promotes loyalty. Travellers who benefit from personalised services tend to spend more on air travel, which is important for the financial sustainability of airlines. Minimising the time spent on processes such as check-in and security checks contributes to a better travel experience, resulting in higher customer satisfaction and loyalty.

4.2.4.2. Brand Positioning

Artificial Intelligence is making a significant impact in the retail sector, allowing brands to develop a Unique Customer Repository that offers a detailed view of each customer within an omnichannel environment, as noted by Saadi et al. (2020). The objective is to maximise turnover and strengthen customer loyalty by offering seamless experiences across digital platforms such as computers, tablets, mobile devices, and physical stores. AI enables brands to conduct real-time predictive analysis by assessing customer data, including purchasing behaviour, browsing history, and transaction information, to provide personalised recommendations. A thorough understanding of customer preferences enhances the brand experience and reinforces the connection with customers.

Brands can leverage emerging technologies, such as AI, to improve their core and supplementary services. While transportation is the core service in the airline industry, Pillai and Devrakhyani (2020) identify that value is added through supplementary offerings such as in-flight entertainment, meals, and the cabin crew's quality, which help differentiate the product. Brands can secure customer loyalty by incorporating emerging technologies to personalise services, creating a competitive advantage in the process. AI-powered Customer Relationship Management programs are crucial for increasing customer retention, optimising operational efficiency, and securing sustainable long-term growth.

4.2.5. Challenges and Limitations

4.2.5.1. Implementation Costs

Jiang et al. (2023) refer that running machine learning and mixed reality applications demands extensive computing power, software, and energy, potentially increasing hardware and software expenses, particularly when processing deep learning algorithms and large amounts of data. The process of training and deploying models requires significant time, resources, and expert knowledge, which increases the overall cost. Additionally, maintaining and upgrading machine learning algorithms requires considerable time and expense, adding more strain to resource management.

Precise and current data is essential for machine learning algorithms in aviation, although changes in the environmental and data collection can create obstacles. Weighing the benefits against the considerable expenses is essential for airlines to ensure effective use of resources (Jiang et al., 2023). Moreover, due to the substantial costs of AI implementation, airlines with smaller investment capacities may hesitate to embrace this technology (Abubakar et al., 2022). As Elhmoud and Kutty (2020) mention, limited financial resources can restrict decision-making in the airline industry, producing fewer effective results.

4.2.5.2. Technological and Data Limitations

According to Jiang et al. (2023), use of machine learning is often constrained by limited processing capabilities, along with excessive noise in aviation data. The noise interferes with pattern recognition by algorithms, leading to imprecise models. Additionally, the complexity and lack of transparency in machine learning models create difficulties for human understanding of their decision-making processes, potentially diminishing trust and confidence. Machine learning models can also face the problem of bias, as training on real-world data may cause them to adopt societal biases, producing unfair or discriminatory outcomes.

In a study conducted by Alam et al. (2023), the authors emphasise that to ensure effective performance, precise and real-time data is essential for training Artificial Neural Networks, which may also require regular retraining to adjust to changing patterns. The difficulty of incorporating AI technologies into current infrastructures presents additional challenges, usually demanding significant data availability and quality (Mishra & Choubey, 2024). Moreover, AI adoption worldwide in aviation will be a gradual process, as it must undergo thorough testing and certification processes by aviation organisations (Abubakar et al., 2022).

Furthermore, Mishra and Choubey (2024) argue that effective collaboration between humans and AI is important to build trust and comprehension of AI decisions, where transparency plays a critical role in ensuring successful implementation.

4.3. How do intelligent systems influence strategic decision-making within aviation organisations in the context of achieving sustainability?

4.3.1. Predictive Analytics

Machine learning improves transportation infrastructure, predicts customer behaviour, and delivers personalised services to improve the passenger experience (Jiang et al., 2023). As noted by Alam et al. (2023), predictive analytics plays a vital role in decision-making, offering data-driven predictions that allow investors and stakeholders to evaluate the potential success of future projects. This facilitates informed decision-making, strategic planning, and improved risk evaluation across different situations. With accurate, data-driven predictions, this tool assists in evaluating risks and potential outcomes in different situations, supporting informed decision-making and strategic planning.

By using Artificial Neural Networks, low-cost airlines can predict passenger demand, leading to better route planning and more efficient resource allocation. Capacity adjustments based on demand predictions can ensure profitability, while pricing strategies adapted to align with demand fluctuations. Moreover, predicting and assessing travel demand enables airlines to reduce risk through an accurate and objective understanding of market trends. This helps airlines make informed strategic decisions, including route optimisation and capacity planning by considering market trends and passenger behaviour. Airlines can lower the chances of overcapacity or underutilisation by adjusting their services according to demand forecasts. Airports can apply the ANN model for infrastructure planning, including expanding terminals and allocating runways, as well as optimising resources by coordinating personnel, security, and services based on forecasted passenger numbers. Aligning sustainability strategies with expected passenger increases ensures reduced environmental impact and supports the creation of energy-efficient infrastructure (Alam et al., 2023).

These predictive insights can be applied by airports and governmental authorities to improve their operational practices and adjust regulations concerning safety, security, and environmental issues. Predicting passenger demand plays a key role in promoting aviation expansion in emerging markets, helping airports and governments to implement long-term strategies based on data-driven analysis (Alam et al., 2023).

Zaoui et al. (2024) refer that predictive analytics can be applied in multiple ways, such as forecasting the demand for spare parts in aircraft maintenance, using real-time video analysis to monitor aircraft turnaround activities, and implementing AI to generate contextual recommendations that improve operational efficiency. AI-powered predictive analytics contribute to predictive data quality management by assisting companies in detecting possible data quality problems and implementing proactive measures (Mishra & Choubey, 2024).

Additionally, Chakraborty et al. (2021) claim that ANN models enable airlines to estimate passenger numbers and adjust airport and cabin handling processes as needed. Machine learning algorithms powered by AI can anticipate failures in critical instrumentation, thereby supporting overall operational efficiency. The aviation industry's decision-making is significantly improved by advanced models such as ANN, which evaluate non-linear relationships, thus supporting airlines in achieving their sustainability and efficiency goals. Classical regression models and ANN frameworks have both demonstrated their effectiveness in facilitating future demand predictions and decision-making processes (Elhmoud & Kutty, 2020).

4.3.2. Resource Allocation and Investment

Pillai and Devrakhyani (2020) emphasise that retaining customers who contribute to profitability is crucial in the aviation industry. For full-service and low-cost airlines, investing in data-driven technologies such as AI and IoT is important to ensure revenue sustainability, improve customer experience, and optimise operational efficiency. Given that safety is a major concern for passengers, it is essential for all airlines to invest in technologies to create safer cabins. As stated by Zaoui et al. (2024), many industries related to aeronautics aside from aircraft manufacturers and suppliers, including airlines and airports, have a growing interest in the use of AI.

According to Alam et al. (2023), predicting passenger demand accurately is key for airlines to manage resources efficiently and organise operations, helping to maximise fleet capacity and increase profits. Machine learning is highly suggested as a valuable tool for forecasting, helping managers make informed decisions in areas such as production, resource allocation, and scheduling.

As highlighted by Zaoui et al. (2024), AI solutions, such as Big Data analytics and decision support systems, process data to increase operational efficiency, minimise delays, and optimise flight routes. AI integration in the aeronautics industry leads to greater efficiency by enabling simplified authentication, offline data storage, and reduced return-to-service times.

Additionally, using vision-based systems for autonomous taxiing, take-off, and landing contributes to greater operational performance.

IoT and AI in airlines help reduce turnaround times through innovations such as automated baggage systems, touchless kiosks, e-boarding passes, and AI-powered camera monitoring of freight. IoT-powered solutions such as AI-driven robotics for sanitisation and data-based operations management have become crucial to meet sanitisation requirements and ensure operational flexibility in the post-pandemic world (Chakraborty et al., 2021).

The integration of beacons, RFID tags, and IoT systems contributes significantly to improving operational efficiency, as noted by Saadi et al. (2020). Strategically placed digital beacons in airports provide passengers with real-time updates, improving passenger satisfaction and contributing to increased revenue for airports. With RFID tags, baggage tracking becomes more secure and efficient, delivering real-time location updates, and reducing operational expenses.

Lastly, by using AI-enabled ultraviolet cleaning robots, the turnaround time for aircraft cleaning is reduced, leading to better operational efficiency and increasing passenger satisfaction (Pillai and Devrakhyani, 2020). Elhmoud and Kutty (2020) mention that effective maintenance systems in airlines help decrease operating expenses and lower greenhouse gas emissions, further improving resource allocation in aviation.

4.3.3. Innovation and Competitive Advantage

The aviation industry has been transformed by digitisation, which has brought forth innovative digital methods that improve operational efficiency, safety, and security, while increasing passenger satisfaction by better addressing their needs and preferences, as mentioned by Jiang et al. (2023). With these innovations, the industry is moving into a new phase characterized by "touchless, seamless, and secure" operations.

With the ongoing evolution of the aviation sector, businesses are taking advantage of the intersection between AI, data science, and sustainability to ensure they remain competitive (Kondinski et al., 2024). According to Zaoui et al. (2024), emerging technologies, including autonomous aircraft, renewable energy, AI, additive manufacturing, and big data, are revolutionising the sector, assisting businesses in enhancing performance while promoting sustainability, and meeting safety and security requirements. The development of innovative solutions and services increasingly relies on AI.

AI is being used in different areas to deliver innovative solutions and simplify complex processes (Zaoui et al., 2024). For instance, AI and ML are essential in creating and manufacturing airplane components, such as wings and propellers, helping engineers to improve performance using dynamic design and 3D printing technologies, as Abubakar et al. (2022) refer. The use of AI in these processes contributes to better manufacturing and design within the aviation industry.

Furthermore, the integration of AI and IoT in operations builds passenger trust and satisfaction, especially by implementing touchless operations and efficient workflows, resulting in an improved customer experience. The sense of safety and comfort provided by these innovations fosters confidence and generates positive word of mouth (WOM). Increased passenger confidence and security lead to more frequent travel, promoting the sustainability of the business (Chakraborty et al., 2021).

Within the competitive airline market, Pillai and Devrakhyani (2020) claim that AI's capacity to deliver personalised, consumer-oriented services offers a competitive advantage. Airlines that implement strong Customer Relationship Management strategies can more effectively differentiate their products and services, optimise operations, and promote long-term business success. Identifying high-value customers and meeting their particular needs is fundamental for achieving a competitive advantage in the marketplace.

In summary, the integration of AI is essential for driving innovation and competitive advantage, and supporting sustainable business development in the aviation industry.

4.3.4. Challenges and Ethical Considerations

4.3.4.1. Implementation Barriers

AI integration in aeronautics management has two major areas of impact, as highlighted by Zaoui et al. (2024). First, for aeronautics managers who remain doubtful about AI implementation and have not yet found AI-driven solutions to address their issues. Second, for managers in specific roles within aeronautical organisations dealing with the impacts of AI adoption. For companies hesitant about integrating AI into their operations can use approaches like Case-Based Reasoning (CBR), which solves new problems by relying on past experiences with similar successful solutions. Several companies in the aviation industry have successfully adopted AI-powered solutions to address recurring issues and improve production processes, providing models that can be applied in different contexts.

In practice, aeronautical managers can identify the most relevant cases from a case database, adapt them to address current issues, refine the solution, and save the revised solution as a new case for future reference (Zaoui et al., 2024). However, achieving full efficiency in initiatives such as baggage handling within the airline industry relies on close coordination with airport operations, as mentioned by Pillai and Devrakhyani (2020). Meanwhile, initiatives such as in-flight entertainment and meal selection are managed exclusively by the airlines. Different implementation challenges arise for each initiative, such as financial considerations, technology development, stakeholder collaboration, regulatory compliance, and operational limitations.

Moreover, Holford (2020) argues that the introduction of new cockpit technologies and automation brings its own set of challenges. The importance of increased pilot training to identify the capabilities and limitations of these technologies has been emphasised. It is important for pilots to maintain their manual override training to respond appropriately in situations of technological limitations. AI might face challenges in addressing the complexities of uncertainty and ambiguity, especially in natural language processing, as only humans have the nuanced conversational abilities known as *mètis* knowledge, which is a combination of contradictory knowledge categories.

4.3.4.2. Ethical Implications

Since machine learning algorithms are trained using datasets that include personal information, Jiang et al. (2023) argue that serious issues are raised related to privacy and data security. Ethical considerations arise from personalisation services based on machine learning, as the data can reveal sensitive information, which may lead to harmful actions including biassed algorithms affecting decision-making and results. These systems can also be targets of cyber-attacks that seek to obtain sensitive information, potentially causing unfair practices and discrimination, including the creation of lists of unwanted passengers, restricting their access to particular services or treating them in a different way.

Although AI has the capacity to process complex data from multiple sources, it remains vulnerable to bias (Holford, 2020). Since algorithms reflect the codified perspectives of their developers, it's important to approach AI decisions with critical analysis. According to Jiang et al. (2023), addressing concerns about bias in decisions, privacy violations, and unfair pricing is crucial for maintaining ethical standards. It has been suggested by Holford (2020) that human involvement is crucial in supervising and guiding AI decisions, as humans have the ability to handle ambiguity through contextualisation and interpretation.

Integrating AI into business processes requires careful consideration of its ethical impacts (Mishra & Choubey, 2024). Considering the fast growth of AI adoption, Pillai and Devrakhyani (2020) highlight that it is crucial to establish strict guidelines for passenger data collection, sharing, and use to guarantee ethical and responsible technological practices, as well as preserve data privacy and trust.

CHAPTER 5
Conclusion

5.1. Synthesis

Based on the information obtained from the bibliometric analysis, along with the discussions and findings, this final chapter synthesises the main insights and presents the central conclusions of the review.

This study highlights multiple important insights about how intelligent systems can impact sustainability in the aviation industry. Intelligent systems have emerged as fundamental contributors in shaping strategic decision-making within aviation organizations, significantly enhancing operational efficiency and reducing environmental impacts. Through technological progress such as fuel optimisation and predictive maintenance, airlines can simplify their operational processes and improve cost-effectiveness while simultaneously addressing the urgent need for decarbonisation.

The integration of advanced technologies enables airlines to apply predictive analytics to accurately forecast demand and allocate resources effectively, thereby promoting innovation and providing a competitive advantage. This capability not only supports informed decision-making that aligns with market demands but also enriches customer experiences through personalised services while ensuring high safety and service standards. Moreover, adopting sustainable technologies and innovative business models is crucial for addressing the challenges associated with climate change, reinforcing the significant contribution of intelligent systems in supporting this transition.

Nevertheless, the process of achieving full integration of these technologies presents a number of challenges. Implementation barriers, including managerial scepticism and the complexities of operational integration, require careful navigation. Additionally, ethical considerations related to data privacy and algorithmic bias highlight the need for careful supervision to ensure the fair and responsible use of AI. As the aviation industry progresses, it will be crucial to create an innovative culture and address ethical considerations to fully unlock the potential of intelligent systems.

Overall, the findings suggest that while intelligent systems present promising opportunities for improving sustainability in aviation, it is important to consider the related challenges to maximise their potential benefits. By strategically adopting these technologies, aviation companies can improve their operational efficiency and contribute to a more sustainable and customer-oriented industry.

5.2. Limitations

One of the main limitations of this study is the sample size. The size of the sample was too small to adequately represent the diversity of information. Even though the initial research resulted in 133 documents, only 11 were considered appropriate for inclusion in the review. It increases the risk of bias, as the selected studies may reflect a limited perspective that does not accurately represent the field. An additional limitation is the information availability. This research was based exclusively on a single research engine, Elsevier Scopus. Findings derived from a limited dataset may not be generalisable to the broader field or population, as the research may not adequately reflect the variety of studies and methodologies available.

5.3. Future Recommendations

For the future, it would be important to provide more data regarding the impact of intelligent systems in the aviation industry. Intelligent systems are being increasingly applied nowadays and having access to a larger set of information regarding these technologies to understand their advantages and limitations to efficiently maximise their benefits in companies is crucial. In addition, introducing detailed case studies of airlines or airports that have successfully integrated intelligent systems will reduce managerial doubtfulness in applying new technologies.

References

Abubakar, M., EriOluwa, O., Teyei, M., & Al-Turjman, F. (2022). AI Application in the Aviation Sector. *2022 International Conference on Artificial Intelligence of Things and Crowdsensing (AIoTCs)*. https://doi.org/10.1109/aiotcs58181.2022.00015

Alam, M. S., Deb, J. B., Amin, A. A., & Chowdhury, S. (2023). An artificial neural network for predicting air traffic demand based on socio-economic parameters. *Decision Analytics Journal*, *10*, 100382. https://doi.org/10.1016/j.dajour.2023.100382

Aria, M., & Cuccurullo, C. (2017). bibliometrix : An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, *11*(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Chakraborty, S., Chakravorty, T., & Bhatt, V. (2021). IoT and AI Driven Sustainable Practices in Airlines As Enabler of passenger confidence, satisfaction and Positive WOM : AI and IoT Driven Sustainable Practice in Airline. *Proceedings of the International Conference on Artificial Intelligence and Smart Systems (ICAIS-2021)*. https://doi.org/10.1109/icais50930.2021.9395850

Elhmoud, E. R., & Kutty, A. A. (2020). Sustainability Assessment in Aviation Industry: A mini- review on the tools, models and methods of assessment. In *Proceedings of the International Conference on Industrial Engineering and Operations Management* (Vol. 59). IEOM Society.

Holford, W. D. (2020). The repression of mètis within digital organizations. *Prometheus*, *36*(3). https://doi.org/10.13169/prometheus.36.3.0253

Jiang, Y., Tran, T. H., & Williams, L. (2023). Machine learning and mixed reality for smart aviation: Applications and challenges. *Journal of Air Transport Management*, *111*, 102437. https://doi.org/10.1016/j.jairtraman.2023.102437

Kondinski, A., Mosbach, S., Akroyd, J., Breeson, A., Tan, Y. R., Rihm, S., Bai, J., & Kraft, M. (2024). Hacking decarbonization with a community-operated CreatorSpace. *Chem*, *10*(4), 1071–1083. https://doi.org/10.1016/j.chempr.2023.12.018

Mishra, N., & Choubey, S. (2024). Artificial Intelligence-Driven Energy Platforms: Applications and Challenges. In *E3S Web of Conferences* (Vol. 540, p. 08012). https://doi.org/10.1051/e3sconf/202454008012

Pillai, R. G., & Devrakhyani, P. (2020). A Data Driven Approach for Customer Relationship Management for Airlines with Internet of Things & Artificial Intelligence. In *IFIP advances in information and communication technology* (pp. 657–672). https://doi.org/10.1007/978-3-030-64849-7_58

Saadi, H., Touhami, R., & Yagoub, M. C. (2020). Revolution of artificial intelligence and the internet of objects in the customer journey and the air sector. *Journal of Information Technology Management*, *12*(2), 59–69. https://doi.org/10.22059/jitm.2020.75791

Shaffril, H. a. M., Samsuddin, S. F., & Samah, A. A. (2020). The ABC of systematic literature review: the basic methodological guidance for beginners. *Quality & Quantity*, *55*(4), 1319–1346. https://doi.org/10.1007/s11135-020-01059-6

Sharno, M. A., & Hiloidhari, M. (2024). Social sustainability of biojet fuel for net zero aviation. *Energy Sustainable Development/Energy for Sustainable Development*, *79*, 101419. https://doi.org/10.1016/j.esd.2024.101419

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, *84*(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Zaoui, A., Tchuente, D., Wamba, S. F., & Kamsu-Foguem, B. (2024). Impact of artificial intelligence on aeronautics: An industry-wide review. *Journal of Engineering and Technology Management*, *71*, 101800. https://doi.org/10.1016/j.jengtecman.2024.101800

Zupic, I., & Čater, T. (2014). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429–472. https://doi.org/10.1177/1094428114562629

Annexes

Annex A - Articles Selection

Year	Authors	Title	Origin	Cited
2024	Mishra, N., & Choubey, S.	Artificial Intelligence-Driven Energy Platforms: Applications and Challenges	India	0
2024	Kondinski, A., Mosbach, S., Akroyd, J., Breeson, A., Tan, Y. R., Rihm, S., Bai, J., & Kraft, M.	Hacking decarbonization with a community-operated CreatorSpace	United Kingdom/ Singapore	1
2024	Zaoui, A., Tchuente, D., Wamba, S. F., & Kamsu-Foguem, B.	Impact of artificial intelligence on aeronautics: An industry-wide review	France	4
2023	Alam, M. S., Deb, J. B., Amin, A. A., & Chowdhury, S.	An artificial neural network for predicting air traffic demand based on socio-economic parameters	Canada/ Bangladesh/ United States	11
2023	Jiang, Y., Tran, T. H., & Williams, L.	Machine learning and mixed reality for smart aviation: Applications and challenges	United Kingdom	23
2022	Abubakar, M., EriOluwa, O., Teyei, M., & Al-Turjman, F.	AI Application in the Aviation Sector	Cyprus	2
2021	Chakraborty, S., Chakravorty, T., & Bhatt, V.	IoT and AI Driven Sustainable Practices in Airlines As Enabler of passenger confidence, satisfaction and Positive WOM: AI and IoT	India	9

		Driven Sustainable Practice in Airline		
2020	Holford, W. D.	The repression of mètis within digital organizations	Canada	1
2020	Elhmoud, E. R., & Kutty, A. A.	Sustainability Assessment in Aviation Industry: A mini-review on the tools, models and methods of assessment	Qatar	8
2020	Pillai, R. G., & Devrakhyani, P.	A Data Driven Approach for Customer Relationship Management for Airlines with Internet of Things & Artificial Intelligence	France	1
2020	Saadi, H., Touhami, R., & Yagoub, M. C.	Revolution of artificial intelligence and the internet of objects in the customer journey and the air sector	Canada/ Algeria	3