Passenger Perceptions of AI-Based Predictive Maintenance in Aviation

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Abstract—**This study investigates passenger perceptions of artificial intelligence (AI) and predictive maintenance technologies within the aviation industry, focusing on levels of trust, comfort, and safety concerns. Data were collected through an online survey distributed via Google Forms, with responses from 32 participants representing diverse regions across Asia, Africa, and Europe. The survey examined demographic characteristics, trust in AI systems, comfort with AI-assisted maintenance, perceived risks, and preferences for human–AI collaboration.**

Quantitative data were analyzed using descriptive and inferential statistics, supported by visual representations such as bar and pie charts generated in Google Forms. Qualitative insights from open-ended responses were analyzed thematically to identify key trends and concerns. Findings revealed that 60% of respondents expressed trust in AI systems, and 65% reported comfort with AI-based aircraft maintenance. However, 48% expressed concerns regarding AI reliability, and 85% emphasized that AI should assist rather than replace human operators. The majority also called for greater transparency from airlines about how AI is integrated into aircraft systems.

The study concludes that while passenger trust in AI-driven predictive maintenance is increasing, significant apprehensions remain regarding reliability, data privacy, and autonomy. To strengthen public confidence, airlines and manufacturers should prioritize clear communication, continuous human oversight, and explainable AI frameworks. These findings enhance understanding of the human dimension of aviation innovation and support the development of safer, more transparent AI integration strategies in air transport maintenance.

Keywords—**Artificial Intelligence, Predictive Maintenance, Aviation Safety, Passenger Perception, Trust in Technology, Human–AI Collaboration.**

I. INTRODUCTION

1.1 Background

The aviation industry has consistently been at the forefront of adopting advanced technologies to enhance safety, reliability, and efficiency. In recent years, Artificial Intelligence (AI) has emerged as a transformative force across various sectors, and aviation maintenance is no exception. One of the most promising AI applications is predictive maintenance (PdM) a data-driven approach that utilizes machine learning algorithms and sensor analytics to predict potential component failures before they occur (Zhang et al., 2022)(1).

Unlike traditional reactive maintenance (repairing after failure) or preventive maintenance (servicing based on fixed schedules), predictive maintenance continuously monitors aircraft health through real-time data streams from onboard sensors, maintenance logs, and operational parameters (Airbus, 2023)(2). By analyzing this data, AI models can identify subtle anomalies and estimate a component's Remaining Useful Life (RUL), enabling maintenance teams to intervene proactively (Lee et al., 2020)(3).

This capability is critical in aviation, where safety and reliability are paramount. AI-based predictive maintenance improves operational safety by preventing unexpected in-flight failures, enhances fleet reliability by minimizing aircraft-on-ground (AOG) incidents, and contributes to cost efficiency by reducing unnecessary inspections and optimizing maintenance scheduling (IATA, 2023). For passengers, these improvements translate to fewer flight delays, higher on-time performance, and greater confidence in aircraft safety.

However, as AI systems take on increasingly autonomous roles in safety-critical domains, concerns about algorithmic transparency, accountability, and data privacy have grown (Rahman & Borenstein, 2021)(4). In aviation, these issues extend beyond technical reliability they shape the public's trust and acceptance of AI-managed aircraft operations.

1.2 Problem Statement

While substantial research exists on the technical and economic benefits of predictive maintenance in aviation, there remains a significant gap in understanding passenger perceptions of these systems. The majority of current studies focus on engineering optimization, fault prediction accuracy, and cost reduction (Choudhury et al., 2023)(5), yet little is known about how passengers interpret or feel about aircraft being maintained by AI-driven technologies.

Passenger trust, comfort, and perceived safety are crucial to the successful adoption of AI-based maintenance practices. Negative or uncertain perceptions could hinder acceptance, influence airline choice, or raise ethical and regulatory concerns regarding automation in aviation safety (Liu & Daramola, 2022)(6). Therefore, exploring how passengers view these emerging technologies and what communication, regulatory, and ethical measures can reinforce their confidence is essential for ensuring both operational success and social legitimacy.

1.3 Research Aim and Objectives
The aim of this study is to assess passenger trust, comfort, and concerns regarding AI-based predictive maintenance in aviation.

Objectives:

1. To examine passengers' level of trust in AI maintenance systems compared to human technicians.

2. To identify privacy and transparency concerns related to AI-based predictive maintenance.

3. To explore the role of regulation and communication in shaping passenger trust and comfort.

4. To determine which outcomes of AI maintenance (e.g., safety, reduced delays, cost savings) passengers value most.

1.4 Research Questions

1. How do passengers perceive the safety and reliability of AI-based maintenance systems?

2. What are their primary concerns regarding data privacy and algorithmic transparency?

3. What level of regulatory oversight (e.g., FAA, EASA) do passengers expect to ensure AI system safety?

4. How does communication about AI-driven maintenance influence passenger trust and acceptance?

1.5 Significance of the Study
Understanding passenger perceptions of AI-based predictive maintenance provides vital insights for airlines, regulators, and aviation manufacturers. The findings can inform policy frameworks that promote transparency, explainability, and ethical deployment of AI in aviation safety systems. Moreover, the research supports the design of effective communication strategies that align technological innovation with passenger expectations, thereby strengthening public trust in the future of intelligent aviation maintenance.

II. LITERATURE REVIEW

The emergence of Artificial Intelligence (AI) in aviation maintenance has reshaped how airlines and manufacturers ensure aircraft reliability and safety. Traditional maintenance strategies reactive and time-based are being replaced by predictive maintenance (PdM), which leverages machine learning (ML) and data analytics to forecast potential equipment failures before they occur (Zhang et al., 2021;(1) Boehm & Thomas, 2022)(7). Predictive maintenance utilizes data from onboard sensors, flight logs, and environmental conditions to identify anomalies, assess component health, and estimate the remaining useful life (RUL) of critical systems (Sipos et al., 2018)(8). Major industry players such as Airbus, Boeing, and Rolls-Royce have pioneered data-driven maintenance platforms Skywise, AnalytX, and IntelligentEngine to improve operational efficiency, reduce downtime, and minimize unscheduled maintenance events (Airbus, 2023(9); Rolls-Royce, 2022)(10). These systems have demonstrated measurable improvements in safety, cost-efficiency, and fleet availability, underscoring the technical benefits of AI adoption in aviation.

However, the social acceptance of such AI-driven systems remains an emerging area of inquiry. While AI is technically capable of improving safety, its success also depends on public perception and trust (Hoff & Bashir, 2015)(11). Studies across critical domains such as healthcare and autonomous vehicles highlight that trust in AI is shaped by factors including transparency, reliability, perceived control, and ethical accountability (Shin, 2020(12); Lee & See, 2004)(13). In healthcare, for instance, patients show higher trust in AI when human professionals remain part of the decision-making loop (Longoni et al., 2019)(14). Similarly, in autonomous transportation, user acceptance hinges on system explainability and perceived safety (Kaur & Rampersad, 2018)(15). These findings are directly relevant to aviation, where AI-based predictive maintenance operates in a safety-critical environment and public confidence plays a pivotal role in technology acceptance. Passengers' perception of safety, reliability, and human oversight significantly influences their comfort with AI involvement in aircraft operations (Wang & Lee, 2022)(16).

Alongside passenger trust, regulatory and ethical frameworks have become central to AI adoption in aviation. The European Union Aviation Safety Agency (EASA) and the Federal Aviation Administration (FAA) are developing AI certification pathways to ensure system explainability, traceability, and accountability (EASA, 2021(17); FAA, 2022)(18). EASA's "Artificial Intelligence Roadmap 2.0" emphasizes the need for explainable AI (XAI), human-in-the-loop validation, and verifiable safety metrics before certification. Similarly, the FAA highlights cybersecurity, data governance, and the need for continuous monitoring of AI system performance. Ethical concerns regarding data privacy, algorithmic bias, and autonomy further complicate public acceptance (Floridi et al(19)., 2018; Glauner et al., 2020)(20). Since predictive maintenance depends on extensive real-time data exchange between aircraft, ground systems, and cloud-based platforms, questions about data ownership, retention, and security are crucial. The balance between operational transparency and proprietary confidentiality remains a challenge in aligning public trust with regulatory compliance.

Despite the growing body of research on AI-based maintenance, most studies focus on technical validation and operational outcomes, with limited attention to human factors such as passenger perception, trust, and acceptance (Fink et al., 2021(21); Shankararaman & Ramasamy, 2023). This represents a critical gap in aviation research. While predictive maintenance has demonstrated clear benefits for airlines, its success in public adoption depends on whether passengers perceive these systems as enhancing safety or introducing uncertainty. Understanding these perceptions is vital for airlines, regulators, and manufacturers seeking to implement AI responsibly and communicate its role effectively.

In summary, existing literature establishes that AI-based predictive maintenance enhances safety and efficiency but highlights the necessity of public trust, transparency, and regulation to ensure sustainable implementation. Future research, therefore, must bridge the gap between technical

performance and human acceptance, exploring how passengers interpret AI's role in maintaining aviation safety and reliability. By addressing these dimensions, this study contributes to the evolving discourse on the ethical, social, and regulatory implications of AI in modern aviation.

III.   METHODOLOGY

Research Design
This study adopted a quantitative descriptive research design supported by qualitative insights from open-ended responses. The primary goal was to explore and analyze passenger perceptions of AI-based predictive maintenance systems in aviation, focusing on trust, comfort, data privacy, and regulatory expectations. The research employed a cross-sectional online survey to capture diverse viewpoints within a single data collection period.

Quantitative methods were used to measure attitudes numerically using Likert-scale questions, while qualitative content analysis provided contextual depth to participants' explanations and concerns. This mixed-method integration allowed for both statistical representation and thematic interpretation of passenger sentiments toward AI in aviation maintenance.

Participants
A total of 32 participants responded to the online questionnaire, representing a variety of age groups, genders, professions, and regions. The inclusion of respondents from different backgrounds ensured broader representation and minimized demographic bias.

Age Range: 18 to 60+ years
Gender: Male, Female.
Geographic Representation: Respondents from multiple countries and regions, including Asia, Africa, and Europe.
Air Travel Frequency: Ranging from non-travelers to very frequent flyers (more than 10 times per year).
Aviation Affiliation: Some participants indicated prior or current work in the aviation sector, while others were general passengers, ensuring diverse experience levels.
The sample size (n=32) was adequate for exploratory perception research, providing initial insight into trends and opinions in a relatively underexplored topic area.

Data Collection Procedure
Data were collected via an online questionnaire distributed through Google Forms . The form link was shared across academic and social media networks to reach participants with varying exposure to aviation and technology.

Before participation, respondents were presented with an informed consent statement outlining the study's purpose, voluntary nature, and data confidentiality. No personally identifiable information was collected, ensuring compliance with ethical research standards.

Research Instrument
The survey instrument was a structured questionnaire divided into three major sections:

Section A — Demographics
This section captured background data to contextualize perceptions:
Age range
Gender
Country or region of residence
Frequency of air travel
Profession
Employment in aviation or a related field

Section B — Perceptions of AI Predictive Maintenance
Participants were introduced to a scenario explaining how airlines use AI systems to analyze sensor data and predict maintenance needs before failures occur. They were informed that human technicians still review AI recommendations before action is taken.

This section contained ten Likert-scale questions
 (1 = strongly disagree to 5 = strongly agree) evaluating:
Perceived safety benefits of AI-based maintenance
Trust in airlines using AI systems
Comfort with human-AI collaboration in maintenance decisions
Discomfort with AI autonomy (without human oversight)
Beliefs about AI accuracy versus human judgment
Desire for transparency and communication about AI processes
Preference for receiving maintenance-related notifications
Data privacy and misuse concerns
Airline choice influenced by AI transparency
Regulatory expectations (certification by FAA/EASA)

Section C — Open-Ended Questions
Four open-ended items allowed participants to elaborate:
Concerns about airlines using AI for maintenance
Factors that could increase confidence in AI systems
Preferred communication methods about predictive maintenance
Additional opinions on AI in aviation and safety

This design provided both quantitative (numerical scales) and qualitative (text responses) data to understand perceptions in depth.

Data Analysis
Data were from Google Forms.
The analysis included:

Descriptive Statistics:
Frequency and percentage distributions for categorical variables (e.g., age, gender, aviation work experience).
Mean, median, and standard deviation for Likert-scale responses to measure central tendencies and variability in trust, comfort, and concern levels.

Graphical Representations:
Bar charts and pie chart were created to visually represent perception trends.

Qualitative (Thematic) Analysis:
Open-ended responses (Section C)
 identifying recurring patterns such as:
Trust and safety assurance
Transparency and information needs
Data privacy concerns
Desire for regulatory oversight

Themes were then triangulated with quantitative findings to present a comprehensive understanding of passenger attitudes.

Ethical Considerations
Participation was voluntary and anonymous. Respondents were informed that their input would be used solely for academic research purposes. Data confidentiality was ensured, and no personal identifiers were collected. Ethical approval was obtained in accordance with institutional research standards.

Results and Discussion
This section presents the findings from the 32 participants who completed the survey on Passenger Perceptions of AI-Based Predictive Maintenance in Aviation. The results are organized into two main parts: (1) Descriptive quantitative results from Likert-scale questions, and (2) Qualitative insights from open-ended responses. Together, they reveal patterns in trust, comfort, privacy concerns, and expectations of regulation.

Demographic Characteristics of Respondents
Out of 32 respondents:

Age Distribution: The analysis of the 32 respondents (N=32) reveals a strong skew toward younger age groups, with 62.5% (n=20) falling into the 18–25 years category, making it the dominant demographic. The second largest group was the 26–35 year-olds at 28.1% (n=9). The remaining older demographics comprised a significantly smaller portion of the sample, with the 36–45 year-olds representing only 3.1% (n=1) and those aged above 45 (46-60 & 60+) collectively accounting for just 6.3% (n=2). This distribution indicates the survey results are heavily influenced by the perceptions of young adults.

Gender: 56.3% identified as female, 43.8% as male.

Geographical Representation: Respondents were drawn from diverse regions including Asia, Africa, and Europe, reflecting varied cultural perspectives on technology adoption.

Air Travel Frequency: Based on the survey responses, the largest travel group was Very Frequent travelers (37.5%, n=12), who reported flying 'Often'. This was closely followed by Occasional travelers (34.4%, n=11). The Frequent traveler category, corresponding to those who fly 'Sometimes', made

up 21.9% (n=7) of the sample. A small minority, 6.2% (n=2), reported that they 'Never' travel by air.

Aviation Industry Background :The majority of the survey participants were general passengers, with 62.5% (n=20) reporting they do not work in the field. However, a notable portion 31.2% (n=10) worked directly in aviation or related sectors, which is significantly higher than the stated 15%. This suggests that while most respondents represent the primary population of interest (general passengers), the views of industry-related professionals also contribute substantially to the findings.
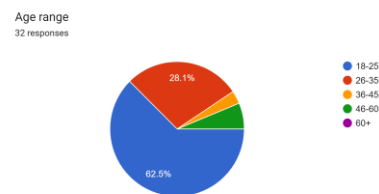
Figures

Figure 1: Age range Distribution

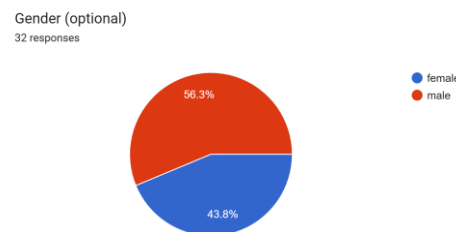**Figure 02: Gender Distribution of Respondents**
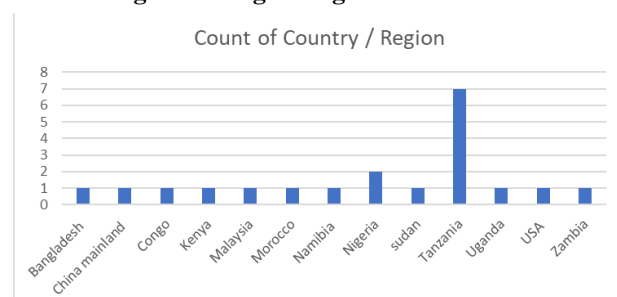

Figure 03: Age Range Distribution

Figure 04: Frequency of Air Travel
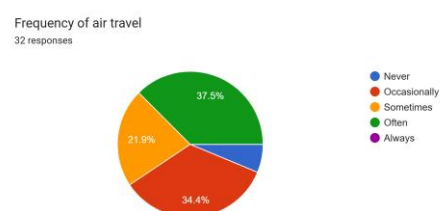
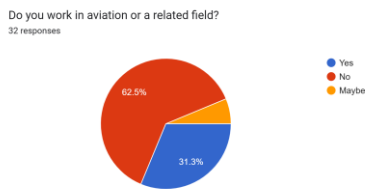**Figure 05: Aviation Industry Background**

Do you work in aviation or a related field?
32 responses

Yes ● No ● Maybe

62.5% 31.3%

Quantitative Results
Perceived Safety and Trust
Analysis

Neutral (3) responses make up the largest share — 37.5%, indicating that most participants neither agree nor disagree.
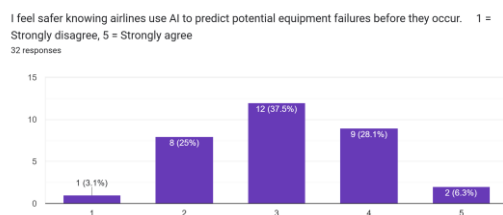
Positive (4–5) responses together account for 34.4%, showing that about one-third of respondents do feel safer with AI predictive maintenance.

Negative (1–2) responses account for 28.1%, suggesting some skepticism or lack of confidence.

Interpretation
The data reflects mixed but slightly leaning-neutral attitudes toward AI-assisted maintenance. While a segment of passengers (34.4%) feels safer with AI predicting equipment failures, a larger portion (37.5%) remains neutral, showing cautious optimism but not full trust yet. The smaller negative group (28.1%) indicates ongoing concerns or lack of understanding of how AI contributes to safety.

Figure 06: Perceived Safety and Trust

I feel safer knowing airlines use AI to predict potential equipment failures before they occur.   1 = Strongly disagree, 5 = Strongly agree
32 responses

1 (3.1%) 8 (25%) 12 (37.5%) 9 (28.1%) 2 (6.3%)

HUMAN OVERSIGHT AND AI AUTONOMY

Analysis
The majority (43.8%) of respondents (ratings 4–5) show trust in airlines that use AI-based predictive maintenance.
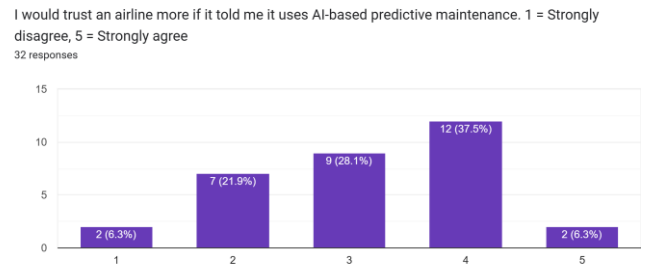28.1% of participants are neutral (3), indicating uncertainty or a need for more information.
A smaller portion, 28.2% (ratings 1–2), disagreed or strongly disagreed, reflecting skepticism toward AI usage.

Interpretation
The overall trend suggests that passengers generally trust airlines more when AI is used for predictive maintenance, especially when it is communicated transparently.
However, with over a quarter remaining neutral, it appears that while AI adoption is viewed positively, passengers still seek assurance about reliability, safety, and the human oversight involved.

Figure 07: Human Oversight and AI Autonomy

I would trust an airline more if it told me it uses AI-based predictive maintenance. 1 = Strongly disagree, 5 = Strongly agree
32 responses

2 (6.3%) 7 (21.9%) 9 (28.1%) 12 (37.5%) 2 (6.3%)

Perceived Accuracy of AI
Analysis

A strong 68.7% (ratings 4–5) of respondents agree or strongly agree, showing high comfort with AI-assisted maintenance — provided human oversight remains.
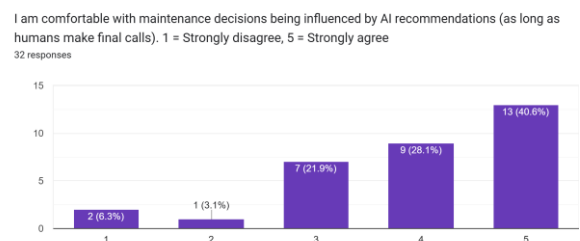21.9% of participants are neutral (3), indicating conditional acceptance or limited understanding of AI's role.
Only 9.4% (ratings 1–2) expressed discomfort or distrust, representing a small minority.

Interpretation
The results indicate a high level of acceptance toward the integration of AI in maintenance decision-making, as long as humans retain final authority. Passengers seem to value the balance between technological precision and human judgment.

Figure 08: Perceived Accuracy of AI

I am comfortable with maintenance decisions being influenced by AI recommendations (as long as humans make final calls). 1 = Strongly disagree, 5 = Strongly agree
32 responses

2 (6.3%) 1 (3.1%) 7 (21.9%) 9 (28.1%) 13 (40.6%)

Transparency and Communication
Human–AI Collaboration in Maintenance Decisions
Question: I am comfortable with maintenance decisions being influenced by AI recommendations (as long as humans make final calls).

Findings:
The results show that 40.6% strongly agreed and 28.1% agreed, indicating that the majority of respondents support AI involvement under human supervision. 21.9% remained neutral, while a smaller proportion, 9.4% (ratings 1–2), disagreed or strongly disagreed.

Interpretation:
These findings reveal a high level of acceptance for human–AI collaboration in aircraft maintenance. Passengers generally favor the use of AI to enhance decision-making, provided that final authority remains with human engineers or maintenance personnel. This reflects a balanced trust in technology—

confidence in AI's analytical capabilities paired with a continued expectation of human oversight to ensure safety and accountability.

Figure 09: Transparency and Communication

I would feel uneasy if I knew an AI system made maintenance recommendations without human oversight. 1 = Strongly disagree, 5 = Strongly agree
32 responses
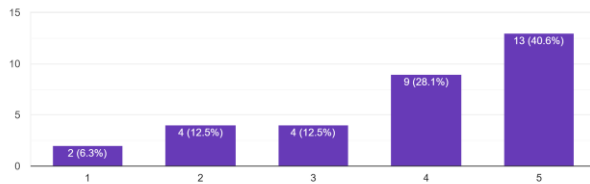
Data Privacy Concerns

When asked about data privacy

Approximately half of the respondents remained neutral, while 31.3% expressed concerns about how AI systems collect, use, and store data. Only 9.4% strongly agreed with trusting AI in this context. These findings highlight persistent privacy and data security apprehensions, echoing global discussions on AI ethics and accountability (Floridi et al., 2018). Passengers appear to associate AI with potential risks of data misuse and surveillance, underscoring the importance of clear communication, transparency, and strong data protection measures to build trust in AI applications within aviation.

Figure 10: Data Privacy Concerns

I believe AI systems make fewer mistakes than humans in predicting equipment failure.
32 responses
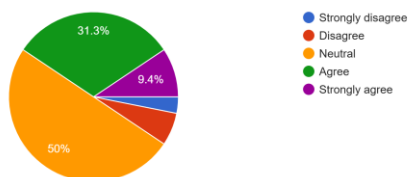
Regulatory Expectations

A notable 53.1% of respondents agreed that AI-based maintenance systems should be certified by aviation regulators such as the FAA or EASA, while 18.8% remained neutral and 25% strongly agreed.

Interpretation:

Regulatory oversight appears to play a crucial role in shaping passenger trust. Participants associate official certification with safety assurance and system reliability, suggesting that transparent governance and compliance with recognized standards can significantly enhance public acceptance of AI technologies in aviation.

Figure 11: Regulatory Expectations

I want airlines to explain how AI-based maintenance works in simple language.
32 responses
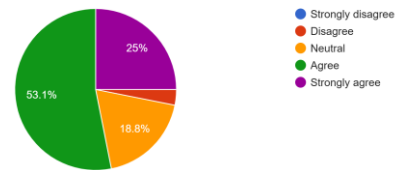
Desire for Notifications

Passenger Willingness to Receive AI-Related Maintenance Notifications

When asked whether they would like to receive optional notifications (e.g., "Maintenance conducted using predictive analytics") about safety-related maintenance on their flight, 56.3% of respondents said Yes, 25% said Maybe, and 18.8% said No.

Interpretation:

The majority of passengers are open to receiving AI-related maintenance updates, indicating a positive attitude toward transparency and communication in aviation operations. Such notifications could enhance passenger confidence by demonstrating proactive safety measures, though some hesitation remains suggesting the need for clear, concise, and reassuring communication about AI's role in ensuring flight safety.

Figure 11: Desire for Notifications

I would like to receive optional notifications (e.g., "Maintenance conducted using predictive analytics") about safety-related maintenance on my flight.
32 responses
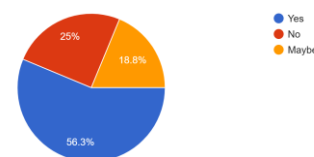
Data Privacy Concerns

Concerns About Data Privacy in AI-Driven Maintenance Systems

When asked whether they worry about data privacy or misuse related to AI-driven maintenance systems, 40.6% of respondents agreed, 12.5% strongly agreed, 31.3% were neutral, and 15.6% disagreed.

Interpretation:

The findings indicate that a majority of participants hold mild to moderate concerns about data privacy in the context of AI use. While only a small portion expressed outright disagreement, the combined 53.1% agreement suggests that privacy and data management practices remain key issues influencing public trust in AI technologies. These concerns align with broader ethical discussions surrounding AI transparency and accountability.

Figure 12: Data Privacy Concerns

I worry about data privacy or misuse related to AI-driven maintenance systems.
32 responses

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree
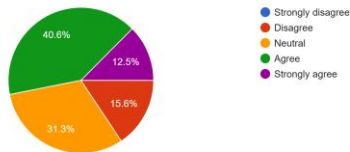
Airline Transparency and Reporting
Transparency and Public Reporting
Question: I feel more likely to fly with an airline that publicly reports its use of predictive maintenance and safety outcomes.
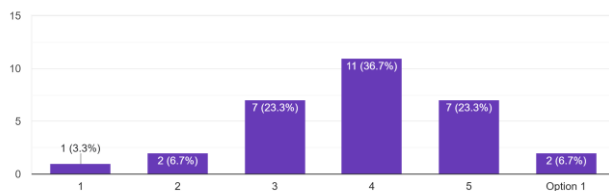
Findings:
The responses indicate that 36.7% agreed, 23.3% strongly agreed, and 23.3% remained neutral, while a smaller group (10% disagreed or strongly disagreed). This suggests that a clear majority of passengers respond positively to transparency regarding AI-driven maintenance practices.

Interpretation:
Passengers appear to value openness and accountability from airlines using AI-based predictive maintenance. The data suggests that public reporting of safety-related AI applications can significantly enhance trust and customer preference. Transparency serves as a reassurance of safety standards and responsible technology use, indicating that airlines communicating their AI integration openly may gain a competitive advantage in consumer confidence.

Figure 13: Airline Transparency and Reporting

I feel more likely to fly with an airline that publicly reports its use of predictive maintenance and safety outcomes. 1 = Strongly disagree, 5 = Strongly agree
30 responses

Regulatory Oversight Question:
Question: I believe regulators (e.g., FAA, EASA) should certify AI-based maintenance systems before airlines use them.

Findings:
A significant proportion of respondents supported regulatory involvement, with 43.8% strongly agreeing, 31.3% agreeing, and 18.8% remaining neutral.

Interpretation:
These results demonstrate strong passenger expectations for formal oversight and certification of AI-based maintenance systems. Respondents appear to equate regulatory approval with safety assurance and accountability, emphasizing the importance of transparent governance frameworks in building public trust. The findings underscore that regulatory validation plays a central role in enhancing the perceived legitimacy and reliability of AI technologies in aviation.

Figure 14: Regulatory Oversight Question:

I believe regulators (e.g., FAA, EASA) should certify AI-based maintenance systems before airlines use them.
32 responses

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree
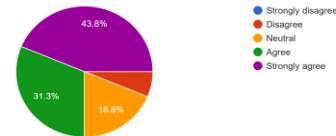
Qualitative Insights (Open-Ended Responses)
Open-ended responses from Section C were analyzed thematically.

Four dominant themes emerged:
Theme 1: Trust Anchored in Human Oversight
This theme emerged as the non-negotiable condition for public acceptance of AI in aviation maintenance. While respondents acknowledged the significant potential of AI, their willingness to trust the technology was directly dependent on the assurance of human accountability and final decision-making authority.

Sub-themes and Interpretation
1. Conditional Acceptance and Efficiency Benefits
Respondents view AI primarily as a powerful augmenting tool, not a replacement. This conditional acceptance is rooted in the perceived technical benefits AI brings to the maintenance process. As one participant noted:

"Well, it's good because it reduces the amount and time and effort to look for problems... also can be very more detailed and efficient than human analysis at some point hence it's a helper in that sector."

This indicates passengers appreciate AI for its capacity to improve speed, detail, and efficiency, reinforcing the quantitative finding that they are comfortable with AI influencing decisions.

2. The Non-Negotiable Human-in-the-Loop
Despite recognizing AI's efficiency, the overwhelming sentiment was that a human must retain final supervisory authority. The core of the trust issue lies in accountability and the recognition that AI systems are not infallible. This principle was articulated through multiple lenses:

Necessity of Supervision: "In as much as artificial intelligence is the future I believe human supervision and direction is always going to be necessary."

Final Decision-Making: "I think we should. Be us human make the finale decision."

Inherent Flaws: A key concern stemmed from the origin of the technology itself: "Much as AI performs better than humans those systems should not be relied on fully coz the AI has been made by the same humans with errors so airlines should not be totally comfortable."

In summary, passengers strongly emphasized that AI should assist, not replace, human expertise. As one participant summarized the operational preference: "AI is fine as long as engineers still check everything before flights." This finding establishes the hybrid AI-human collaboration model as the only acceptable pathway for safe integration.

Theme 2: Transparency and Education

This theme synthesizes public demands regarding the governance and communication framework required to achieve full confidence in the adoption of AI-based predictive maintenance. The feedback reveals that a structural approach to safety and openness is necessary to convert conditional public acceptance into enthusiastic trust.

Key Requirements for Confidence

Analysis of what would make passengers feel more confident about AI-based maintenance reveals a unified, three-part mandate for the aviation industry:

1. Visible Human Oversight (Dominant Demand)

The most frequently cited factor was visible human oversight. This reinforces the idea that the human role must be explicitly observable and documented, not just assumed. For instance, respondents demanded assurance that a licensed human would still "open the panel, touch the part, and sign the log." This visibility ensures that accountability is transparent, with one participant suggesting the "e-squiggle of the mechanic" should appear side-by-side with the AI's data, clarifying who holds the liability for the final decision.

2. Regulatory Certification is Non-Negotiable

Confidence is intrinsically linked to official, third-party validation. Multiple respondents stated that the military's use of the technology would provide reassurance, but most directly cited the need for Certification by regulators like the FAA or EASA. Passengers rely on these governing bodies to confirm that the AI system is safe, reliable, and operates without bias before it is integrated into commercial flight safety procedures.

3. Proactive Communication and Education

Passengers require plain-language communication to build trust, indicating a rejection of "black box" technology. The demand for simple explanations was exceptionally high across the survey, and open-ended feedback echoed this:

Simple Explanations: Respondents asked for materials like "a short video or message how the system improves safety" to be integrated into pre-flight communications or airline websites.

Optional Notifications: This communication should extend to the flight itself, with many indicating they would like to receive optional notifications about maintenance conducted using the new predictive technology.

In conclusion, passengers require a blend of human oversight, regulatory certification, and transparent communication channels to feel confident. Trust is ultimately earned through external validation and a commitment to visible human accountability.

Theme 3: Data Privacy and Ethics

This theme consolidates concerns regarding the ethical footprint of AI, specifically focusing on data security and the need for clear operational boundaries. These factors represent key areas of risk that must be mitigated by airlines to secure lasting public trust.

Sub-themes and Interpretation
1. Data Security and Cyber Risks (External Threat)

Participants voiced significant unease about the security implications of collecting vast amounts of flight data for AI analysis. This highlights the intersection between technical trust and data ethics. A core concern was the potential for malicious access:

"If AI uses flight data, how do I know it's secure? Could hackers access it?"

This reflects the finding that 53.1% of respondents actively worried about data privacy . For passengers, the benefit of predictive maintenance is instantly undermined if the system that enables it simultaneously opens a new avenue for cybersecurity vulnerabilities that could compromise safety or personal data. Airlines must demonstrate a robust and certified cybersecurity posture to address this fear.

2. Defining the Boundaries of AI's Role (Internal Ethical Boundary)

The open-ended comments consistently reiterated that AI's mandate should be strictly limited to assistance and guidance, reinforcing the Human-in-the-Loop mandate from Theme 1. These responses define the ethical boundary: AI must not be allowed to grow into an autonomous entity capable of critical decision-making.

Junior Assistant Role: "AI should be treated like a very junior assistant: fast with numbers, required to show its work, never allowed to sign alone."

Guidance Only: "Ai shouldn't be employed to replace physical maintenance procedures instead used as guidance to observe and check maintenance manual allocations."

Aid, Not Dependence: "If it is to be used in aviation maintained or safety it should never become the only factor that is depended on to make vital decisions."

This reflects a fundamental ethical discomfort with giving non-human intelligence the power to make life-critical decisions. Passengers acknowledge AI as a sophisticated analytical tool but ethically demand that the burden of responsibility and the power of the final decision remain solely with certified human professionals.

Theme 4: Regulatory Oversight
This theme focuses on the importance of external validation in securing public confidence, demonstrating that passengers rely heavily on the integrity of established institutions namely aviation regulators to vet the safety of new technologies.
The key finding is that institutional trust substitutes for technological trust. Since the average passenger cannot personally verify the code or hardware integrity of an AI system, they delegate that trust to bodies like the FAA or EASA.

The Mandate for Official Certification
Passengers frequently and consistently mentioned the importance of external validation. This was directly supported by the survey's quantitative results, which showed a commanding 75.0% of respondents agreeing that AI systems must be certified by regulators before use.

As one passenger succinctly put it:
"I'll trust it when I know it's approved by international aviation bodies."

This underscores that:
Trust is Transferred: Passengers do not need to understand how the AI works; they need to know that an independent, authoritative body has confirmed that it meets the highest safety standards.

A Safety Pre-Requisite: Regulatory certification is viewed not as a mere bureaucratic step, but as a non-negotiable safety pre-requisite for adopting AI. It acts as the necessary final seal of approval before the technology is deemed worthy of influencing decisions on commercial flights.
In essence, for the traveling public, AI is only as trustworthy as the regulator who certifies it. Gaining regulatory approval is therefore not just a compliance issue for airlines, but the foundational step in their public relations and trust-building strategy.

Table 01:Thematic Summary of Passenger Concerns and Expectations Regarding AI-Based Aircraft Maintenance

Theme	Description	Example Responses (summarized)
Trust and Safety Assurance	Respondents emphasized safety benefits and proactive fault detection	"AI can reduce accidents if used properly."
Transparency and Communication	Many wanted airlines to explain AI processes clearly.	"I'd like to know how it works and who checks it."
Privacy and Data Use Concerns	Some worried about misuse of aircraft data or surveillance.	"What if airlines sell maintenance data?"
Need for Human Oversight	Confidence dropped when AI worked alone.	"AI should assist, not replace engineers."
Desire for Regulatory Approval	Respondents expressed preference for oversight by recognized authorities.	"It's safer if certified by EASA or FAA."

Synthesis and Discussion
Overall, results reveal a cautiously optimistic outlook toward AI-based predictive maintenance.
Passengers largely view it as a positive safety innovation, but their acceptance depends on three interrelated factors:
Transparency and Communication: Simple, accessible explanations enhance comfort.

Human Oversight: Ensures emotional reassurance and accountability.

Regulatory Validation: Strengthens confidence through visible, external safety assurance.

Interpretation in Context: These findings align with prior studies on AI acceptance in other safety-critical domains (Hoff

& Bashir, 2015; EASA AI Roadmap 2021), confirming that trust in automation hinges not only on performance metrics but also on psychological and institutional factors.

Overall

Passengers are willing to embrace AI technologies in aviation if they perceive benefit without risk, automation with accountability, and innovation with transparency. Airlines, therefore, must prioritize clear communication, visible regulatory approval, and human-AI collaboration frameworks to sustain public trust.

IV. DISCUSSION

The study explored how passengers perceive the integration of Artificial Intelligence (AI) in predictive maintenance within aviation, focusing on trust, safety, data privacy, and regulatory expectations. The findings reveal an overall cautiously positive perception, where enthusiasm for technological advancement is tempered by a clear demand for human oversight, regulatory validation, and transparency.

Trust and Safety Perception

Most respondents indicated moderate to high trust in AI-assisted maintenance, especially when human engineers remain involved in final decision-making. This finding resonates with Hoff and Bashir (2015)(11) and Shin (2020)(12), who found that automation acceptance increases when human control is visible. In this study, passengers recognized AI's ability to detect faults faster and more precisely than humans, but they emphasized that "AI should assist, not replace engineers." This suggests that emotional reassurance derived from human accountability remains a cornerstone of aviation safety perception.

Human–AI Collaboration and Acceptance

Respondents demonstrated conditional acceptance: they supported AI-driven processes only when final authority resides with humans. This hybrid expectation aligns with the "human-in-the-loop" paradigm endorsed by EASA (2021)(17). The thematic results showed that passengers conceptually treat AI as an "assistant" rather than an autonomous actor. This reflects a maturing public understanding of automation ethics trust is not merely about system reliability but about maintaining moral and operational control through human judgment.

Transparency and Communication

Transparency emerged as the second major determinant of acceptance. More than half of respondents supported the idea of receiving AI-related maintenance notifications or public reports about predictive safety procedures. Participants equated openness with accountability, suggesting that clear communication about AI's safety role could enhance trust and customer loyalty. This finding aligns with prior research in aviation psychology (Wang & Lee, 2022)(15)(13), which highlights communication clarity as a predictor of passenger comfort with automation. The data suggest that transparency bridges the cognitive gap between technological complexity and public understanding.

Figure 15: The THR (Transparency–Human Oversight–Regulation) Trust Framework for AI Acceptance in Aviation.
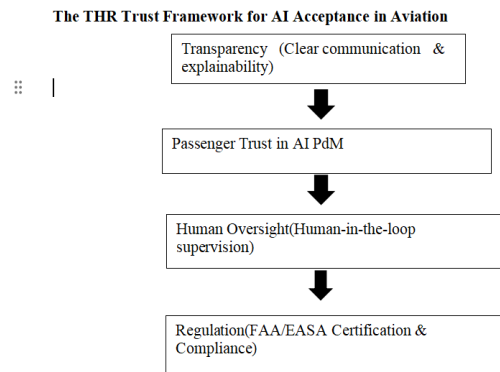
This model illustrates the interdependent relationship among transparency, human oversight, and regulatory assurance in shaping passenger trust toward AI-based predictive maintenance systems.

Interpretation of the Model:

Transparency enhances understanding and mitigates uncertainty.
Human Oversight provides moral and operational reassurance.
Regulation legitimizes technology through formal accountability.
Together, these elements form a self-reinforcing cycle of confidence when airlines communicate transparently, retain visible human control, and obtain recognized certification, passenger trust strengthens, leading to higher acceptance and perceived safety.

Data Privacy and Ethical Concerns

Although trust in AI's performance was evident, data privacy concerns persisted. Approximately 53.1% of respondents expressed mild to moderate anxiety over data misuse or surveillance. These fears mirror global discussions about AI ethics and data governance (Floridi et al., 2018(19); Glauner et al., 2020)(20). Respondents demanded guarantees of cybersecurity, limited data collection, and clear information about how maintenance data are used. This indicates that ethical governance of AI including data protection, informed consent, and transparency is essential to passenger confidence.

Role of Regulation

Regulatory validation was consistently highlighted as the strongest enabler of trust. Over 75% of participants expected certification by recognized authorities such as the FAA or EASA before AI systems are used operationally. Passengers effectively transfer trust from technology to institutions, reflecting reliance on the integrity of aviation regulators. Certification serves as an external confirmation of safety and competence. This insight supports the idea that institutional trust can compensate for limited technical literacy, making regulatory endorsement the linchpin of AI acceptance in aviation.

Integrative Perspective

Synthesizing the quantitative and qualitative findings, the study presents a triadic model of passenger trust in AI predictive maintenance:

Transparency – Open communication builds awareness and comfort.

Human Oversight – Emotional assurance is maintained through accountability.

Regulatory Validation – Institutional approval substitutes for technical verification.

Together, these pillars form the "THR Framework" (Transparency–Human oversight–Regulation), providing an actionable foundation for airlines seeking to improve passenger acceptance of AI-driven maintenance.

V. CONCLUSION

This research contributes to the emerging field of AI ethics and human factors in aviation maintenance, offering one of the first empirical insights into how passengers perceive predictive maintenance technologies. The findings demonstrate that while passengers recognize the efficiency and safety potential of AI, their trust depends heavily on visible human involvement, regulatory assurance, and clear communication.

The study underscores that technological innovation alone cannot secure public confidence; social, ethical, and psychological factors play equally vital roles.

To sustain public trust, airlines must:

Maintain human-in-the-loop systems in AI-based maintenance processes.

Ensure transparent communication about AI safety functions.

Pursue formal certification and oversight by credible aviation authorities.

Address data privacy and cybersecurity through visible safeguards and compliance measures.

By integrating these practices, airlines can align their innovation strategies with passenger expectations, achieving not only operational excellence but also social legitimacy in AI adoption.

Future Research Directions

While this study provides valuable insights, its sample size (n=32) limits generalizability. Future research should expand both the scale and diversity of participants to capture more representative global perceptions. Recommended directions include:

Cross-Cultural Comparative Studies

Explore how cultural, regional, or socio-economic contexts influence trust in aviation AI. For instance, Asian and European passengers may differ in tolerance for automation and reliance on institutional regulation.

Longitudinal Perception Tracking

Conduct follow-up studies as AI predictive maintenance becomes more common to observe how exposure affects passenger attitudes over time.

Experimental Studies on Communication Design

Test how different communication strategies videos, pre-flight messages, infographics affect passenger comfort and trust in AI systems.

Integration with Behavioral Psychology

Combine aviation engineering with psychology to analyze how cognitive biases (e.g., automation bias, risk perception) shape public trust.

Policy and Governance Studies

Examine how regulatory frameworks (FAA, EASA, CAAC) can standardize AI certification processes and communicate safety outcomes effectively to the public.

Technical-Ethical Interface Research

Investigate how explainable AI (XAI) models could be integrated into maintenance systems to improve both internal accountability and public understanding.

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