DATA ANALYSIS & ENGINEERING PROJECT

Flight Risk: A Data-Driven Analysis of Aviation Accidents (1962–2023)

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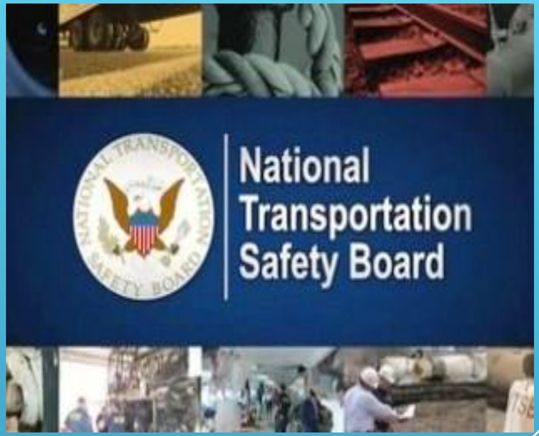
Non-Technical Presentation

- **Context**: The aviation sector is strategic for companies seeking to expand their mobility, logistics, and operational efficiency. However, the technical complexity, safety-related risks, and high costs associated with incidents require thorough analysis before any investment. The history of aviation accidents provides valuable insights to better guide these decisions.
- **Problem statement**: How can we identify the most reliable aircraft profiles, the recurring causes of accidents, and high-risk contexts in order to reduce investment risks and ensure the safety of aviation operations for a company looking to enter the aviation sector?

CONTEXT AND PROBLEM STATEMENT

- **Scientific**:This study is based on exploratory and statistical analysis of an extensive historical dataset (1962–2023) provided by the National Transportation Safety Board, enabling the identification of patterns and regularities in aviation safety.
- **Social and Political**: Aviation safety is a global public concern. Reducing accidents helps save lives, enhances user confidence, and optimizes civil aviation policy-making.
- **Personal** : The project aims to provide a fictitious company with a rigorous analytical framework to maximize its chances of success in a capital-intensive and highly regulated industry.



STUDY JUSTIFICATIONS

- **General Objective** : Identify the most reliable aircraft and high-risk contexts based on historical accident data to guide strategic investments in aviation
- **Specific Objectives** :
  - Determine the aircraft models most frequently involved in accidents.
  - Identify the main causes of aviation accidents (human factors, mechanical issues, environmental conditions, etc.).
  - Analyze the geographical and temporal conditions that contribute to incidents.
  - Provide practical recommendations to limit acquisition and operational risks.

STUDY OBJECTIVES

- **sources**: Base de données officielle de la *National Transportation Safety Board* (NTSB), période 1962 à 2023.
- **Analyzed Variables** :

1- Categorical variables (aircraft model, type of operator, weather conditions, state/location of the accident...)

2- Numerical variables (year of the accident, number of fatalities, number of injuries, altitude, latitude/longitude...)

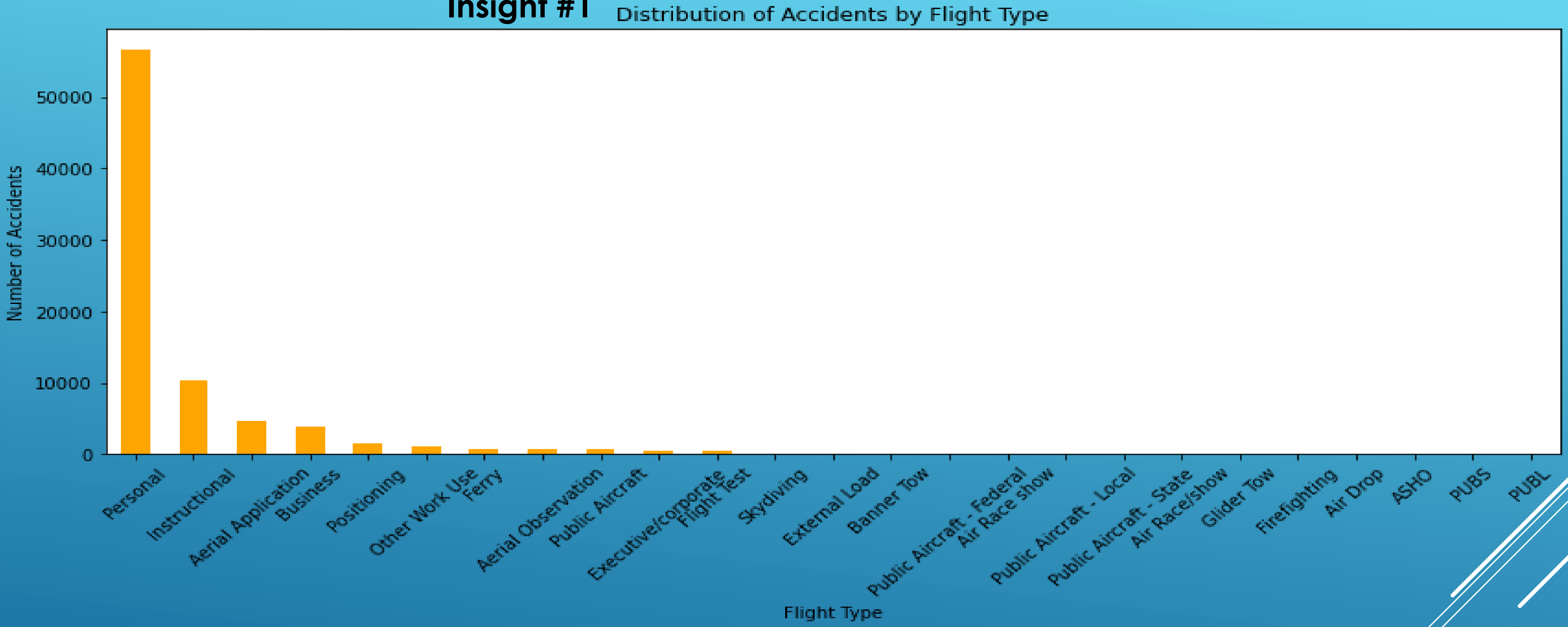
- Inclusion Criteria: Accidents for which key information is complete, including the aircraft model, probable cause, accident severity (number of fatalities/injuries), and type of operation (private or commercial).

METHODOLOGY (1/2)

- **Statistical Tools**:
- Descriptive analysis (means, frequencies, trends)
- Cross-tabulation analysis between cause and severity
- Temporal and geographical segmentation

METHODOLOGY (2/2)

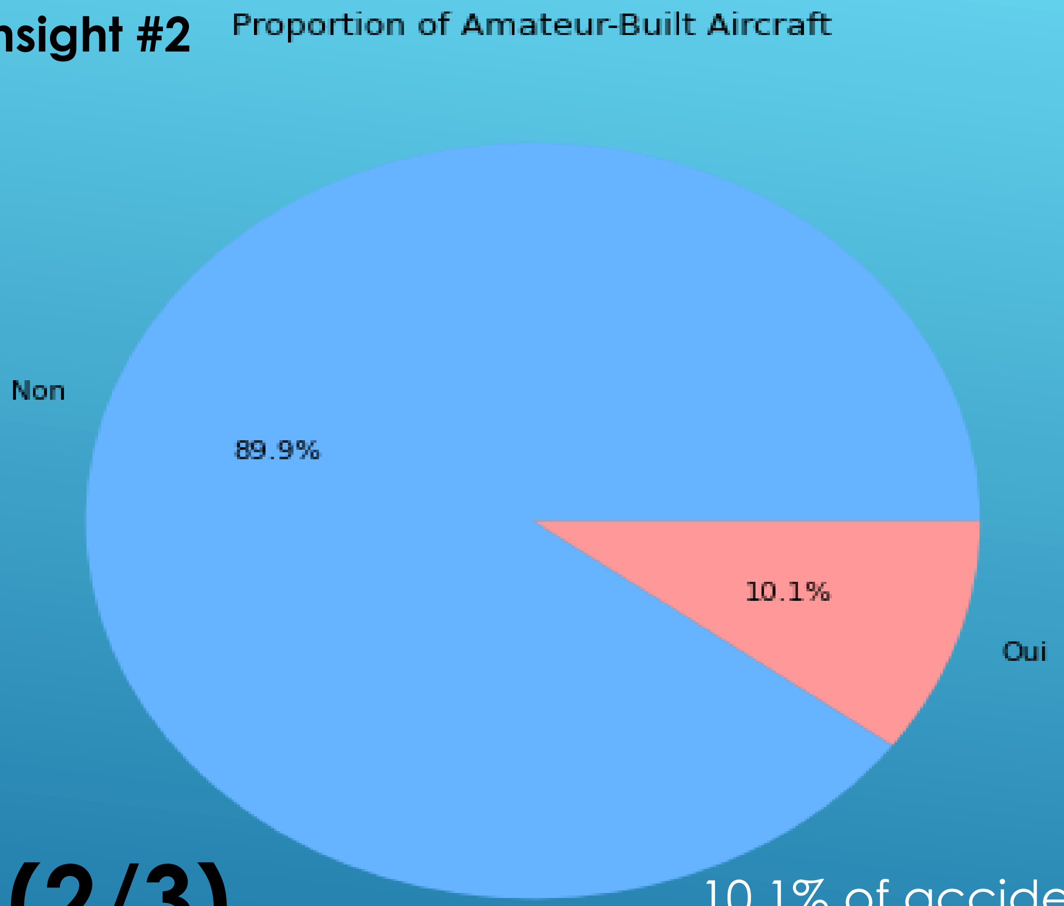
Insight #1



KEY FINDINGS (1/3)

Personal flights account for the majority of accidents, followed by training flights. This private segment, which is less regulated, is more exposed to risk—highlighting the importance of aircraft selection and pilot training.

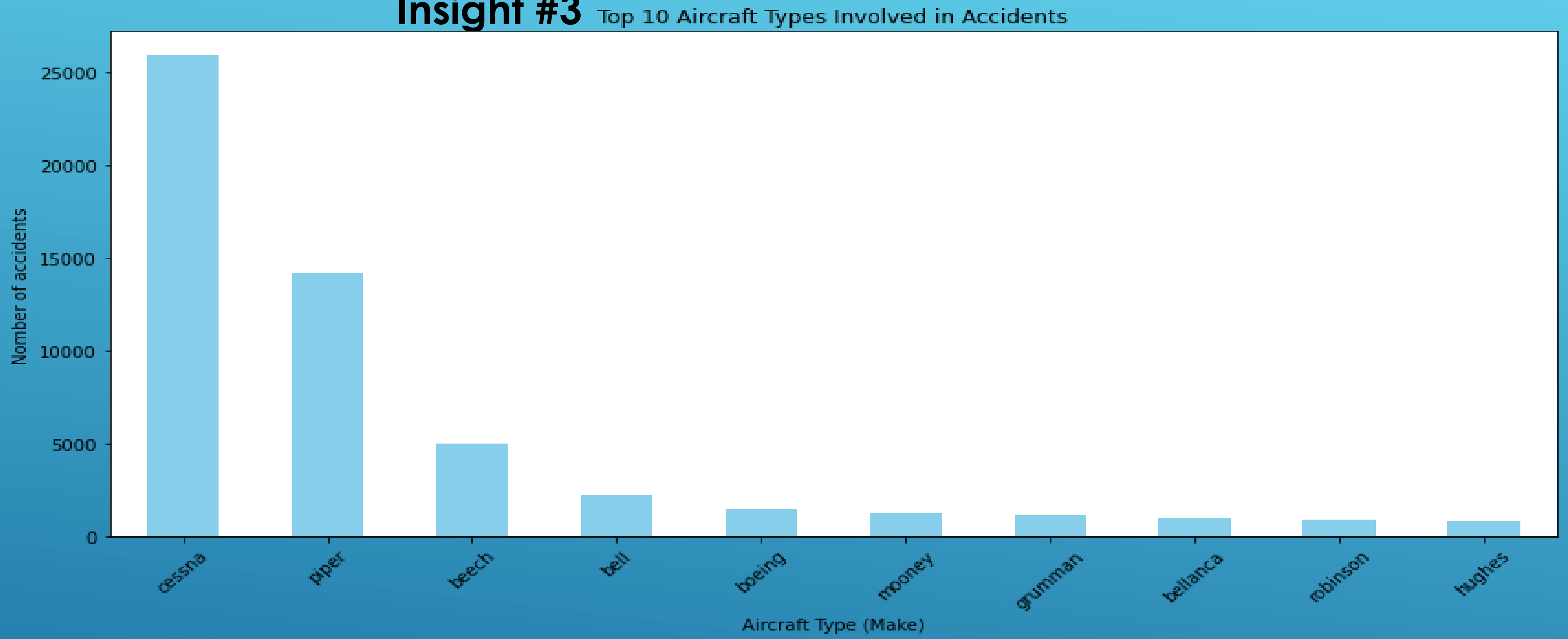
Insight #2



KEY FINDINGS (2/3)

10.1% of accidents involve amateur-built aircraft, highlighting specific risks despite their low share of overall traffic.

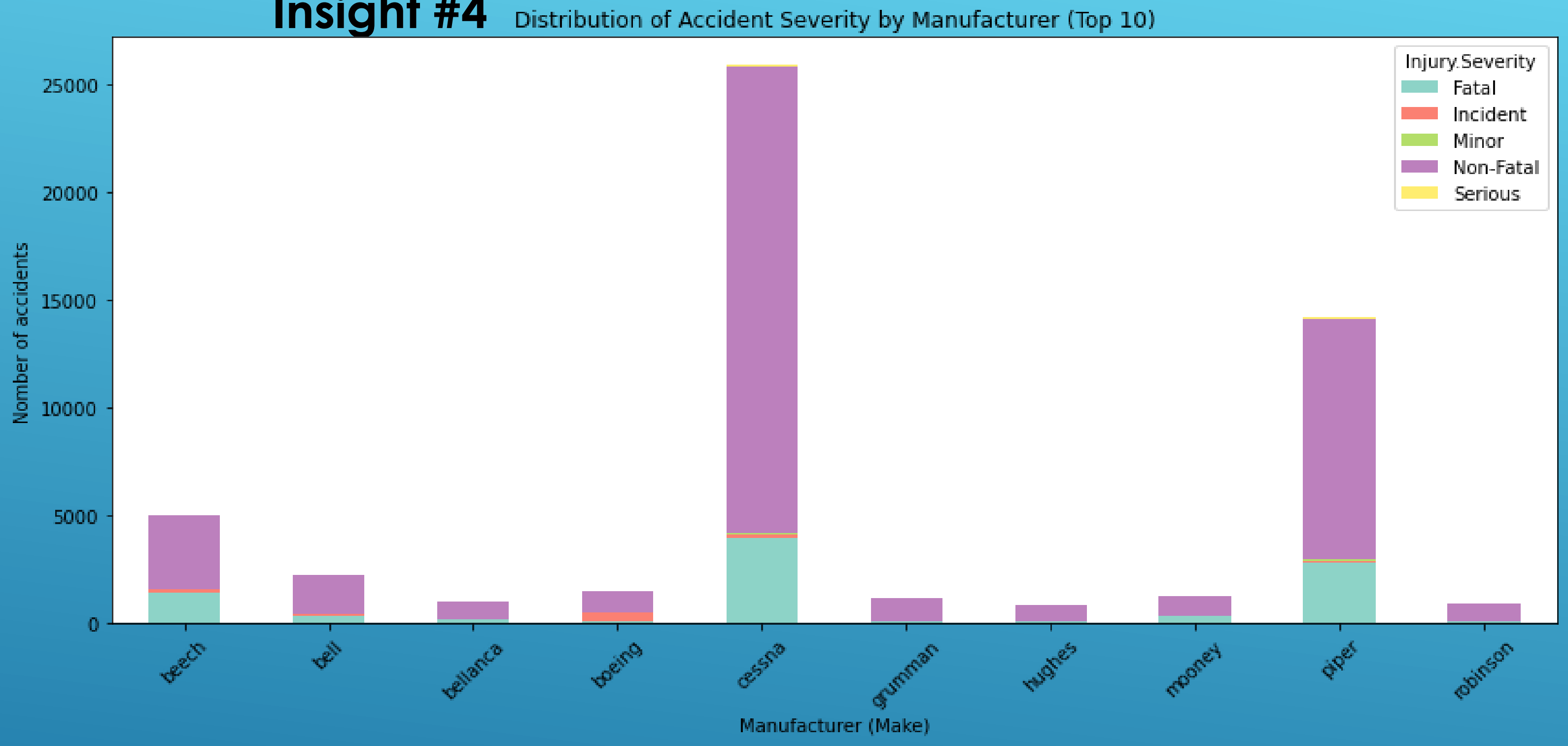
Insight #3



KEY FINDINGS (2/3)

Cessna and Piper account for the highest number of accidents, reflecting their strong presence in the general aviation fleet rather than a lack of reliability.

Insight #4



Despite their high number of accidents, Cessna and Piper are mostly involved in non-fatal cases, suggesting a certain robustness of their aircraft. Smaller manufacturers, on the other hand, show a higher severity rate.

KEY FINDINGS (2/3)

- **Private aircraft** (General Aviation) account for the majority of accidents, particularly within small non-commercial operations.
- **Human factors** (pilot errors, lack of training) remain the leading cause of accidents, ahead of mechanical failures.
- **Certain aircraft models** such as the Cessna 172 or the Piper PA-28 are overrepresented in incidents, especially among private operators.
- **Rural areas and domestic** flights in certain regions such as Alaska or Arizona show abnormally high accident rates.

KEY FINDINGS

- **Absence of Economic Variables** (maintenance costs, number of flight hours per aircraft).
- Potential Underreporting of Certain Minor Incidents
- The database does not always specify whether safety measures had been implemented prior to the incident.

LIMITATIONS OF THE STUDY

- Prioritize investments in certified commercial aircraft known for their reliability, excluding models with a historical record of frequent accidents.
- Strengthen pilot training requirements, especially for private flights or operations in complex areas (mountainous terrain, unstable weather conditions).
- Avoid establishing operations in high-accident regions and prioritize air corridors with modern infrastructure and enhanced monitoring.

RECOMMANDATIONS

This analysis of 60 years of aviation accidents has made it possible to identify the most reliable aircraft models to support strategic investment decisions.

Although frequently cited in incident reports, Cessna and Piper models show a relatively lower risk, largely due to their widespread use and well-structured maintenance ecosystems.

In contrast, smaller or lesser-known manufacturers tend to present higher severity risks, despite being less represented in the data.

By focusing on well-regulated segments and modern, certified fleets, the company can enter the aviation sector with caution, efficiency, and strategic ambition.

CONCLUSION

- Assessment of the financial and operational feasibility of the recommended aircraft.
- Integration of complementary data (costs, profitability, technical performance).
- Development of a dynamic decision-support tool (dashboard) for real-time monitoring.
- Implementation plan for recommendations: acquisition, training, safety audit, etc.

NEXT STEPS

THE END