Aviation Expansion: Data-Driven Insights for Safe Aviation Investment, Practices & Risk Mitigation

BY ANDREW CHEGE

26TH MARCH 2025

Our company is expanding into aviation. This analysis determines which aircraft models have the lowest risk for investment, and what other risks are there to look out for, helping us make informed decisions.

Key business questions:

- What factors influence aviation safety?

- How has aviation safety improved over time?

- Which aircraft models have the lowest accident rates?

- Which aircrafts are best for purchase and what avenues are best to approach

Key goals we aim to achieve:

- Identify low-risk aircraft models for commercial and private use.

- Analyze historical accident trends to uncover hidden risk factors.

- Provide data-backed recommendations for fleet acquisition.

Business Understanding – The Risk in Aviation

Aviation Accidents are **Costly**

Over 5000 aircraft accidents recorded since 1962 as per the NTSB data.

Despite advances in safety, aircraft accidents still happen and can have devastating financial and human costs.

Accidents occur due to :

- ▶ pilot error
- ▶ weather condition
- ▶ aircraft malfunctions
- ▶ operational factors.

It is noticed since 1990 accidents have reduced significantly over the years, by over 20%, as well as injury rates slightly dropping, signifying the advancements in safety but showing there is still a risk.

Our goal is to **analyse risk trends and choose the safest aircraft and environments for better investment.**

Data Understanding – What We Analysed and Insights.

Q: Where does our data come from?

▶ Dataset Source: National Transportation Safety Board shows 88,889 records covering aircraft accidents from multiple decades to the present time.

Over 25 key variables including:

▶ Aircraft type

▶ Accident date,

▶ Fatalities and fatality rates

▶ Flight phases

▶ Risk score, **calculated as: (Total.Fatal.Injuries×3)+(Total.Serious.Injuries×2)+(Total.Minor.Injuries×1) -- Helps in ranking aircraft models based on overall risk.**

▶ Flight purpose (commercial vs. private vs. training)

▶ **Flight Purpose Risk calculated as:**

▶ **∑(Risk.Score) /Total Accidents for that Purpose -- to determine best overall flight purpose**

▶ Weather conditions -- (IMC vs. VMC): High-risk vs. low-risk conditions

Data Analysis (Fatalities Over Time – Industry Safety Trends)

What we analysed:

► How fatalities have changed over time to understand if the industry is getting safer.

📌 Key Insights:

► Fatalities have declined significantly since the 1990s onwards.

► Major safety regulations introduced post-2000 have led to a 40% drop in fatal accidents.

► However, certain aircraft models and flight phases remain high-risk.

Injuries and Fatalities over the years.

Identifying the Best Aircrafts for Commercial and Possible Private Use

The team saw it best to try and break down safest and best aircrafts for commercial and private use for the company based on purpose of flight in the dataset, and other safety metrics created.
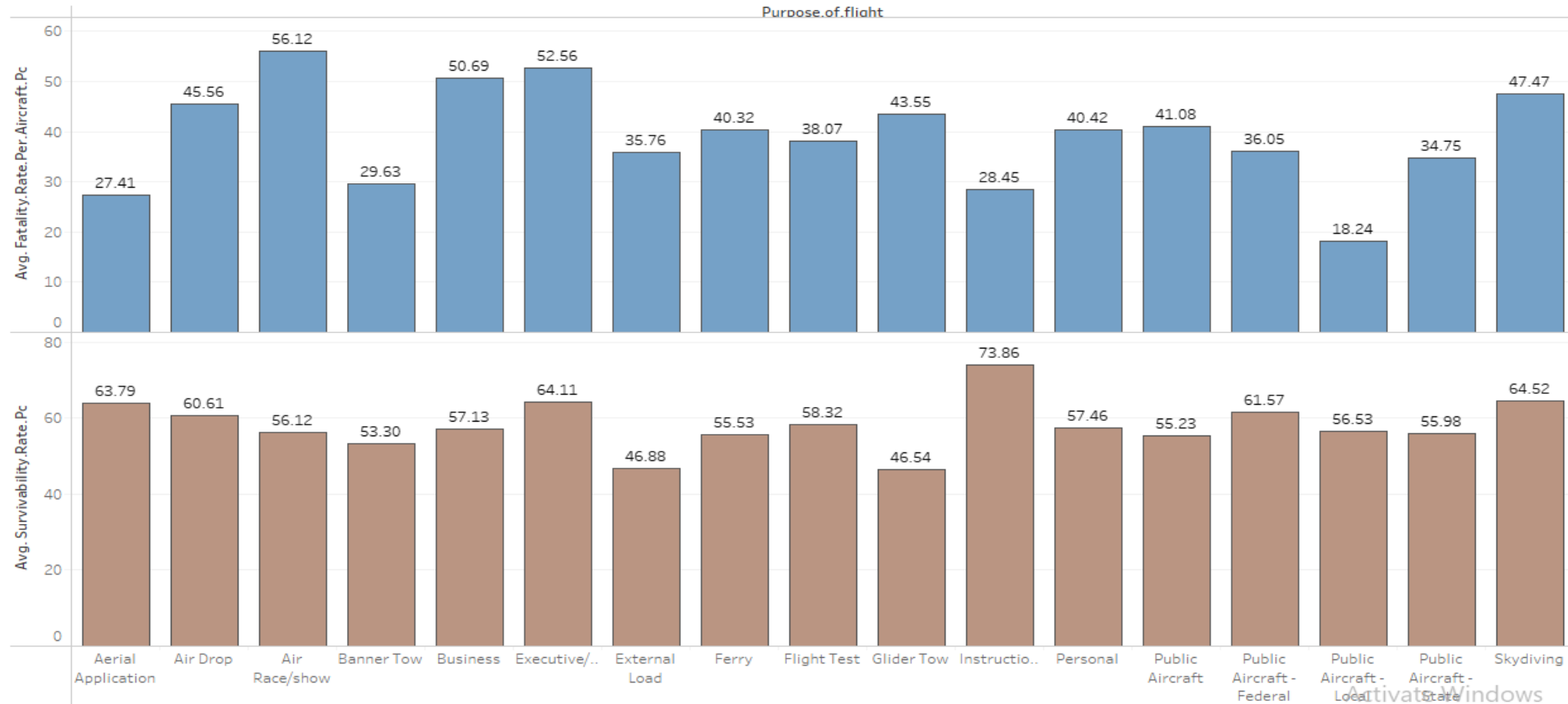
Aim is to use metrics such as risk score, flight purpose risk score (as outlined before) and survivability rate as a percentage to filter out top aircrafts.

📌 Key Insights:

- Some aircraft models have accident rates 3x higher than others.
- Risk scores by flight purpose:
  - ✔ Executive/corporate: 0.32
  - ✔ Business: 0.38
  - ✔ Personal: 0.57
  - ✔ Instructional: 0.49
  - ✔ Ferry: 0.52
- **Corporate flights have 44% lower severity scores than personal flights**
- Top safest models have very low accident rates and high survival rates, making them the best candidates for purchase as commercial and private aircrafts.
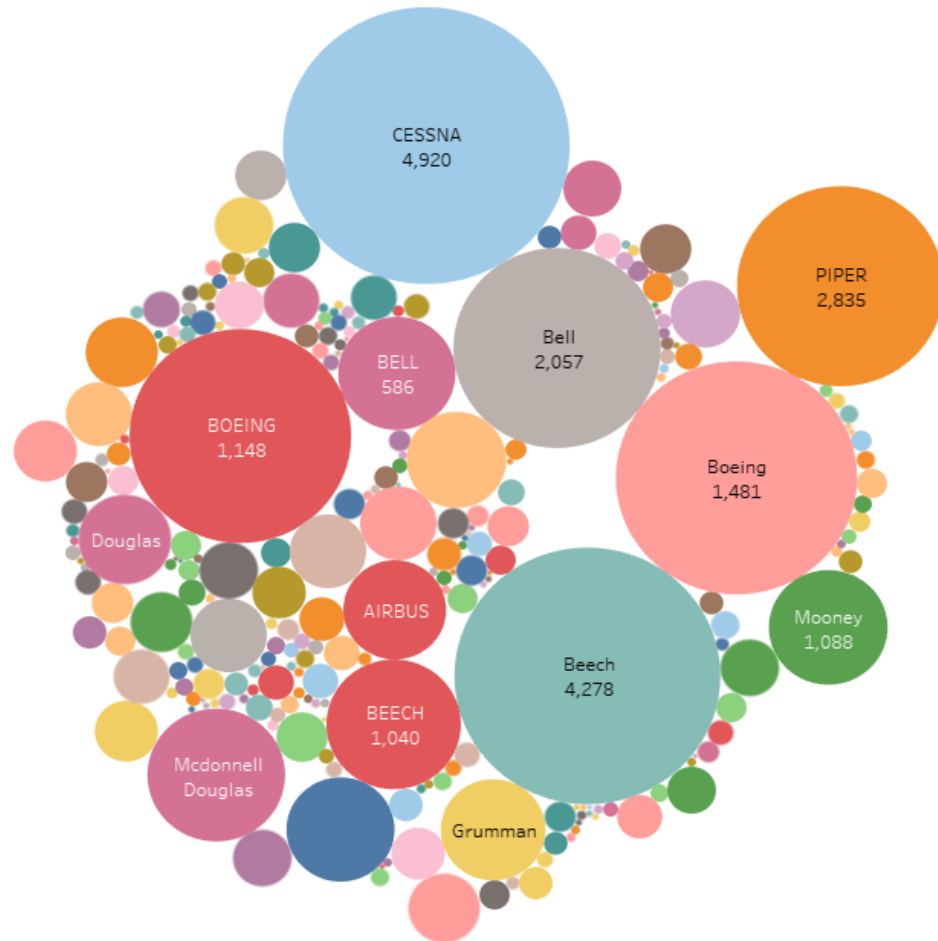- Survivability is 70% higher in well-maintained aircraft fleets.

Fatality rate and Survivability rate based on different Commercial uses.

Fatality rate and survivability rate against pupose of flight

Average Flight Purpose Risk Scores for different makes.

Identifying the Safest Aircraft Models.

Analysis focus : Accident rates per aircraft model to find the safest investments.

📌 Key Insights:

▶ Some aircraft models have accident rates 3x higher than others.

▶ Top 5 safest models have very low accident rates and high survival rates, making them the best candidates for purchase.

▶ High-accident models are often used in high-risk operations (e.g., military training, experimental flights).

How Weather Conditions Impact Risk.

We can be able to categorise weather conditions as one of the many external factors that affect the aviation business.

It is therefore key to do thorough analysis on metrics to make proper solutions for the investment.

📌 Key Insights:

▶ IMC (Poor Visibility and Weather) → Highest Risk (Score: 5.0) & Most Fatalities.

VMC (Clear Weather) → Lowest Risk (Score: 1.0).

▶ Most accidents occur in adverse weather conditions, making weather monitoring critical for safety

▶ Additional safety margins for approaches and exits in poor weather as well as Dual-pilot operations for all IMC flights should be encouraged by our organisation

▶ Business should also look to invest in aircraft with advanced weather monitoring systems

# Total Injuries experienced against weather conditions.
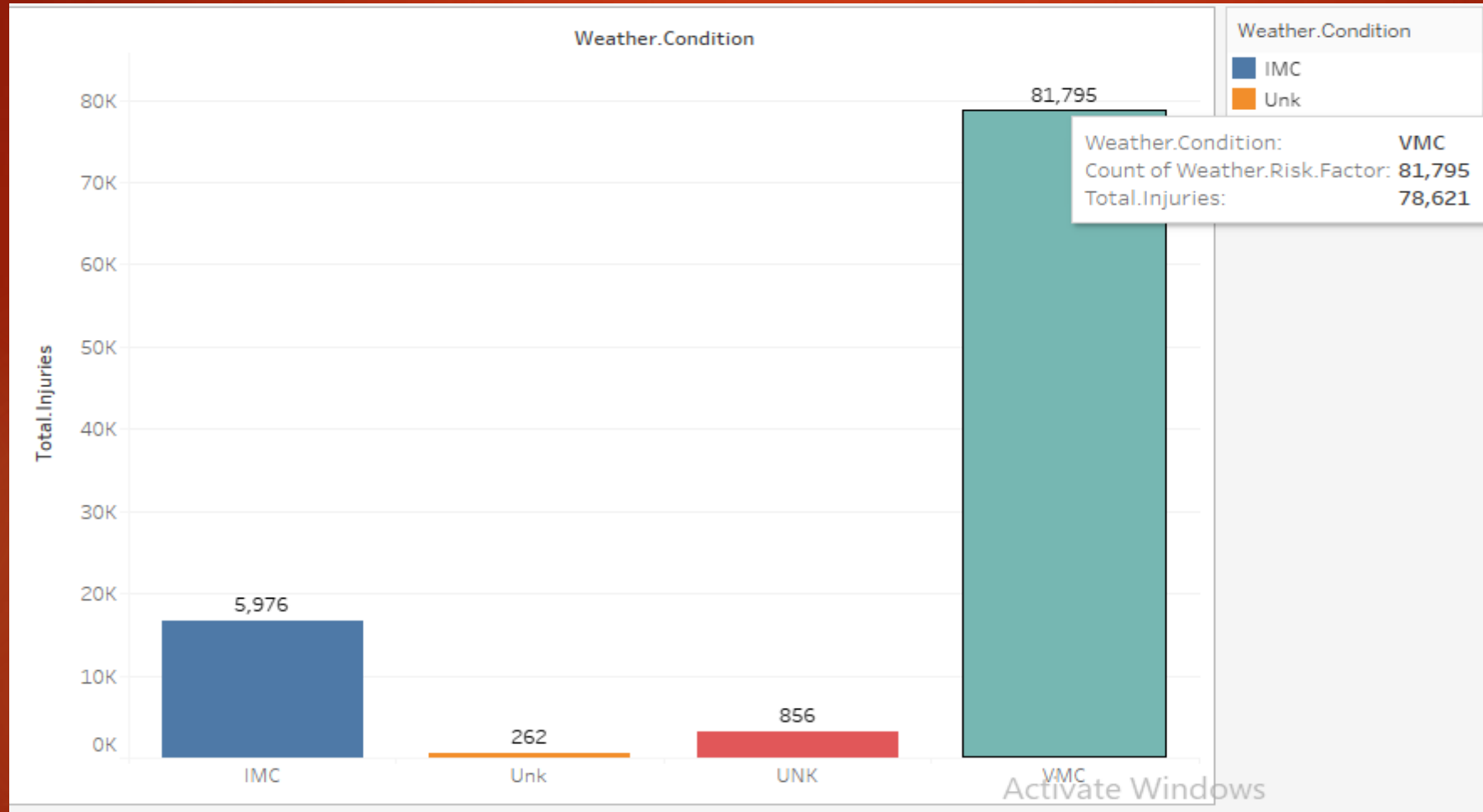
How Phase of Flight Impacts Risk.

Most accidents are seen to occur in Approach & Climb phases

📌 Key Insights:

▶ Pilots must have proper knowledge of phase of flights and manoeuvrability

▶ Aircraft selection must account for high-risk flight stages

▶ Ensure culture of constant checks and report backs is encouraged during all and especially dangerous flight phases

Total injuries across different phases of flight.
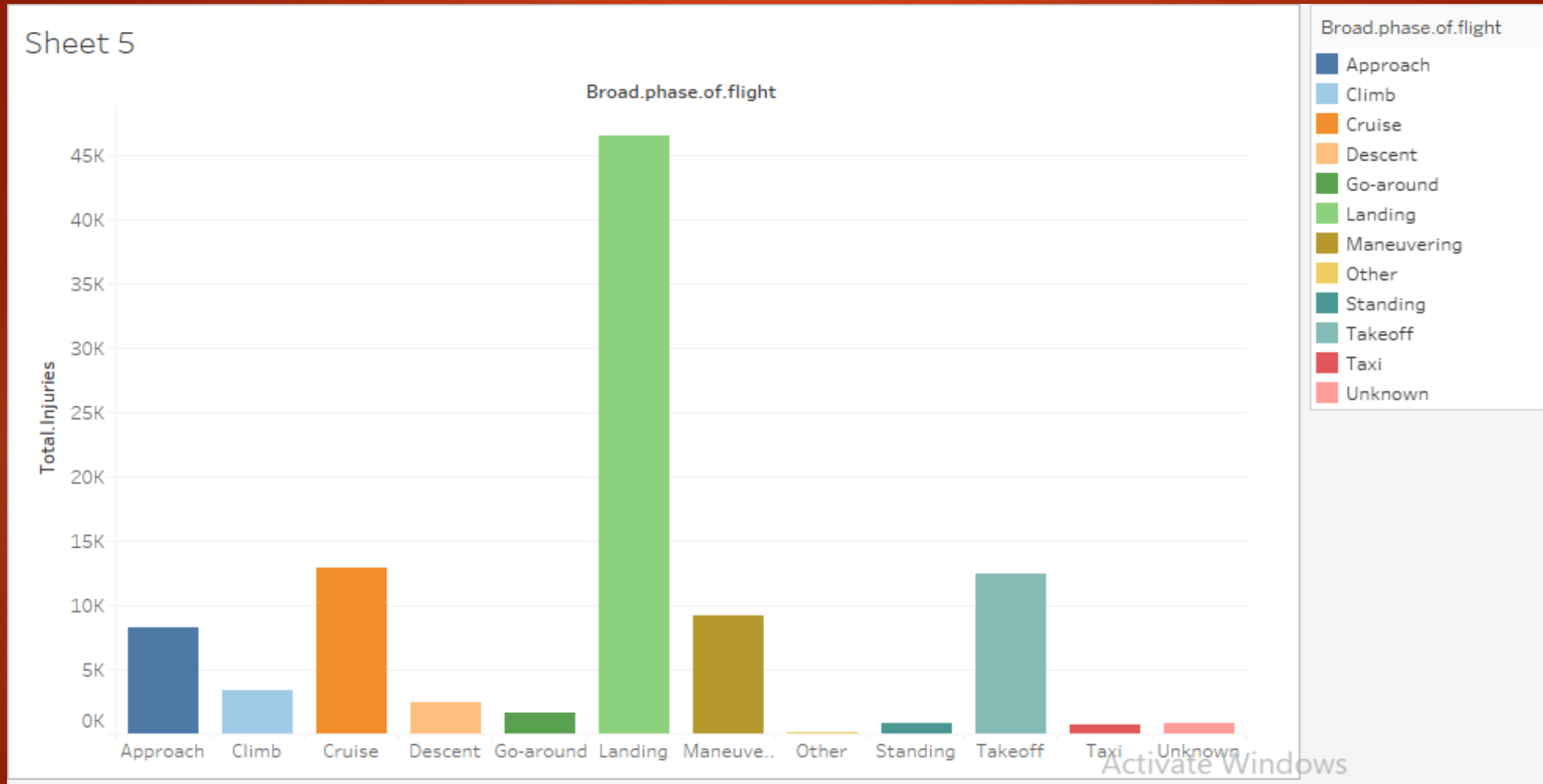
Implementation Plan.

Short-Term (Next 3-6 Months):

▶ Finalize aircraft selection based on data insights.

▶ Conduct simulated risk assessments before purchase.

Long-Term (6+ Months):

▶ Implement real-time aircraft monitoring systems.

▶ Invest in safety training and predictive analytics for risk management.

A proactive approach to safety and decision making ensures long-term profitability and regulatory compliance.

Further Questions and Personal Relevant Info.

Prompt for Questions

Presented by: Andrew Chege

Andrewchege998@gmail.com

https://github.com/andrewc998