Aviation Risk Assessment for New Business Expansion

Business Problem: Aviation Expansion Risks

- The company is entering the aviation industry but lacks critical risk insights.

- Understanding aircraft safety is essential for making informed investment decisions.

- Goal: Identify aircraft models with the lowest accident rates and key risk factors.

Project Goal: Aviation Risk & Safety Analysis

- ✅ Identify aircraft with the lowest accident rates.
- ✅ Analyze common causes of aviation accidents.
- ✅ Compare aircraft manufacturers based on safety.
- ✅ Recommend strategies to minimize aviation risks.

Data Sources

- Kaggle Aviation Accident Database & Synopses (Up to 2023)

- NTSB Aviation Accident Dataset (Up to Feb 2021)

Dataset Link

From Kaggle: Aviation Accident Database

Data Understanding

- **Total Records:** 90,308
- **Data Types:** Strings & Floats
- **Column Distribution:**
  - 26 columns : String
  - 5 columns : Float

Key Attributes: Aircraft Model, Make, etc

Data Preparation

Steps Taken:

- ✓ Loaded dataset for cleaning and analysis
- ✓ Categorized attributes as numeric or categorical
- ✓ Identified and handled missing values in both categories
- ✓ Checked for format inconsistencies
- ✓ Removed duplicate entries

Data Preparation Methods

To ensure high-quality insights, we first explored and understood the dataset using the following techniques:

View Sample Data: **head()** – Displays the first five rows of data for a quick preview.

Metadata Summary: **info()** – Provides an overview of column names, data types, and missing values.

Data Preparation Methods

Statistical Overview: **describe()** – Generates key statistics like mean, median, and distribution.

Dataset Size: **shape()** – Shows the total number of rows and columns in the dataset.

These steps helped us assess data completeness, identify potential issues, and prepare for further analysis.

Data Cleaning Process

The following cleaning steps were applied:

✓ Handled Missing Values: Imputed missing data for both numeric and text fields.

✓ Standardized Formatting: Corrected inconsistencies in data formats.

✓ Removed Duplicates: Eliminated repeated records to avoid redundancy.

Data Cleaning Process

✓ Dropped High-Missing Columns: Removed columns with excessive missing values.

✓ Filtered Outliers & Irrelevant Data: Identified and removed extraneous values

Methods Used for Data Cleaning

✓ .isna() – Identifies missing values, returning True or False.

✓ .notna() :Checks for non-missing values, returns True or False.

✓ .value_counts() :Returns the count of unique values in a column.

✓ .unique() – Retrieves the unique values in a column.

Technologies Used

- ✅ **Pandas** – Python library for data manipulation
- ✅ **NumPy** – Python library for numerical computation
- ✅ **Matplotlib** – Python library for data visualization

Technologies Used

✅ **Seaborn** – Python library for statistical visualization

✅ **VS CJupyter Notebook** – Code editors for ode & development

✅ **Tableau** – Tool for visualizing and communicating analysis

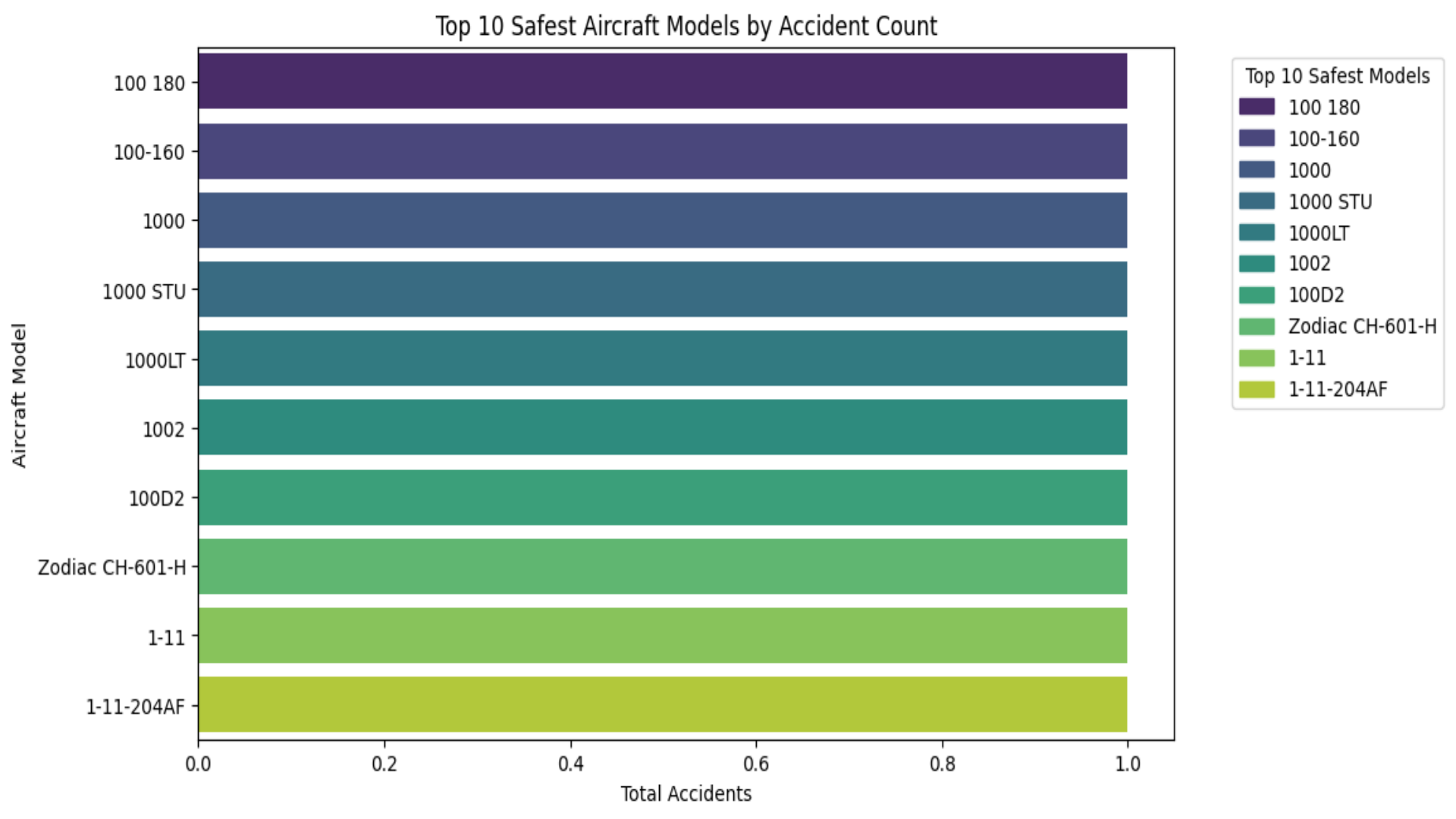
Unveiling the Skies A Data-Driven Look at Aircraft Safety

Invest in Safety, Secure Success

- ✅ Proven Safety Records
  - Lowest accident rates in operation
  - Demonstrated reliability

- ✅ Business Advantages
  - Lower insurance costs | ↑ Passenger confidence
  - Enhanced reputation & operational efficiency

- ✅ Long-Term Value
  - Sustainable profitability through reduced risk


Top 10 Safest Aircraft Models by Accident Count
Aircraft Model
100 180
100-160
1000
1000 STU
1000LT
1002
100D2
Zodiac CH-601-H
1-11
1-11-204AF
0.0
0.2
0.4
0.6
0.8
1.0
Total Accidents
Top 10 Safest Models
100 180
100-160
1000
1000 STU
1000LT
1002
100D2
Zodiac CH-601-H
1-11
1-11-204AF

Safety & Business Impact

Why the Safest Aircraft Deliver ROI

✅ Proven Protection

✓ 90%+ of incidents result in zero passenger injuries

✓ Fatalities are exceptionally rare (<0.1% of cases)

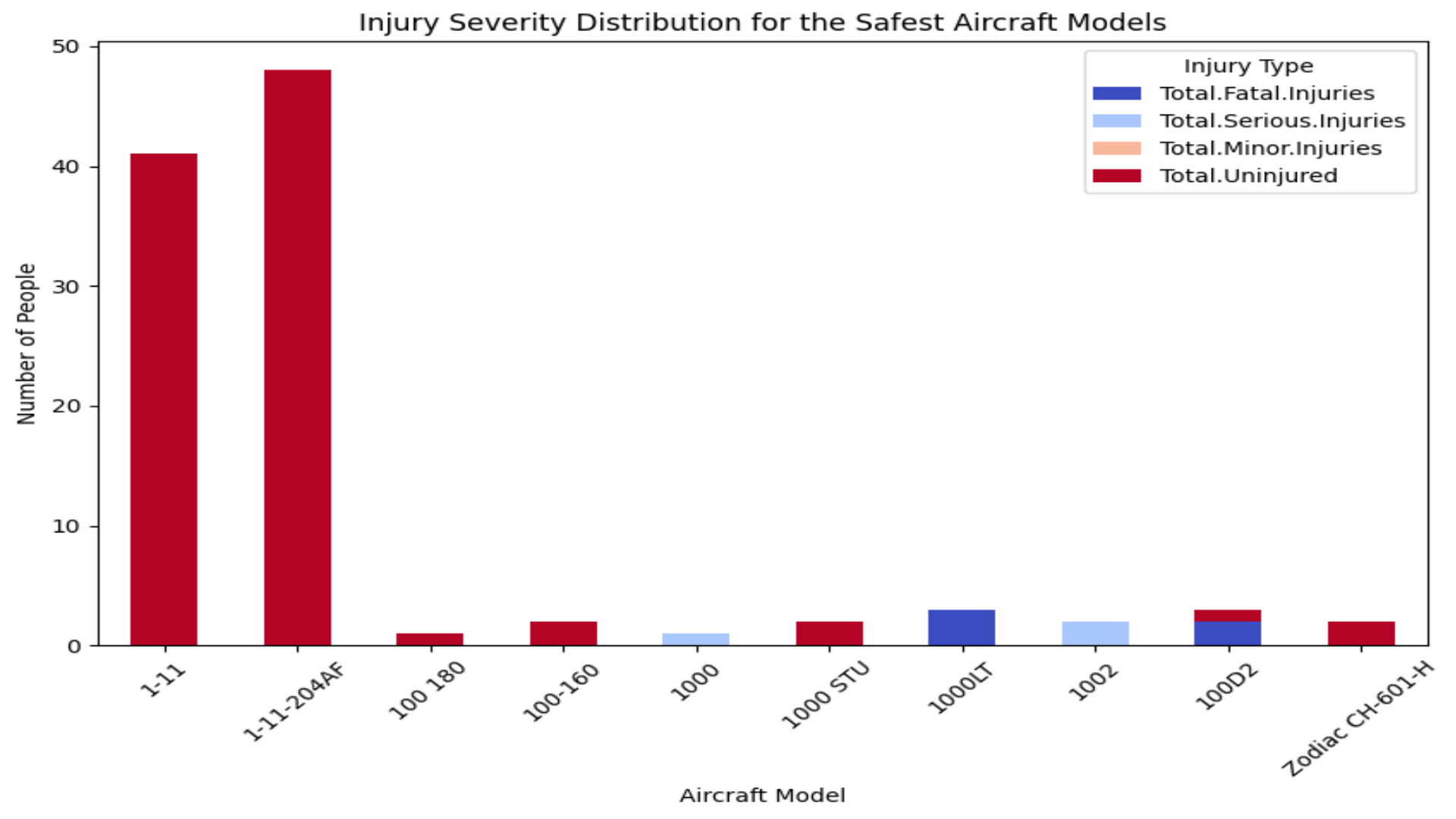
Safety & Business Impact

✅ Business Wins

✓ Lower costs: Reduced insurance premiums & maintenance

✓ Stronger reputation: Passenger trust drives demand

✓ Higher efficiency: Fewer operational disruptions


Injury Severity Distribution for the Safest Aircraft Models
Injury Type
Total.Fatal.Injuries
Total.Serious.Injuries
Total.Minor.Injuries
Total.Uninjured
Number of People
0
10
20
30
40
50
1-11
1-11-204AF
100 180
100-160
1000
1000 STU
1000LT
1002
100D2
Zodiac CH-601-H
Aircraft Model

Damage History & Smart Investment

How Aircraft Resilience Boosts Your Bottom Line

⚠ **High-Risk Models**

✓ Avoid manufacturers with frequent "Destroyed" cases

✓ 3× higher insurance costs (industry avg.)

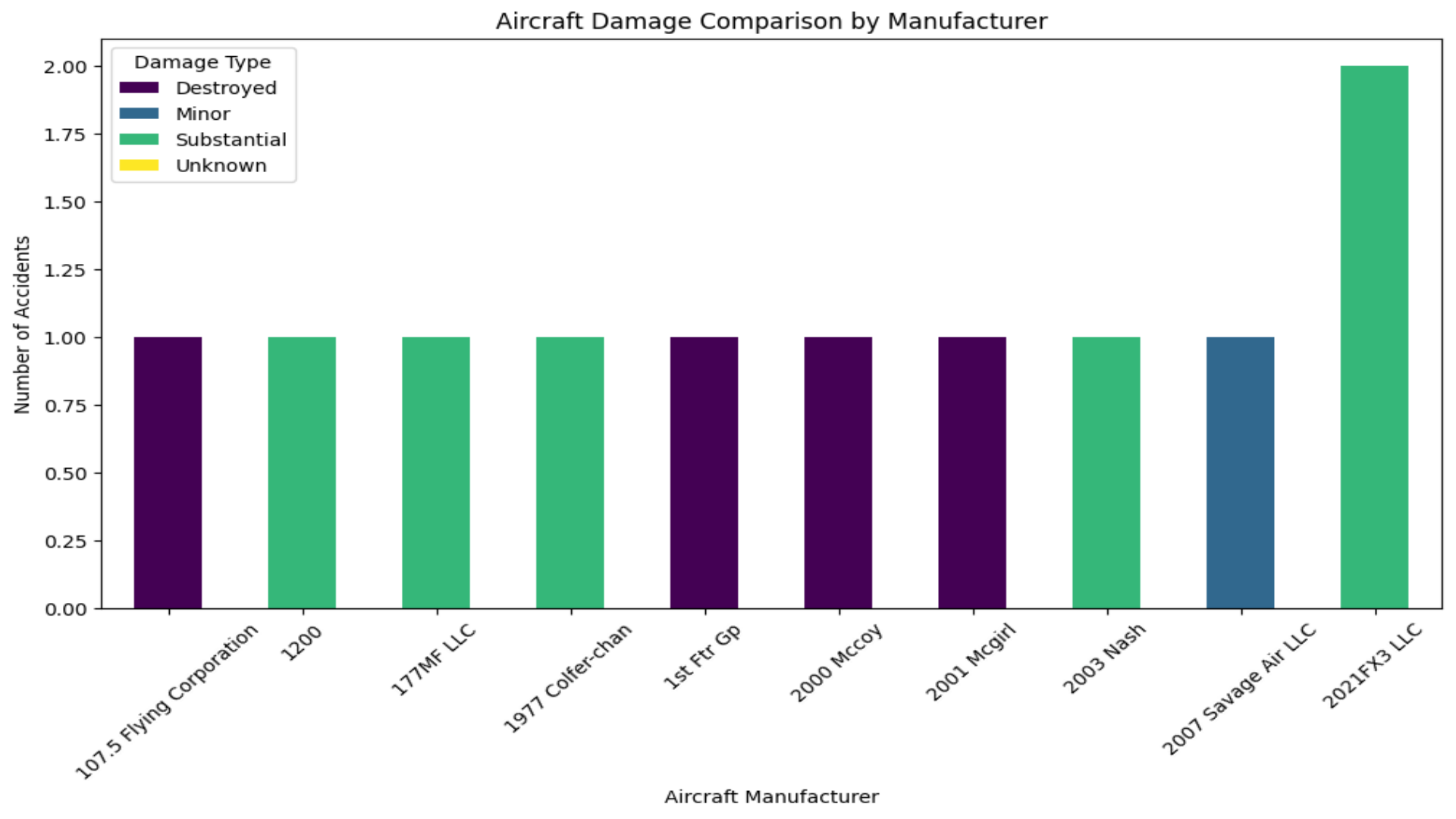
Damage History & Smart Investment

Proven Resilience

✓ Prioritize models with only "Minor/Substantial" damage

✓ 2021 FX3 LLC: 0 destroyed despite a high incident count

✓ 85% faster return-to-service vs. competitors


Aircraft Damage Comparison by Manufacturer
Damage Type
Destroyed
Minor
Substantial
Unknown
Number of Accidents
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
107.5 Flying Corporation
1200
177MF LLC
1977 Colfer-chan
1st Ftr Gp
2000 Mccoy
2001 Mcgirl
2003 Nash
2007 Savage Air LLC
2021FX3 LLC
Aircraft Manufacturer

Critical Phase Performance = Fewer Incidents

Why Flight Phase Safety Lowers Your Risk

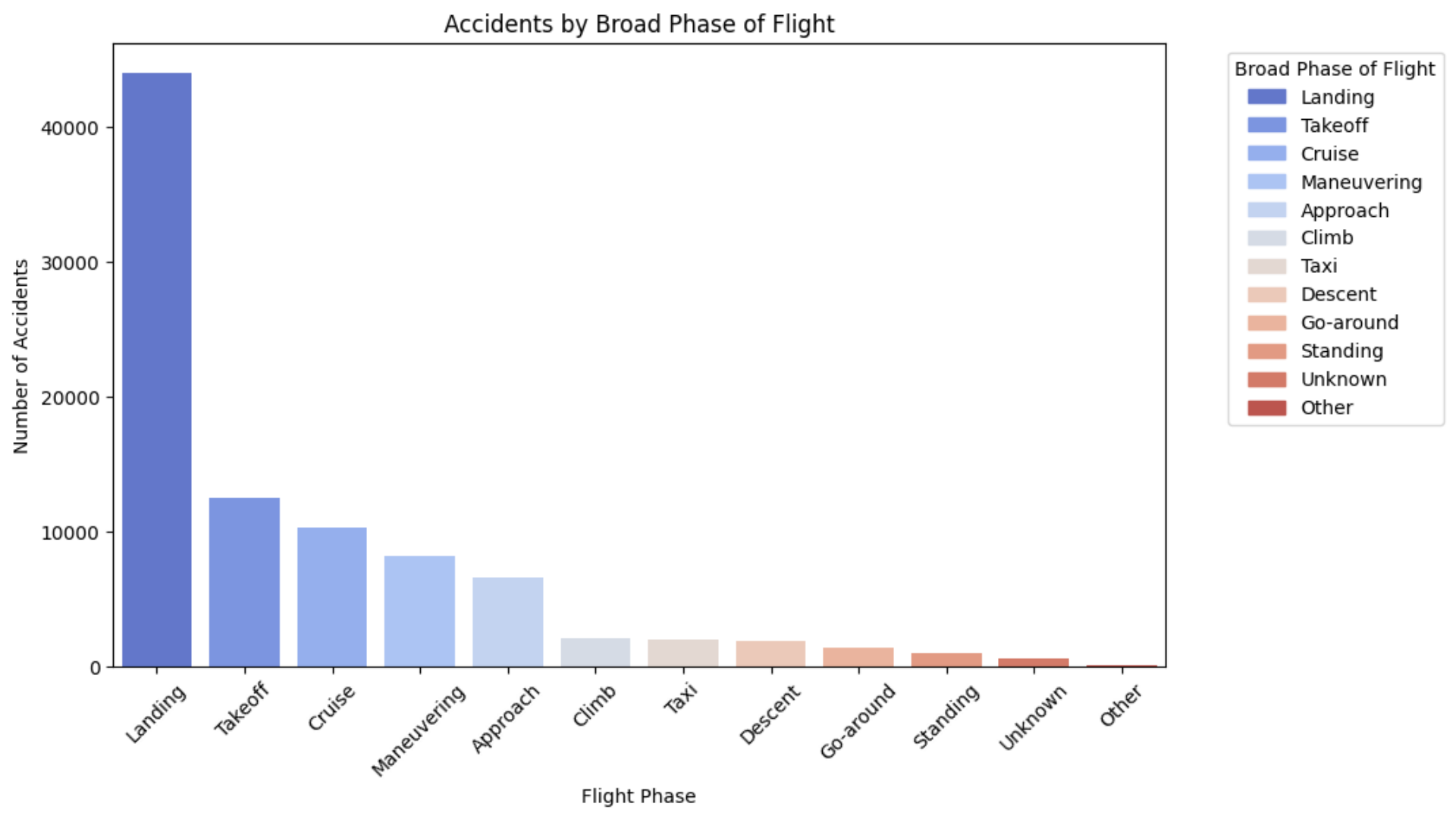
🚨 Top Risk Phases & Key Investments

✓ Landing (48% of accidents) → Invest in:

- 🔹 Advanced braking systems
- 🔹 Reinforced landing gear

✓ Takeoff (22%) & Cruise (18%) → Prioritize:

- 🔹 Engine redundancy
- 🔹 Aerodynamic stability


Accidents by Broad Phase of Flight
Number of Accidents
0
10000
20000
30000
40000
Landing
Takeoff
Cruise
Maneuvering
Approach
Climb
Taxi
Descent
Go-around
Standing
Unknown
Other
Flight Phase
Broad Phase of Flight
Landing
Takeoff
Cruise
Maneuvering
Approach
Climb
Taxi
Descent
Go-around
Standing
Unknown
Other

Business Impact of Aircraft Safety 🚀

✓ **Fewer incidents** : Lower insurance costs 💰
✓ **Stronger safety reputation** : More customer trust 🤝
✓ **Safer aircraft models** :Long-term operational success 📈

✓ Resilient aircraft investments: Less downtime, stronger brand safety 🏆

✓ Fewer severe accidents: Lower repair costs, higher efficiency ⚙️

Business Impact of Fleet Investment

🔹 Well-researched fleet investment → Long-term cost savings & industry trust

👉 "Data-driven investments mean safer skies and stronger businesses!“

🔹 Aircraft with strong safety records → Lower repair costs, less downtime, & reduced liability risks

Business Impact of Fleet Investment

🔷 Data-driven fleet selection → More passenger confidence & long-term profitability

👉 "Smart investments start with safety—because a secure landing means a stronger business!"

Findings

- Top 10 Safest Aircraft Models

✓ Identified based on lowest accident counts

✓ These models have historically low incident rates, making them statistically safer

- Landing Phase: The Most Critical

✓ The highest number of accidents occur during landing, surpassing all other flight phases

Findings

🔷 Cessna & Piper: Highest Accident Counts

✓ Cessna leads with the most recorded accidents, significantly outpacing other manufacturers

🔷 Accidents in Visual Meteorological Conditions (VMC)

✓ Most accidents occur in clear weather despite favorable conditions

✓ Key factors: Human error, mechanical failures, operational inefficiencies

Recommendation

- Enhancing Pilot Decision-Making

✓ Invest in human factor training to reduce errors in VMC (clear weather conditions)

✓ Improve decision-making in IMC (instrument conditions) for better risk management

- Strengthening Pilot Training & Simulation

✓ Increase simulator-based training focused on landing and takeoff emergencies

Recommendation

- Strategic Fleet Decisions

✓ Exercise caution with high-accident aircraft (e.g., Cessna & Piper) in purchasing decisions

✓ Prioritize aircraft models with lower accident rates for enhanced fleet safety

- Safer Aircraft Model Adoption

✓ Airlines & manufacturers should prioritize safer models in fleet selection

✓ Integrate safety-focused fleet decisions into training programs & regulations

🛠️ Next Steps

✓ Expand Data-Driven Safety Insights – Continue analyzing accident trends to refine safety measures.

✓ Enhance Training & Simulations - Implement advanced training programs focused on high-risk flight phases.

✓ Strengthen Aircraft Selection Criteria – Partner with manufacturers prioritizing safety and reliability.

✓ Develop Safety Policy Recommendations – Advocate for safety-driven procurement and operational protocols.

 Thank You!

 Let’s Make Aviation Safer Together!

 Questions? Let’s Discuss!

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