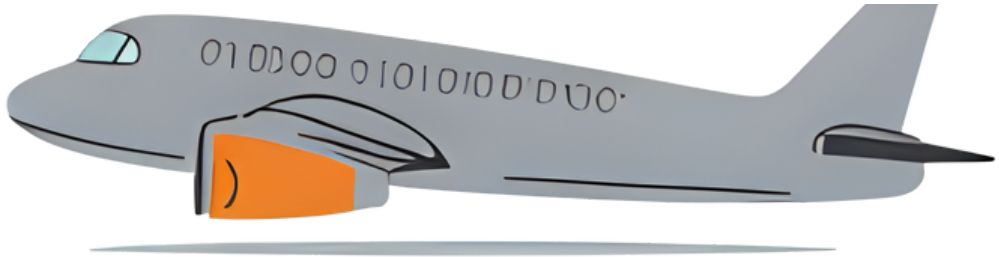
Aviation Safety Risk Analysis



Strategic Aircraft Acquisition & Operational Recommendations

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Overview / Executive Summary

Project Goal: Launching a Safe & Successful Aviation Division

Our company is expanding into aviation. To ensure a successful and safe launch, we conducted a deep-dive analysis of historical aviation accident data.

Our Core Mission:

To identify the lowest-risk aircraft models to acquire and the safest operational strategies to implement, minimizing risk for our new aviation division.

Our Approach:

We used Data Science—applying statistical analysis and pattern-finding techniques to a large dataset of past aviation incidents—to uncover actionable, evidence-based insights.

Business Understanding

The Business Problem We Solved

Entering the aviation industry comes with inherent risks. To make smart, safe, and profitable decisions, we needed to answer three key questions:

1. Aircraft Selection: Which specific aircraft models have the best safety records?
2. Operational Risk: What factors—like weather, flight phase, or flight purpose—most impact safety?
3. Strategy: How should we structure our operations to minimize risk from day one?

This analysis provides the data-driven answers to these critical questions.

Data Understanding

Our Data: A Deep Well of Aviation History

To find our answers, we analyzed a comprehensive dataset from the National Transportation Safety Board (NTSB).

- What it is: A detailed log of over 90,000 aviation accidents and incidents.
- Time Period: Data spans from 1948 to the present day.
- Key Information Included:
    - Aircraft Details: Make, Model, Engine Type
    - Accident Severity: Fatalities, Injuries, Aircraft Damage
    - Operational Context: Weather, Phase of Flight (Takeoff, Cruise, Landing), Purpose of Flight (Personal, Business, Instructional)

We cleaned and prepared this data, focusing only on full "accidents" to ensure our analysis of risk is accurate and relevant.

Data Analysis & Methods

How We Found the Patterns

We used a process called Exploratory Data Analysis. In simple terms, we:

1. Grouped & Compared: We grouped the accident data by aircraft model, weather condition, and phase of flight.
2. Calculated Key Metrics: For each group, we calculated crucial safety metrics:
    - Total Accidents: How often does this type of event occur?
    - Fatal Accident Rate: What percentage of these accidents resulted in a fatality?
    - Survival Rate: When an accident occurs, what is the likelihood of survival?

This method allowed us to move from raw data to clear, comparable insights about relative risk.

Visualization 1 - Aircraft Safety

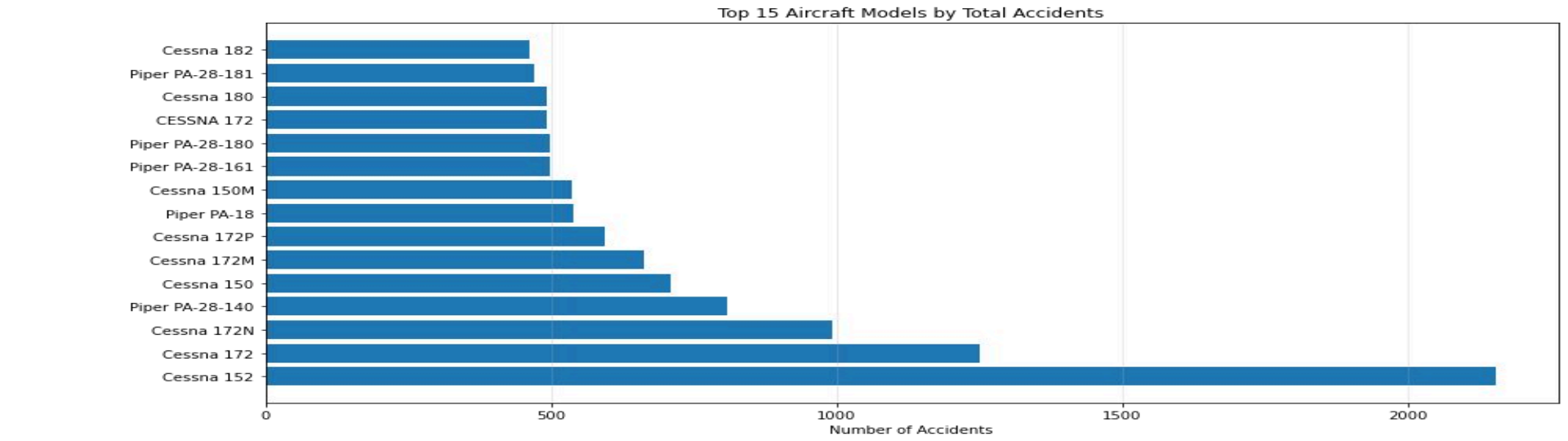
(Visual: A bar chart showing Aircraft Model on the Y-axis and Fatal Accident Rate on the X-axis. Models like Cessna 172 and Piper PA-28-161 are highlighted with lower rates, while others like Piper PA-28-181 have higher rates.)

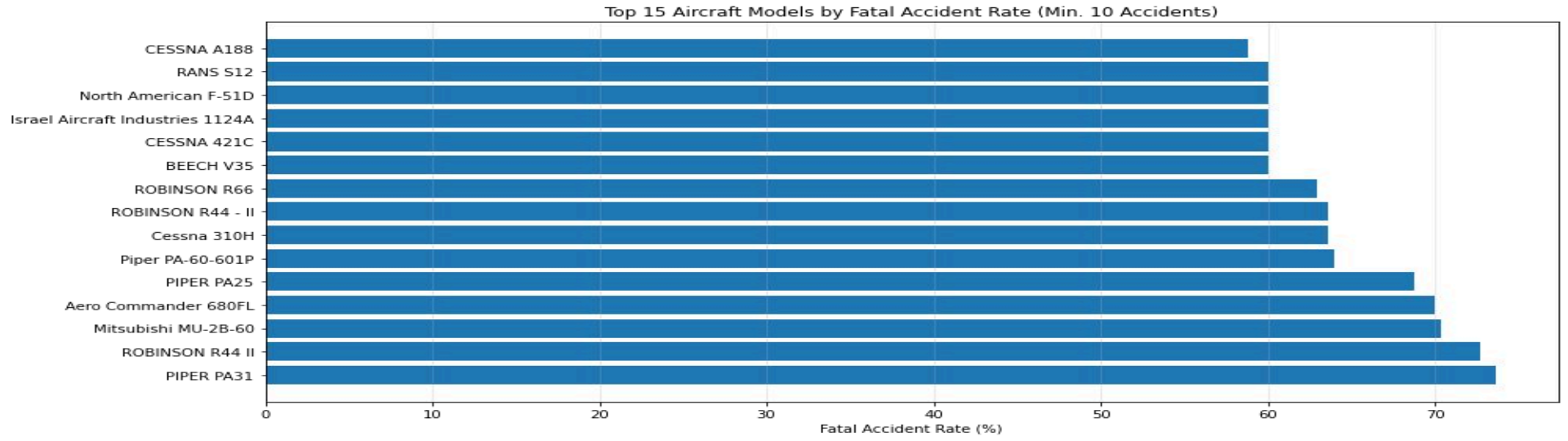
Key Finding: Not All Aircraft Are Created Equal

Insight: Safety profiles vary dramatically between different aircraft models, even from the same manufacturer.

What this means for us:

- We can make strategic acquisitions by targeting models with inherently lower fatal accident rates.
- This allows us to build our fleet on a foundation of proven safety, rather than cost or availability alone.


Top 15 Aircraft Models by Total Accidents
Cessna 182
Piper PA-28-181
Cessna 180
CESSNA 172
Piper PA-28-180
Piper PA-28-161
Cessna 150M
Piper PA-18
Cessna 172P
Cessna 172M
Cessna 150
Piper PA-28-140
Cessna 172N
Cessna 172
Cessna 152
0
500
1000
1500
2000
Number of Accidents


Top 15 Aircraft Models by Fatal Accident Rate (Min. 10 Accidents)
CESSNA A188
RANS S12
North American F-51D
Israel Aircraft Industries 1124A
CESSNA 421C
BEECH V35
ROBINSON R66
ROBINSON R44 - II
Cessna 310H
Piper PA-60-601P
PIPER PA25
Aero Commander 680FL
Mitsubishi MU-2B-60
ROBINSON R44 II
PIPER PA31
0
10
20
30
40
50
60
70
Fatal Accident Rate (%)

Visualization 2 - Weather Risk

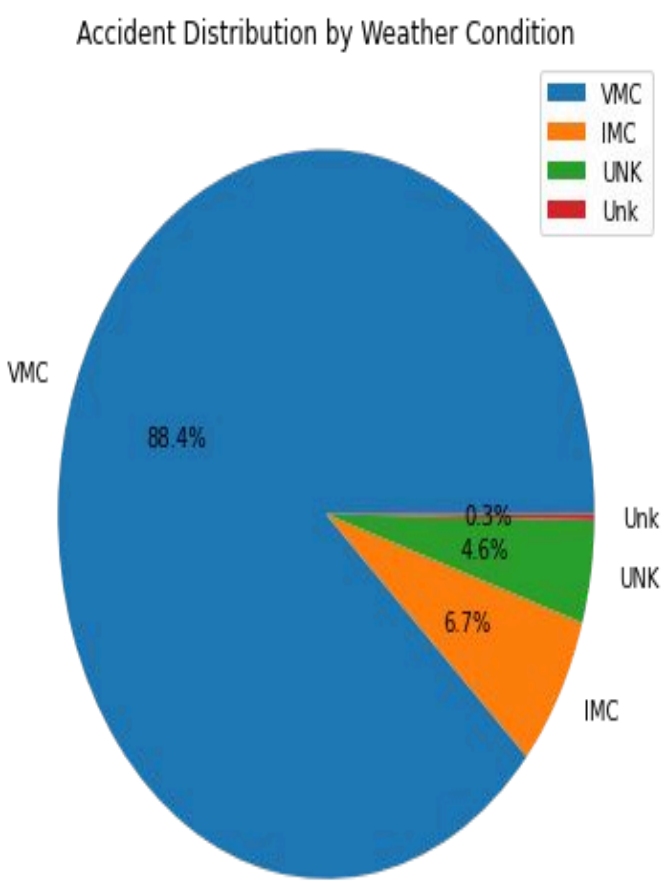
(Visual: A pie chart or donut chart showing the proportion of fatal accidents that occurred in VMC (Visual Meteorological Conditions - clear weather) vs. IMC (Instrument Meteorological Conditions - poor weather). The slice for IMC will be disproportionately large.)

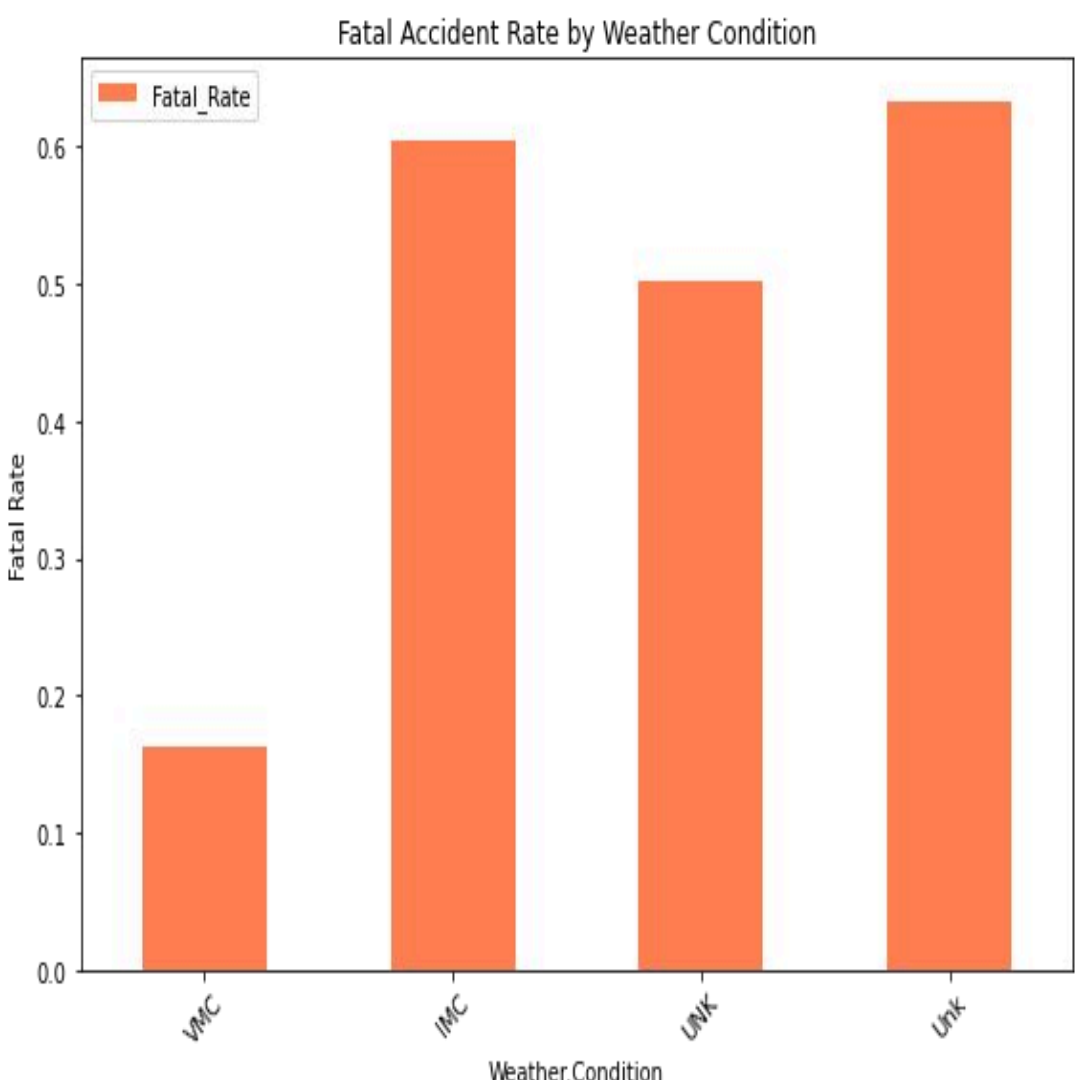
Key Finding: Weather is a Critical Risk Multiplier

Insight: A significantly higher percentage of accidents in poor weather conditions (IMC) are fatal, even though there are fewer flights in such conditions overall.

What this means for us:

- The consequence of an accident is far greater in bad weather.
- This isn't just about avoiding turbulence; it's about managing severe, life-threatening risk.


Accident Distribution by Weather Condition
VMC
IMC
UNK
Unk
VMC
88.4%
0.3%
Unk
4.6%
UNK
6.7%
IMC


Fatal Accident Rate by Weather Condition
Fatal_Rate
Fatal Rate
0.0
0.1
0.2
0.3
0.4
0.5
0.6
VMC
IMC
UNK
Unk
Weather Condition

Visualization 3 - Critical Flight Phases

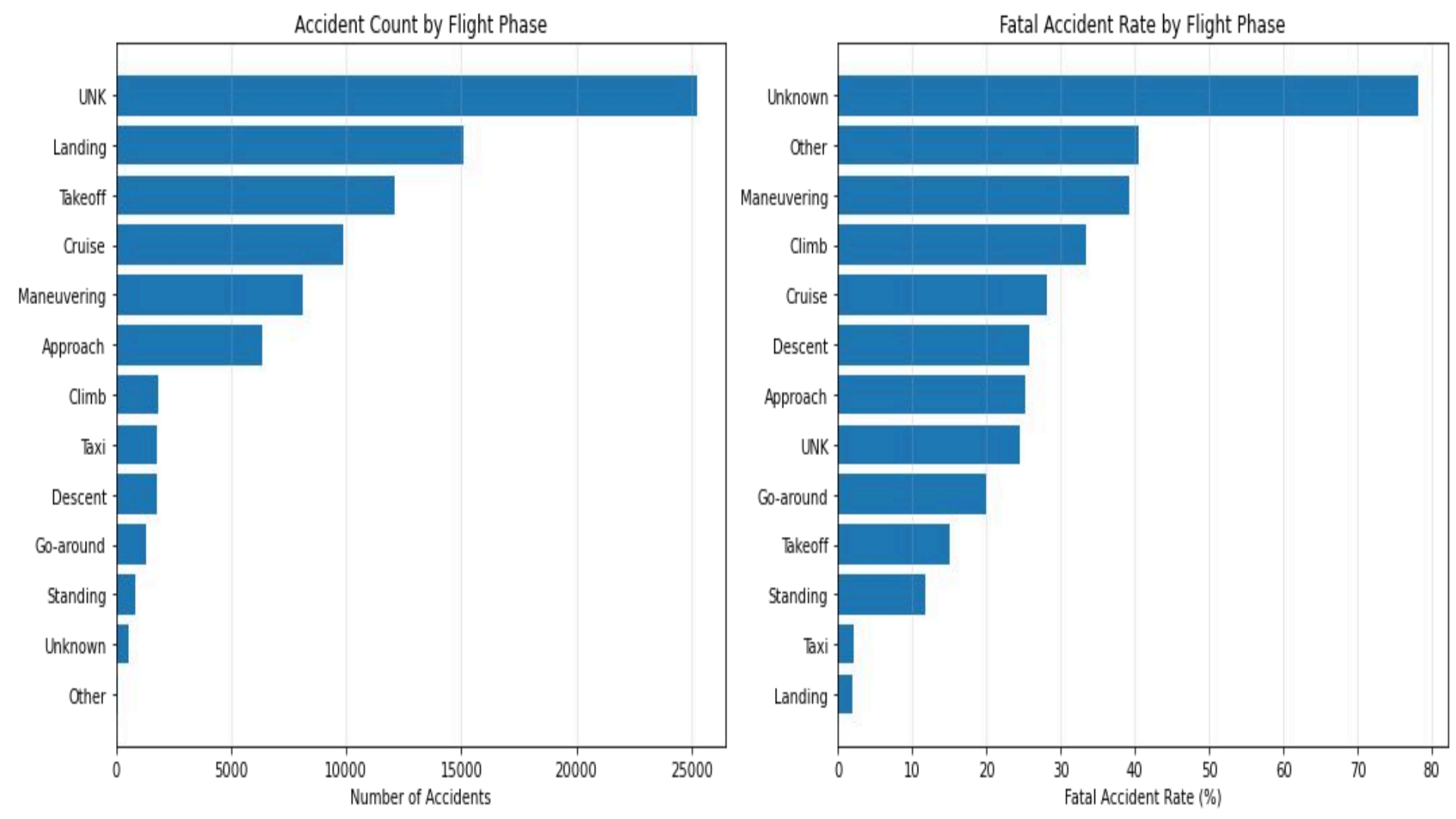
(Visual: A horizontal bar chart listing phases of flight like "Takeoff," "Cruise," "Approach," "Landing," and "Maneuvering." The length of the bars represents the number of accidents in that phase.)

Key Finding: Risk is Concentrated in Specific Phases

Insight: Accidents are not evenly distributed across a flight. The most complex phases—Approach, Landing, and Takeoff—are where the majority of accidents occur.

What this means for us:

- Our operational training and safety protocols should be heavily focused on these critical, high-workload phases of flight.
- A generic safety approach is less effective than a targeted one.


Accident Count by Flight Phase
UNK
Landing
Takeoff
Cruise
Maneuvering
Approach
Climb
Taxi
Descent
Go-around
Standing
Unknown
Other
0
5000
10000
15000
20000
25000
Number of Accidents
Fatal Accident Rate by Flight Phase
Unknown
Other
Maneuvering
Climb
Cruise
Descent
Approach
UNK
Go-around
Takeoff
Standing
Taxi
Landing
0
10
20
30
40
50
60
70
80
Fatal Accident Rate (%)

Recommendation 1: Strategic Fleet Acquisition

Acquire Aircraft with Proven Safety Records

- Action: Prioritize the acquisition of models like the Cessna 172 and similar aircraft that demonstrate a consistently low fatal accident rate in the historical data.
- Rationale: This is our primary risk mitigation strategy. Starting with a safe fleet is the most effective way to ensure the long-term safety and reputation of our division.
- Business Impact: Reduces potential for catastrophic loss, lowers insurance premiums, and builds stakeholder trust.

Recommendation 2: Implement a Conservative Weather Policy

Establish Strict Operational Limits for Poor Weather

- Action: Develop and enforce a stringent weather minimums policy that severely limits or prohibits operations in Instrument Meteorological Conditions (IMC), especially during the initial phase of our operation.
- Rationale: The data shows that poor weather dramatically increases the severity of accidents. A proactive avoidance strategy is the best defense.
- Business Impact: Protects assets and lives, minimizes flight delays and cancellations due to unmanageable risk, and reinforces a culture of safety.

Recommendation 3: Target Advanced Training

Focus Training Resources on High-Risk Phases of Flight

- Action: Invest in advanced, specialized simulator and flight training for our pilots, with a heavy emphasis on mastering Approach, Landing, and Takeoff procedures.
- Rationale: Since most accidents happen during these complex phases, enhanced pilot proficiency here will have the greatest direct impact on reducing accident frequency.
- Business Impact: Creates a higher-skilled pilot workforce, reduces incident rates, and improves operational efficiency and on-time performance.

Next Steps

To turn these insights into action, we propose the following next steps:

1. Detailed Fleet Analysis: Conduct a cost-benefit analysis of the top-rated safe aircraft models for final acquisition decisions.
2. Policy Development: Collaborate with our Chief Pilot and legal team to draft the formal Weather Policy and Training Program outlined in these recommendations.
3. Continuous Monitoring: Establish a process to continuously monitor our own safety data as we begin operations, creating a feedback loop for ongoing improvement.

Let's build the safest and most successful aviation division in the industry.

Thank You & Questions

Thank You

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I welcome your questions.