Aviation Risk Analysis Presentation

Strategic Aircraft Selection for Portfolio Diversification

Slide 1:

Overview

Expanding Safely into Aviation: A Data-Driven Approach to Aircraft Selection

Prepared by: Rosemary Wanjiru Date: 29/06/2025Audience: Head of Aviation Division

- Objective: Identify the lowest-risk aircraft for our company's entry into commercial and private aviation markets.
- Data Source: National Transportation Safety Board (NTSB) aviation accident data (1962-2023).
- Goal: Three concrete business recommendations backed by 60+ years of safety data.
- Impact: Strategic guidance for initial aircraft purchases to minimize operational risk.

Slide 2:

Business Understanding

Why Aviation? Why Now? Why Risk Matters?

- Market Opportunity.
- The aviation industry represents a significant diversification opportunity.
- Growing demand in both the commercial and private sectors.
- Potential for stable, long-term revenue streams.

The Challenge

- Zero aviation experience within our organization.
- High-stakes decision - Aircraft purchases are a multi-million dollar investment.
- Safety is paramount - Accidents impact reputation, finances, and most importantly, lives.

Our Approach

- Let our data guide our entry strategy.
- Prioritize safety as a competitive advantage.
- Make informed decisions based on historical performance.

Slide 3:

Data Understanding

Dataset Overview

- Source: National Transportation Safety Board (NTSB).
- Timeframe: 1962-2023 (61 years of data).
- Scope: Civil aviation accidents and incidents in the US and international waters.
- Scale: 70106 total records analyzed.

Key Data Points Analyzed

- Aircraft make and model.
- Accident severity (fatal vs. non-fatal).
- Purpose of flight.
- Weather conditions and contributing factors.

- Engine type and number of engines.

Data Quality Approach

- Addressed missing values through dropping columns and rows, assigning missing values to unknown where appropriate, and also using mean and mode appropriately.
- Focused on top model aircraft used for both private and business purposes for reliable analysis.
- Used data across all years to get the trend to help make the right decision from the analysis.

Slide 4:

Data Analysis Methodology

How We Transformed Data into Insights

Analysis Framework

1. Accidents per aircraft type relative to weather condition, purpose, engine type, and engine.
2. Fatal vs. non-fatal incident ratios.
3. Safety improvements over time.
4. Common causes and contributing factors.

Key Metrics Developed

injury severety - severity_weights = {'Fatal': 4, 'Serious': 3, 'Minor': 2, 'Non-Fatal}

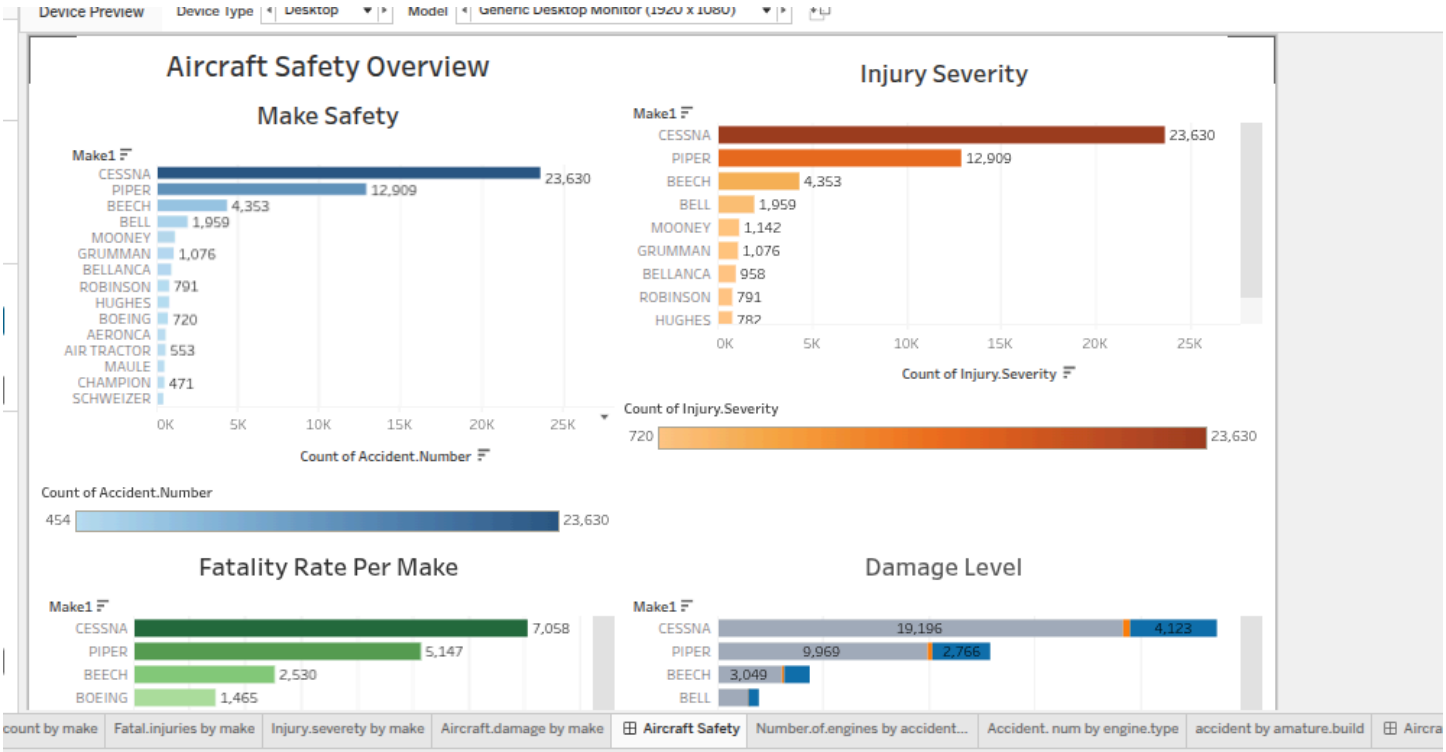
Fatality Rate - fatal_rate = data.groupby('Make')['Total.Fatal.Injuries'].sum() / data.groupby('Make').size()

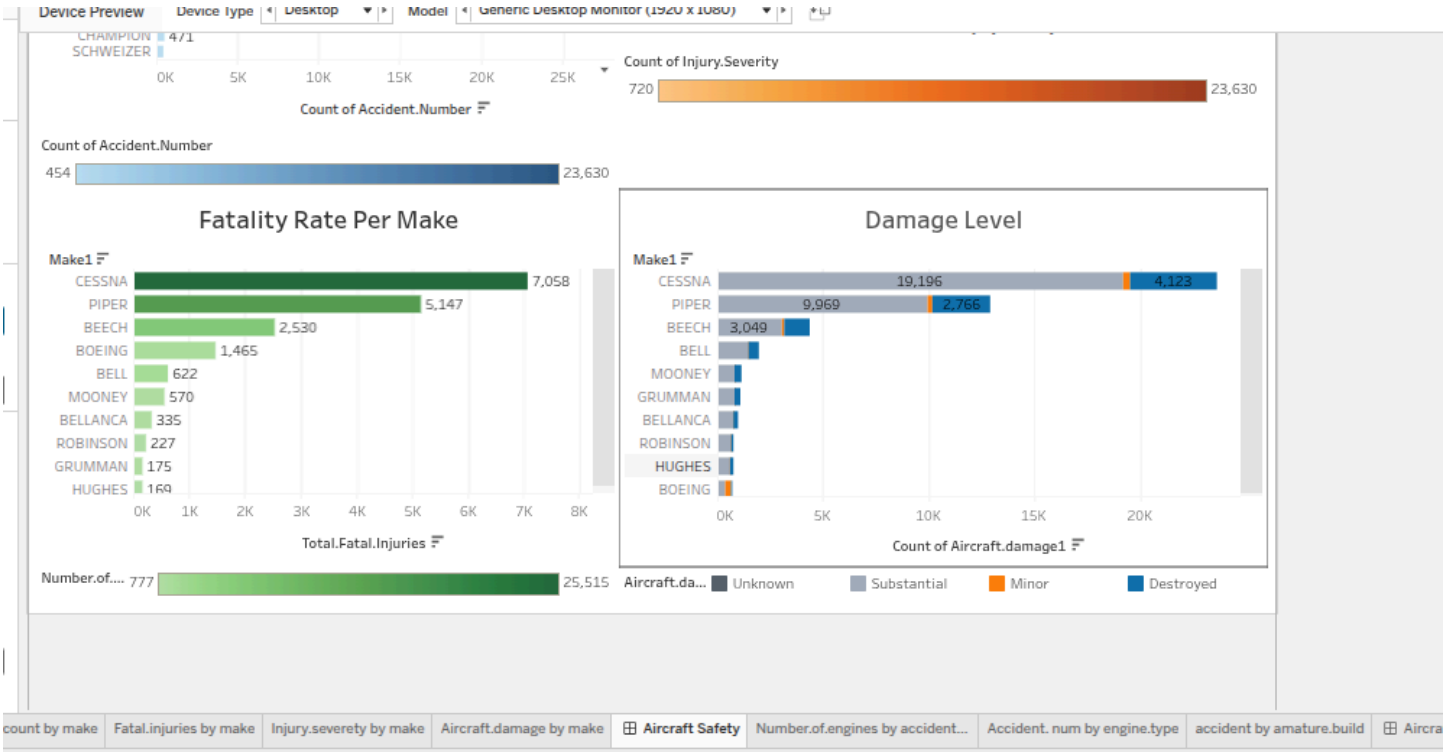
Risk Score - accidents_by_make = data.groupby('Make').size()

accidents_by_model = data.groupby(['Make', 'Model']).size()

Slide 5:

Finding 1 - Cessna Aircraft Demonstrates Highest Risk Profile





Key Insight

Safety Performance

- Cessna leads in total accidents: 23,630 incidents (highest among all manufacturers)
- Fatality rate: 7,058 fatal injuries - significantly higher than other manufacturers
- Injury severity: 23,630 total injuries, with 12,909 serious injuries

Comparative Analysis

- Piper: 5,147 fatal injuries (much lower than Cessna)
- Beechcraft: 2,530 fatal injuries
- Boeing: 1,465 fatal injuries
- Bell: 1,959 fatal injuries
- Mooney: 1,142 fatal injuries
- Grumman: 1,076 fatal injuries

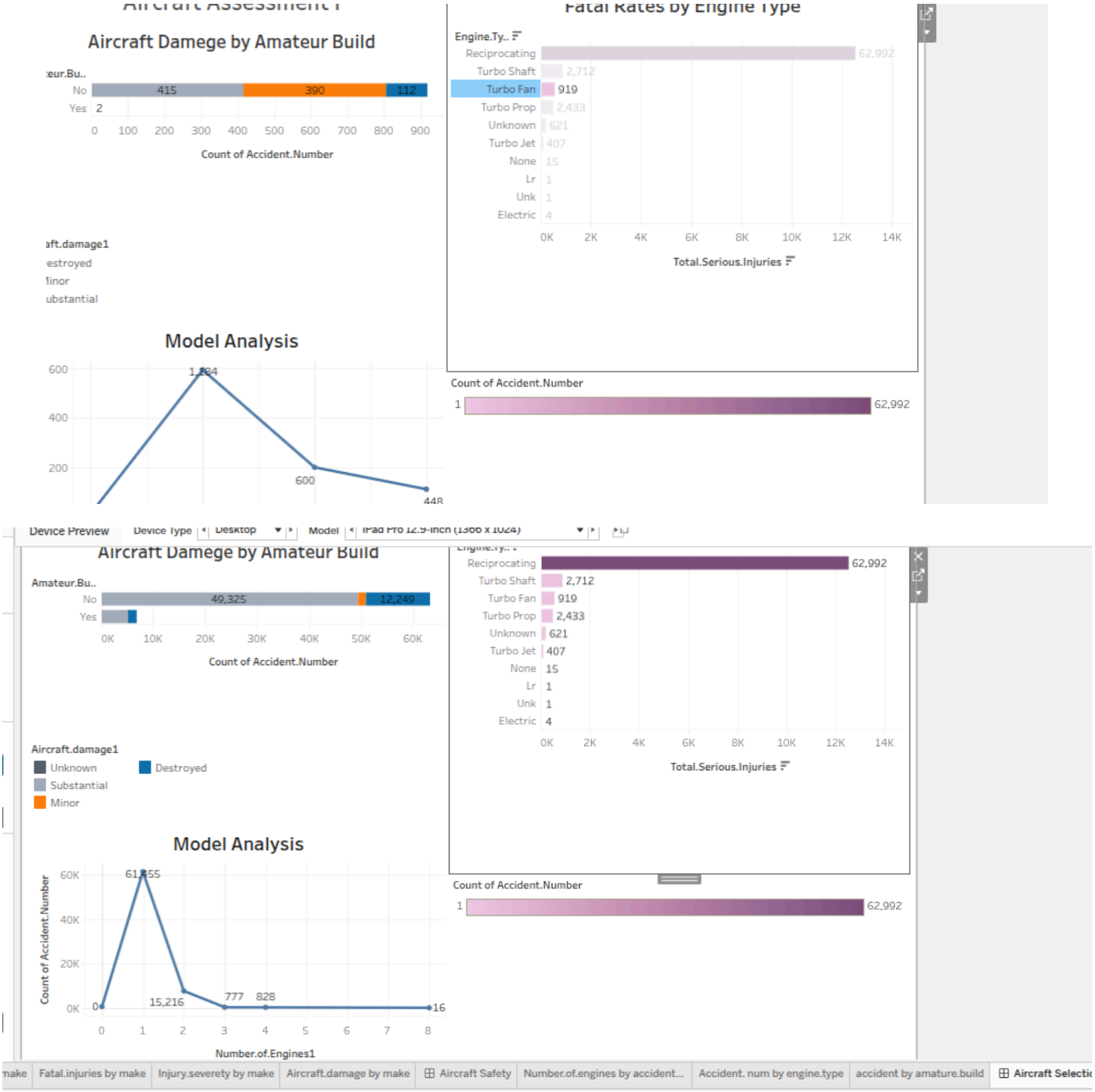
Damage Patterns

- Cessna aircraft damage - 19,196 substantial damage cases and 4,123 destroyed, showing a Mixed damage profile.

On hovering over the visuals, you can get any desired result for other attributes as well.

Slide 6:

Finding 2 - Amateur Build Status, Engine Count, and Engine Type Are Critical Risk Factors



Amateur Build Analysis:

- Amateur-built aircraft- Only 415 total accidents.
- Professionally-built aircraft- 45,325+ accidents.
- Key insight- Professional aircraft have 110x more accidents than amateur-built.

BUT - This could mean:-

- Professional aircraft likely have much higher flight hours/exposure.
- Amateur aircraft may have different usage patterns.
- Question for decision: Are we considering amateur-built aircraft for commercial operations?

Engine Count Impact

- Single engine (1)- Highest accident concentration (Approximately 61,000 plus accidents based on the peak).
- Twin engine (2)- Significantly lower (Approximately 15,000 accidents).

- Multi-engine (3+)- Much lower accident rates (under 1,000 each).
- We can see a clear pattern- More engines = better safety profile.

Engine Type Hierarchy highlights Risk from Highest to Lowest

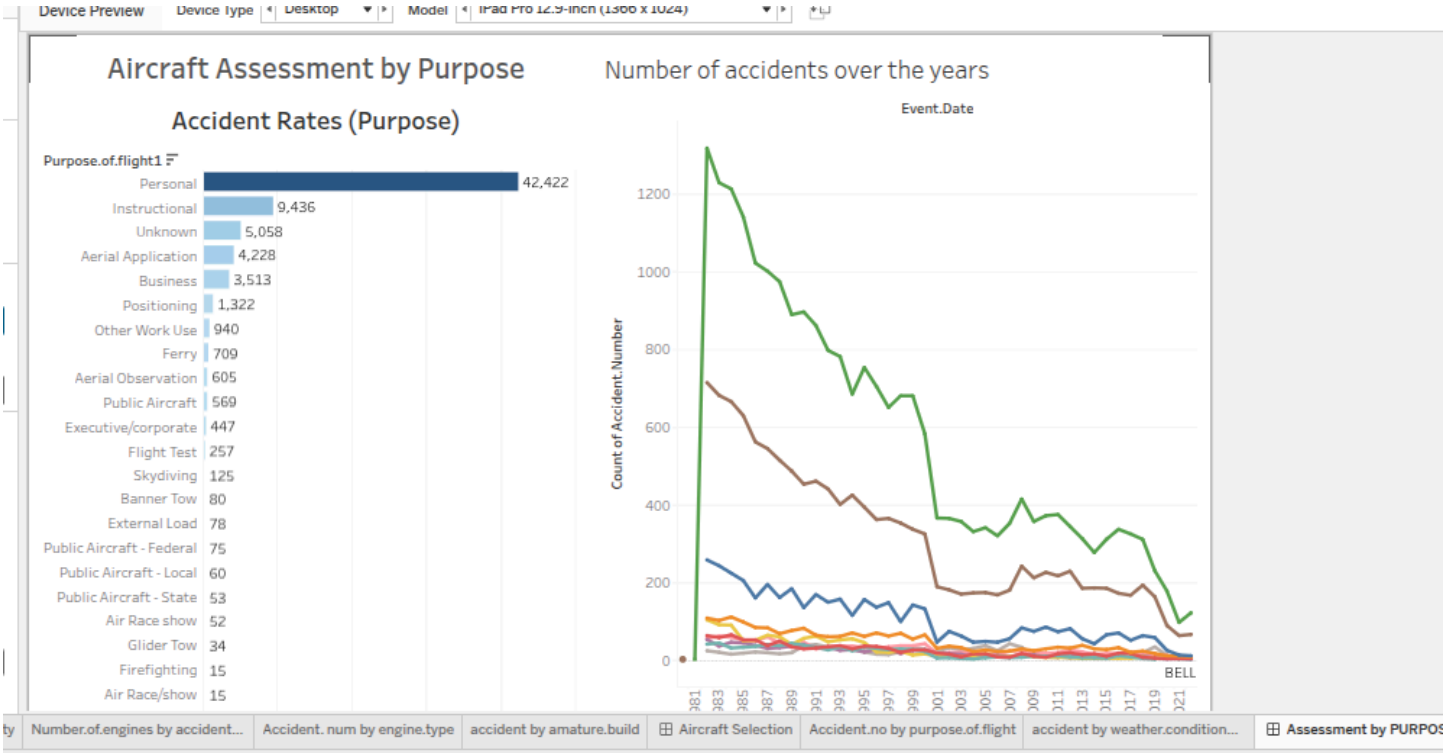
1. Reciprocating: 62,992 accidents HIGHEST RISK
2. Turbo Shaft: 2,712 accidents
3. Turbo Prop: 2,433 accidents
4. Turbo Fan: 919 accidents, LOWEST RISK

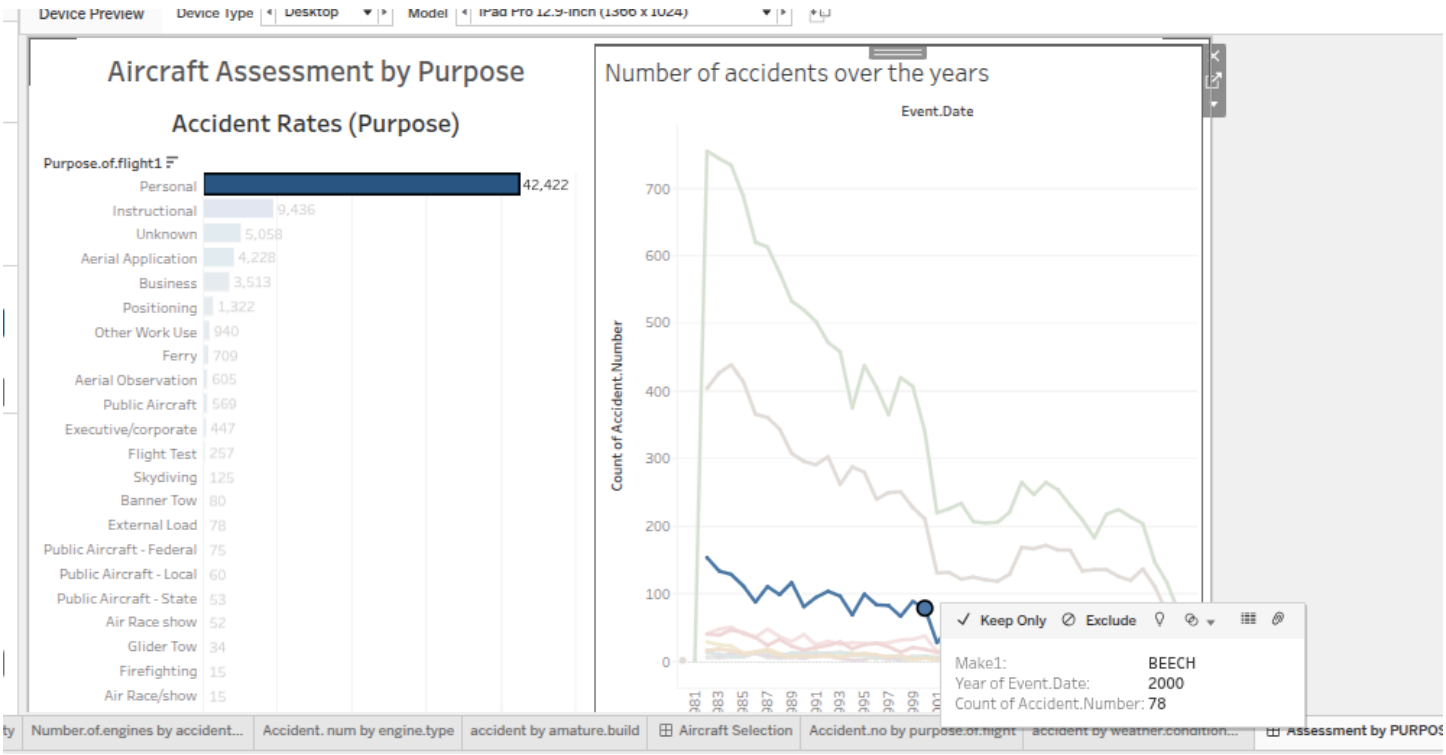
You can be able to explore each type of engine and any given number of engine to see how safe each one of them is. Hovering on any gives you the outcome of how it's related to the other, and the safer option you can get.

Slide 7:

Finding 3: Aircraft Purpose and Manufacturer Trends Reveal Operational Risk Patterns

Purpose-Based Risk Analysis





Highest Risk Categories:

- Personal flights: 42,422 accidents - HIGHEST RISK - massive lead over all other purposes.
- Instructional flights: 9,436 accidents - second highest.
- Unknown purpose: 5,058 accidents.

Lower Risk Categories

- Aerial Application - 4,228 accidents.
- Business flights - 3,513 accidents.
- All other purposes can be seen in the visual.

Time Trend Analysis 1962-2021

Historical Pattern

- 1970s-1980s: Peak accident periods, 700 plus accidents per year.
- Steady decline: Clear downward trend from the 1980s onward.
- Modern years: Significantly lower accident rates under 200 per year.

Manufacturer Performance Over Time

Hovering over them, you can be able to see what makes each and relate to its purpose, and you can clearly see the trend to choose the best relating to your needs at hand.

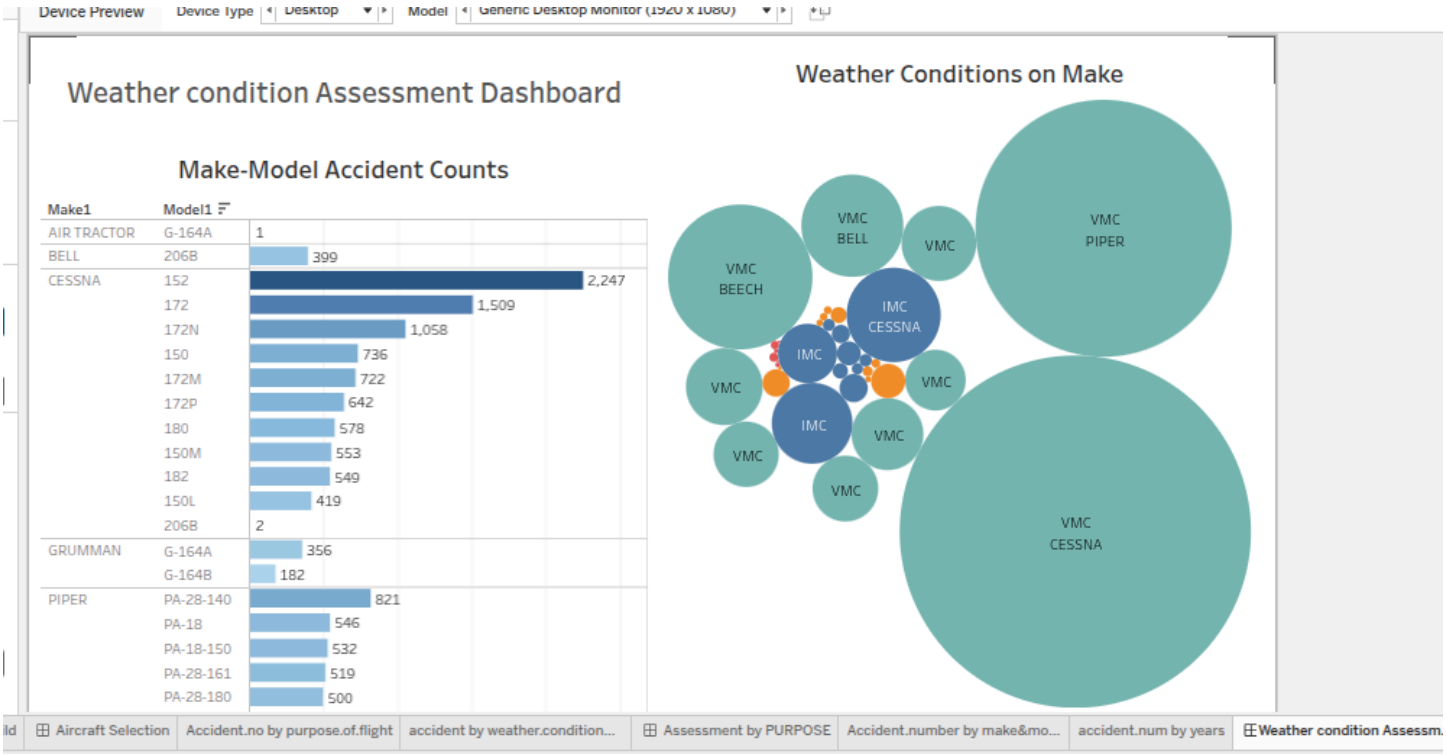
Key Insights

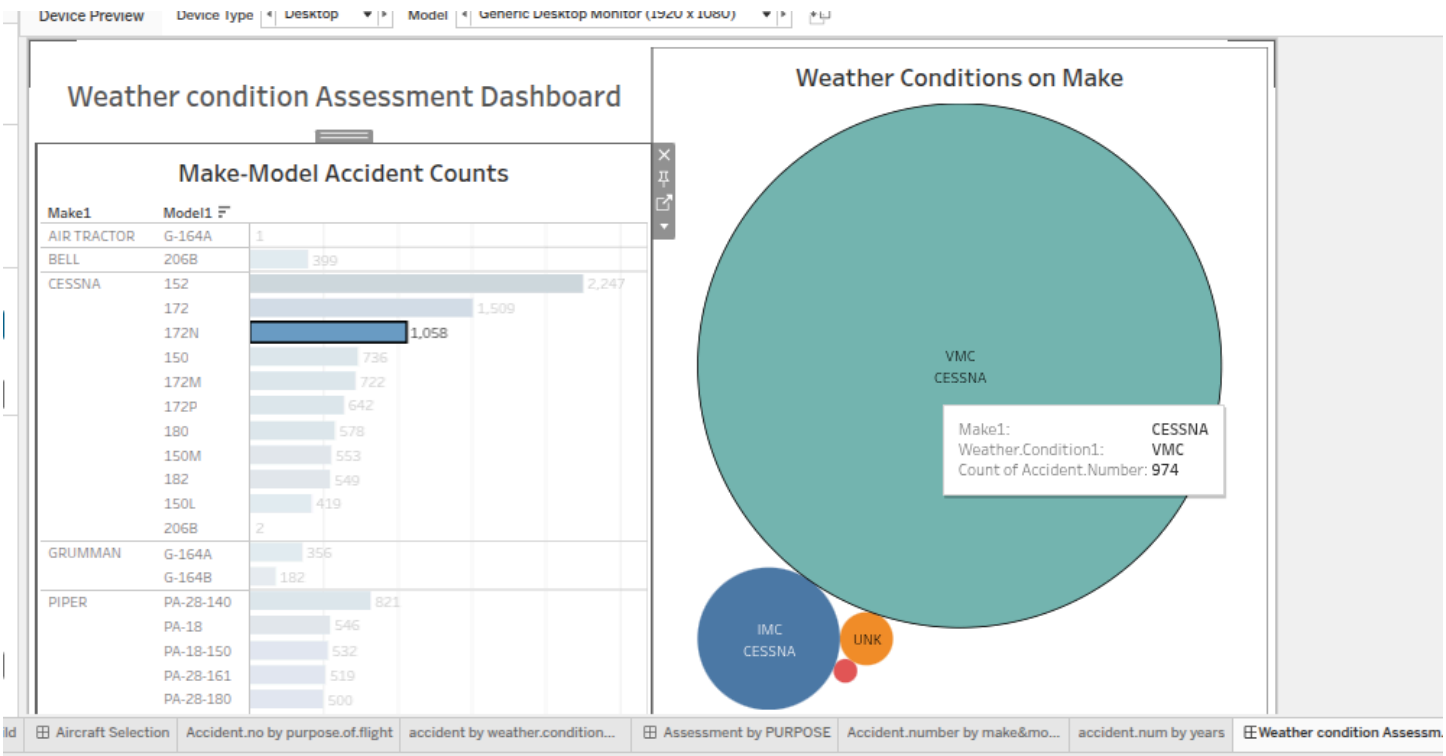
1. Personal aviation carries the highest risk, 42,422 vs. 3,513 for business use.
2. Aviation safety has exemplarily improved - modern aircraft are much safer than historical.
3. Some manufacturers show better consistency over time periods.
4. Business operations show lower accident rates than personal use.

Slide 8:

Finding 4: Aircraft Model Selection and Weather Conditions Are Critical Risk Factors

Model-Specific Risk Analysis Within Manufacturers





Cessna Model Performance

- Cessna 152: 2,247 accidents -highest risk model.
- Cessna 172: 1,500 accidents.
- Cessna 172N: 1,058 accidents.
- Other Cessna models: Generally under 1,000 accidents each.
- Key insight: Even within the same manufacturer, model choice dramatically impacts risk.

Piper Model Performance

- Piper PA-28-140: 821 accidents - highest among Piper models.
- Piper PA-18: 546 accidents.
- Piper PA-18-150: 532 accidents.

- Piper PA-28-161: 510 accidents.
- Pattern: More consistent risk distribution across models compared to Cessna.

Other Manufacturers

- Bell 206B: 399 accidents
- Grumman models: Generally lower accident counts

Weather Condition Impact

Weather Risk Categories we have

- VMC (Visual Meteorological Conditions)- Dominates the bubble chart, indicating the majority of accidents.
- IMC (Instrument Meteorological Conditions)- Smaller but significant portion (blue sections).
- Unknown conditions - Small orange segment.

Critical Business Insight:

- Most accidents occur in GOOD weather (VMC) - not what we might expect!
- This suggests pilot error/training issues rather than weather being the primary cause
- VMC accidents may indicate overconfidence or inadequate training in good conditions

Slide 8: Recommendations Summary

Three Strategic Actions for Safe Market Entry

Aircraft Selection Strategy

Avoid Cessna aircraft for initial fleet acquisition

- Cessna represents the highest risk category with 23,630 total accidents
- The fatal injury rate of 7,058 is more than double the next highest manufacturer
- Insurance costs would likely be significantly higher
- Reputational risk for a company entering the aviation market

Alternative Focus:

- Consider manufacturers with lower incident rates (Boeing, Bell, and Mooney show much better safety profiles)
- Piper shows intermediate risk, but is still much safer than Cessna

Focus on Business-Configured Aircraft from Manufacturers with Consistent Safety Records like Mooney. Avoid Cessna at all costs.

Fleet Configuration Approach

The Triple Safety Filter: Avoid Single-Engine Reciprocating Aircraft, Consider Professional Multi-Engine Turbine Aircraft

Optimal Risk Profile:

- Professional-built (despite higher absolute numbers, likely due to higher usage)
- Multi-engine configuration (2+ engines for redundancy)
- Turbine engines - Turbo Fan or Turbo Prop preferred over reciprocating

Highest Risk Combination to Avoid

- Single-engine + Reciprocating engine aircraft

Model-Specific Selection and Weather-Based Training Programs

Aircraft Selection Strategy:

- Avoid high-risk models: Cessna 152, Cessna 172 show significantly higher accident rates.
- Consider Piper alternatives: More consistent safety across the model range.
- Model matters more than make: Even within the same manufacturer, choose carefully.

Operational Safety Protocol:

- Enhanced VMC training: Since most accidents occur in good weather, focus on preventing overconfidence
- Pilot proficiency programs: Regular training even in favorable conditions
- Model-specific training: Different aircraft models require specialized knowledge

Slide 9:

Next Steps

Implementing Our Data-Driven Aviation Strategy

Immediate Actions in the next 30 Days

Aircraft Market Research

- Source multi-engine turbine aircraft from Boeing, Bell, or Mooney manufacturers. Or any other you will prefer for your business.
- Avoid all Cessna aircraft and single-engine reciprocating models

Risk Assessment Integration

- Develop insurance cost projections based on recommended aircraft types.
- Create a safety management system framework prioritizing VMC training protocols.

Short-term Implementation (1-3 Months)

Aircraft Acquisition Strategy

- Finalize 2-3 aircraft selections from approved manufacturers with low risk. (Mooney, Bell).
- Negotiate purchase agreements with safety record documentation requirements.
- Establish maintenance partnerships specializing in engines.

Operational Framework Development

- Design a comprehensive pilot training program emphasizing good weather operations.
- Create model-specific operational procedures for selected aircraft types.

Long-term Objectives 3 months and beyond

Market Entry Execution

- Complete initial fleet acquisition and certification processes.
- Launch commercial or business aviation operations with enhanced safety protocols.

Success Metrics: Zero incidents in first year, insurance cost reduction of 15-20% vs. industry average, profitable operations within 18 months

Slide 10:

Thank You

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