UCD Michael Smurfit Graduate Business School

MSc Business Analytics

MIS41040 - Business Decision Support System

Tableau Report

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Under the guidance of

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Group 27

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1. **Executive Summary**

This decision support system (DSS) is developed in response to the increasing demand for data-driven insights in the aviation sector namely, managing flight delay—more specifically. The fundamental need for information here is the capacity to know not only where and when delays occur, but also why delays occur and how to prevent them from occurring. Airlines, operations managers, airport authorities, and government agencies all need to be equipped with dynamic, real-time analytics that allow them to traverse multidimensional delay data—airline, airport, aircraft type, day of the week, season, and weather.

The system integrates multiple datasets—namely flight activity, weather, cancellations, and aircraft information—into a unified visual interface built with Tableau. The dashboards provide interactive snapshots tailored to quick decision-making, trend detection, and operational forecasting. The need for high-level summaries as well as granular drill-downs did shape the dashboard configuration, with end-users being able to toggle from general KPIs to specific incidents with ease.

The main use cases driving the system configuration are:

- Monitoring flight delay patterns by carrier and region to identify recurring bottlenecks
- Understanding the root causes of delays and learning about seasonality
- Reviewing aircraft reliability by age and type to inform fleet upgrades
- Comparing carriers' performance for punctuality and consistency
- Identifying which airports experience the highest delays and the reasons behind

These information requirements require not just an informative but also a responsive DSS—allowing users to experiment with scenarios, measure variance, and improve modeling. Decision-makers can use this platform to prioritize infrastructure investment, reengineer scheduling procedures, and improve customer communication.

The resulting analysis reveals that a small number of airports and airlines account for a large percentage of delays. The system enables the identification of systemic issues—like aging fleets, weather vulnerability, and poor ground logistics—and helps stakeholders comprehend where and when intervention will be most effective.

By incorporating temporal filters, predictive indicators, and category contrasts, the DSS assists in both tactical and strategic planning. It interprets static historic data into an animated decision situation tailored to the realities of air travel today.

2. **Data Preparation and Integration**

To ensure a clean and analyzable dataset, the following steps were undertaken:

Datasets Used

- US_flights_2023.csv — Full flight schedule and performance data
- Cancelled_Diverted_2023.csv — Cancellations and diversions with reasons
- Weather_meteo_by_airport.csv — Daily weather metrics by airport
- Airports_geolocation.csv — Airport codes and geospatial mapping info

Data cleaning included

- Outliers were identified but not excluded, as they capture significant information
- Typographical errors corrected (e.g., 'hight' → 'high', 'aicraft' → 'aircraft ')

Joins Performed

- Joined flight and weather data on FlightDate + Dep_Airport
- Joined weather and cancellation data using Airport_ID
- Matched airport geolocation data to flight departure/arrival points

Issues Encountered

- Incomplete weather data for certain smaller airports
- Some tail numbers had inconsistencies — ignored in aircraft-level charts
- Overlapping bar chart axes were fixed using diverging formats

3. Key Analytical Questions

The dashboards answer several key questions:

i. What are the most common delay causes?
Carrier-related issues (e.g., tardy aircraft, maintenance) are the most common, followed by NAS congestion and weather disruption.

ii. What is the average time lost due to delays?
San Marcos (SMX) for example has an average of ~58 minutes of departure delays, and other airports like COD and PPG have 40–50 minute delays as well.

iii. Which aircraft types experience the most delays?
The DA40 and Airbus A350 have the largest average delays, while the older Boeing planes have delays associated with fleet age.

iv. How seasonal are delays?
Delays are highest during March–April, June–August, and December, with weather playing a big role in winter.

v. Which airlines are most affected?
JetBlue and Frontier stand out with high average delays and high variability.

4. Integrated Insights

Weather Impact: Only about 1.07% of flights were directly delayed due to weather, but 3.2% were cancelled for weather-related reasons. Wind speed (avg 12.42 m/s) is highly correlated with delays, especially at snow- and storm-prone airports such as BJI, BRD, and EWN. Mornings and late evenings experience more delays due to low visibility and operational resets.

Aircraft Behavior: Certain aircraft models, especially the DA40 and A350, show disproportionately high delays. Airbus aircraft averaged 18 minutes of delay versus 15 for Boeing. Embraer models demonstrated lower delays and higher usage. Notably, older Boeing aircraft (avg age 52 years) correlate with longer turnaround times.

Airport Performance: SMX consistently ranks highest for both departure and arrival delays. Other hotspots include PSE, BQN, and SFB. Delay reasons vary by season—airline and NAS in spring/summer, weather in winter. Regional infrastructure gaps, such as limited ATC capacity or gate availability, exacerbate delays at high-impact airports.

Airline Operations: JetBlue and Frontier recorded the highest average delays, with average times exceeding 22 minutes and significant variance. Delta, by contrast, had delays closer to 10 minutes and much lower standard deviation. Low-cost carriers tend to show less predictable service levels, suggesting opportunities for process optimization and better planning.

5. Advanced Insights & Recommendations

The dashboard observations provide targeted prescriptions:

- Airlines with chronic delay problems (e.g., JetBlue) must invest in predictive maintenance and staff resourcing.
- Airports like SMX and COD require ATC upgrades or more comprehensive gate capacity.
- Aging Boeing aircraft need to be retired or reshuffled onto off-peak flights.
- Weather delays must be predicted with dynamic scheduling linked to forecasting.
- Crew planning must be realigned by the airlines according to seasonal trends.
- Real-time passenger notifications can minimize disappointment amid predictable high-delay seasons.
- Scenario planning in Tableau can simulate rerouting options or terminal switches amidst seasonal disruption.

6. Conclusion

This report demonstrates that flight delays result from a complex interaction of controllable and uncontrollable factors. Airline decisions, aircraft reliability, airport processes, and weather conditions all contribute to real-time disruption. With structured Tableau dashboards, this DSS offers an evidence-based approach to identifying problem areas and prioritizing interventions.

The following information allows executives to invest in operational bottlenecks, airports to optimize throughput, airlines to enhance punctuality, and planners to design more resilient schedules.

By applying these tools, the aviation industry can shift away from reactive disruption management and move towards proactive resilience planning.

[Tableau Public Link]