AeroStream Operational Efficiency Report

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May 15, 2025

Executive Summary

This report outlines the development and findings of AeroStream, a simulated operational monitoring system designed to analyze check-in counter usage, passenger flow, and slot adherence at a fictional airport terminal. The objective was to identify inefficiencies in the current (as-is) allocation process and provide a data-driven framework for process improvement.

Project Scope

AeroStream was developed to reflect the kind of work an airport operations analyst or coordinator would perform. It involved:
- Simulated data generation for counter usage, passenger distribution, and flight schedules.
- Data cleaning and transformation using Python and Pandas.
- Visual dashboards built in Power BI to highlight key operational metrics.
- Process mapping using diagrams.net to compare the current manual system with a proposed automated one.
- SQL integration to simulate ad-hoc query capabilities for operations teams.

Methodology

Three datasets were created using Python scripts:
1. Counter Usage Logs – occupancy by airline, date, and time.
2. Passenger Flow by Zone – hourly passenger density across terminal zones.
3. Slot Adherence Logs – scheduled vs actual slot usage and delays.

Data was cleaned using Pandas, and KPIs were calculated including:
- Average counter occupancy %
- Overcapacity detection in terminal zones
- On-time flight rate and average delay

An in-memory SQLite database was used to run operations-focused queries (e.g., peak congestion hours, counters over capacity).

Power BI was used to visualize:

- Heatmaps of counter usage by day
- Passenger flow trends over time
- Flight delay statistics and status breakdowns
- Dynamic filters for time, zone, and airline

As-Is and To-Be workflows were designed using diagrams.net:

- As-Is: manual, spreadsheet-based counter assignment
- To-Be: automated analytics-driven counter allocation with real-time feedback

Key Insights

- Counter Occupancy: Counters A3 and A10 (77.78%), and A7 (76.98%) show the highest sustained usage, indicating potential for overload or redistribution. Counter A6 shows the lowest usage, averaging 72.22%.
- Zone Overcapacity: Approximately 3.7% of zone-hour periods were over capacity, most frequently during morning hours.
- Flight Adherence: Only 15.5% of flights were on time; delays are most significant for Air Canada and United, averaging nearly 5 minutes.

Process Analysis: As-Is vs To-Be

As-Is Process:
- Manual review of airline schedules
- First-come, first-served counter allocation
- No integration with passenger flow data
- Logged in spreadsheets; reactive to conflicts

To-Be Process:
- Automated schedule ingestion
- Analytics-based counter availability checks
- Power BI dashboards guide assignment decisions
- Live monitoring and alerts for reallocation
- Updates tracked in a centralized system

Recommendations

1. Automate Counter Assignment – Integrate flight schedule ingestion and build automated rules for assigning counters based on utilization patterns.
2. Use Real-Time Dashboards – Implement occupancy and passenger flow dashboards like those in AeroStream to inform daily operational decisions.
3. Monitor Overcapacity Periods – Set thresholds (e.g., >85% usage) to trigger automatic alerts or conflict resolution workflows.
4. Improve Schedule Reliability – Current on-time rate (15.5%) is significantly below target.

Encourage tighter turnaround times and review root causes with carriers.
5. Centralize Process Tracking – Replace spreadsheet-based logs with a centralized digital system for visibility and traceability.

Visual Highlights

- Heatmap: Counter A3 and A10 consistently over 77% occupancy.
- Line Chart: Congestion consistently peaks from 07:00 to 10:00.
- Donut Chart: 15.5% Late, 29% Early, 55.5% On-Time.
- Bar Chart: Air Canada shows highest average delay (~5 mins).
- KPI Cards: 3.7% OverCapacityRate, 15.5% OnTimeRate.

Conclusion

AeroStream demonstrates how simulated analytics and process redesign can support more efficient airport operations. By transitioning from manual workflows to data-driven systems, airports can improve resource allocation, reduce passenger congestion, and enhance real-time decision-making capabilities.