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**MIS 584 Business Intelligence**

**Final Report**

**Team 2**

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# Table of contents:

1. **Executive Summary**
   1. Overview of Transportation and BTS
   2. Project Goals and Key Deliverables
2. **Introduction**
   1. Background of BTS
   2. Importance of Transportation Statistics
3. **Proposed BI Solutions**
   1. BI Definition and Framework
   2. Key Components and Value
4. **Implementation**
   1. Operational Dashboard
   2. Tactical Dashboard
   3. Conjoint Analysis
5. **Managerial, Technical, and Ethical Implications**
   1. Managerial Insights
   2. Technical Standards
   3. Ethical Considerations
6. **Summary and Conclusion**
   1. Project Outcomes
   2. Role of BI in BTS
7. **References**
8. **Acknowledgment**

# Section 1: Executive Summary

# Transportation is defined as the movement of people and materials from one point to the other for one reason or another. It is an essential part of human activity and, in many ways, forms the basis (starting point or foundation) of all socioeconomic developmental processes.

Transport statistics are grouped into four basic categories, namely, rail, road, water and air transportation. Our project focuses mainly on air transport. Air transportation is a system with many interrelated parts. Each airport is connected to the system through the airways and other airports with which it exchanges flights. Our project talks about The Bureau of Transportation Statistics (BTS) which collects and publishes transportation statistics around the United States.

We are focusing on the aviation area of BTS, the aviation department relies heavily on data-driven insights for decision-making. Business Intelligence (BI) plays a crucial role in this process as well. We have assumed that the current BI system at BTS lacks the capabilities required for modern-day analysis, leading to inefficiencies in bringing out actionable insights. Our project aims to address this gap by enhancing BTS's BI system with creative and interactive dashboards to meet modern-day data analysis demands. We aim that these dashboards will provide an intuitive and user-friendly interface, enabling non-technical stakeholders to visualize, interpret, and act on weather-related delays and customer satisfaction.

**1.1 Goals**

The primary goal of this project is to enhance BTS's BI system by developing creative and interactive dashboards that cater to modern-day data analysis demands. These dashboards aim to improve data accessibility and usability for both technical and non-technical users who want to get insights from the dashboards. Our focus in aviation is on weather-related delays and on passenger satisfaction for different airlines. Through the dashboards and predictive analysis, we aim to inform every individual on the airline companies that are part of the BTS.

**1.2 Business Problem**

The issues that we presumed were fragmented data system, the current data system of the The current data systems used by BTS are fragmented across various departments, hindering the integration and centralization of data from different states and the U.S. airspace. The root cause of this issue stems from receiving statistics from different airline companies in varying formats and at inconsistent intervals. Thereby leading to low-quality research analysis and cross department collaboration to solve future problems or to prevent such problems. Second problem that we identify is the lack of comprehensive analyses regarding flight delays and cancellations. Poor understanding of how external factors, such as weather, influence airline performance. The third business problem that we identify is not using up-to-date tools such as Tableau for data visualization, to help make non-technical stakeholders (staff, suppliers and vendors, employees) understand the data is critical in decision making.

The fourth business problem is the limited development of Business Intelligence (BI) capabilities. BTS is in the early stages of BI implementation and still relies heavily on outdated reporting methods. According to the BTS website, the company generates monthly data analytics reports; however, these reports are overly lengthy, placing an additional burden on staff to process them. As a result, these reports fail to provide meaningful and consistent value to the organization. Therefore, BTS is missing opportunities for preventive actions such as actionable insights on why there are delays, what can they do to prevent is and how they can inform their airline companies.

**1.3 Summary of the Project Deliverables**

This project addresses the challenges faced by the BTS in analyzing and visualizing their aviation data, to enhance its operational efficiency, provide actionable insights, and improve its decision-making this project we have assumed that the BTS does not use modern BI tool to do their data visualization for the delays caused by weather and their customer satisfaction. Using the data we have developed two dashboards- an operational dashboard that shows weather-related cancellations and a tactical dashboard, designed to represent customer satisfaction. These user-friendly dashboards are customizable, enabling stakeholders to focus on the data most relevant to their needs. Additionally, we modernized BTS's BI system, centralizing data and introducing advanced visualization tools for better insights. This project also empowers passenger preference with the help of the conjoint analysis so that BTS and associated airline companies can be informed about the most and the least important factors for passenger booking behavior.

# Section 2: Introduction

**Client Company**

The Bureau of Transportation Statistics (BTS) is a division of the U.S. Department of Transportation, operating within the government and transportation industry. Its primary mission is to collect, analyze, and share data regarding the movement of people and goods across the United States (Bureau of Transportation Statistics, 2019).

The Bureau of Transportation Statistics (BTS), part of the Department of Transportation (DOT) is the preeminent source of statistics on commercial aviation, multimodal freight activity, and transportation economics, and provides context to decision-makers and the public for understanding statistics on transportation. BTS assures the credibility of its products and services through rigorous analysis, transparent data quality, and independence from political influence. BTS promotes innovative methods of data collection, analysis, visualization, and dissemination to improve operational efficiency, to examine emerging topics, and to create relevant and timely information products that foster an understanding of transportation and its transformational role in society. The Bureau’s National Transportation Library (NTL) is the permanent, publicly accessible home for research publications from throughout the transportation community; the gateway to all DOT data; and the help line for the congress, researchers, and the public for information about transportation (Bureau of Transportation Statistics, 2019).

**The Mission**

The Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation provides timely, accurate, credible information on the U.S. transportation system, the movement of people and goods, and the consequences of transportation for the economy, society, and the environment.

**The Vision**

BTS is the preeminent source of statistics on multimodal freight and passenger movement, transportation economics, and commercial aviation, and is a portal to understanding the transportation system and the system’s consequences in U.S. BTS promotes innovative methods of data collection, analysis, visualization, and dissemination to improve operational efficiency, examine emerging topics in terms of transportation, and create relevant and timely information products that foster an understanding of transportation and its transformational role in society.

The BTS provides information on the transportation industry, including:

* Commercial aviation
* Multimodal freight activity
* Transportation economics
* Freight flows
* On-time flight performance
* Noise exposure

Its geographic market is The United States, BTS does not have a market area, but it can give you the market area of other airlines. With regards to our department, The BTS has approximately 7 office directors, and approximately 50 statisticians, economists, geographers, and specialists in data science, library and information science, information technology, and transportation.  With approximately 150 employees in the Department of Aviation., serving 26 airline companies around U.S. (Bureau of Transportation Statistics, 2024).

**Structure**

**BTS is part of four communities, each with its own set of partners and stakeholders:**

* **The transportation community:** BTS serves DOT as a source of statistical expertise and of objective information on transportation (especially from the perspective of system users rather than from suppliers of modal components); and BTS serves both DOT and the broader transportation community as a repository of research, data, and institutional knowledge through the NTL and the Bureau’s activities through partners like the Transportation Research Board.
* **Federal statistical agencies:** BTS represents the transportation community on the Interagency Council on Statistical Policy, chaired by the Office of Management and Budget, and collaborates with individual federal statistical agencies such as the Census Bureau to meet the information needs of the transportation community.
* **Federal geographic data and mapping community:** BTS is the principal integrator of geographic data related to transportation and works with a variety of organizations that develop and compile geo-spatial data to establish a high-quality, comprehensive, detailed electronic map of transportation that can be used throughout government and industry.
* **The knowledge management community:** BTS works through the NTL with the Library of Congress, the National Library of Medicine, the National Agricultural Library, state DOT libraries, universities, and others to assure that transportation data, results of research relevant to transportation, and institutional memory are maintained and shared in forms that are readily accessible to the transportation community .

**Current Status of Reporting, BI, and Analytics**

Business Intelligence software is widely used throughout the federal government, both to assemble and present data, as well as to guide funding and inform strategic decisions. In most cases, business intelligence software must be able to distill massive amounts of data down to few key performance indicators (KPIs) that can be communicated to the public, to agents in the field, and to politicians charged with creating legislation. The Bureau of Transportation utilizes popular Business Intelligence (BI) tools like Microsoft Power BI, Qlik Sense, and potentially Domo to analyze and visualize transportation data, allowing them to track trends, identify patterns, and make informed decisions based on factors like traffic patterns, traffic times and wait time (Bureau of Transportation Statistics, 2024).

**Use of MS Excel:**  
 BTS uses MS excel along with other Business Intelligence (BI) tools like Microsoft Power BI, Qlik Sense, and potentially Domo to analyze and visualize transportation data, allowing them to track trends, identify patterns, and make informed decisions based on factors like traffic patterns, traffic times and wait time.

**Data Warehousing:**   
 The Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation (DOT) has a data warehouse that stores transportation data some of these are as follows: Secure Data Commons (SDC): A cloud-based environment that allows users to access transportation data and develop tools for analysis. The SDC provides researchers with access to transportation data sets. TranStats: A system that stores data in tables, with databases organized by transportation modes, subjects, and data providers. Users can search for data by selecting a mode, subject, or agency, or by typing in keywords. ITS DataHub: An open-access data portal from the USDOT ITS JPO. National Transportation Library (NTL): A public resource that provides access to DOT data, research publications, and information about transportation.

Freight Analysis Framework (FAF): A partnership between the BTS and the Federal Highway Administration that combines data from multiple sources to create a picture of freight movement. FLOW: A program that collects and aggregates information from participants, which is then anonymized and protected by the BTS.

**Integrated Information Systems:**

The Bureau of Transportation uses RITIS which is the leading big data aggregation and dissemination platform for solving challenging and complex transportation problems.

Its broad spectrum of advanced analytics – from comprehensive situational awareness to in-depth archived data evaluation – provides enhanced, multi-faceted insight of the transportation system across geographic and agency boundaries. RITIS is used nationwide by thousands of decision-makers in planning, operations, research, the military and Homeland Security for developing smart, cost-effective mobility, safety and security solutions.  
The organization employs multiple systems to manage datasets. However, these systems are not integrated, leading to data silos that restrict cross-departmental collaboration and analysis.

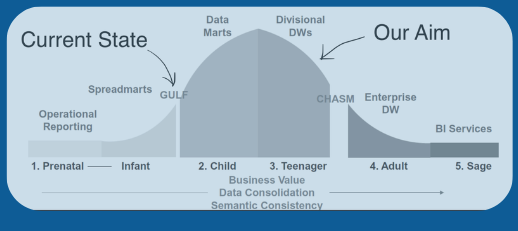
**BI Team:**  
 BTS does have a dedicated BI team. There collects and manages large amounts of transportation data which would benefit from advanced analytics capabilities to generate insights and reports for decision-making. But there is not explicit information on this.

**BI Tools and Systems:**  
 The BTS Definity uses BI tools such as TransStats, ITS DataHub, Freight Analysis Framework and FLOW to do their visualization and to get insights on the data they gather.

There is no information about in-house BI tools, but they do use data from TransStats, ITS DataHub, Freight Analytics Framework and FLOW.

**BI Maturity Level:**

We have presumed The Bureau of Transportation is in its Gulf and we would want to get it to the teenager level. While originally their actual BI models come in the adult stage.



**Summary of Case Studies**

To enhance our understanding of the airline industry, we checked similar case studies that successfully applied the BI solution.

**Case Study 1:** All Nippon Airways (ANA)

All Nippon Airways (ANA), a Japanese airline company headquartered in Minato, Tokyo, sought to leverage data insights to better understand demand patterns and respond to an ever-changing environment. The primary business problem stemmed from delayed data reporting. ANA’s previous BI solution provided booking data on a biweekly basis, which lacked real-time market insights. As a result, the company faced challenges in responding to unforeseeable events, such as weather disruptions, epidemics, and natural disasters.

ANA identified its business goal as increasing revenue by utilizing real-time data insights to understand fluctuations in sales and booking volumes. In their new BI model, they integrated big data as a powerful asset. With the implementation of new dashboards, users could visually monitor bookings across various dimensions, such as routes, airlines, and booking classes, and take timely action based on the insights. By adopting data-driven strategies, ANA not only improved inventory management but also identified opportunities for growth by extracting valuable insights from existing market information.

**Case Study 2:** American Airlines

American Airlines currently serves over 350 destinations across 50 countries on five continents. Despite its extensive operations, the airline struggled with identifying recurring issues that required attention, compounded by missed alerts and inaccurate results.

To address this, American Airlines collaborated with its Tech Operations department to develop a new BI model. This model enabled the airline to track recurring issues effectively. By implementing a unified platform, they were able to identify, manage, and validate corrective actions for repetitive problems. The new system also included enhanced filter controls, which allowed for more precise data management. Additionally, the incorporation of customized alerts and reporting features into the BI tool empowered the team to detect recurring defects that might otherwise go unnoticed by employees. Through this improved system, American Airlines enhanced its ability to address persistent operational challenges, contributing to greater efficiency and reliability in its services.

# Section 3: The Proposed BI Solutions

**Definition of Business Intelligence**

BI covers the technologies, applications, and processes for gathering, cleaning, storing, analyzing, summarizing, and visualizing data to help users make better decisions.

**The main components of a BI solution**

Main Components of a BI Solution for the Bureau of Transportation Statistics (BTS) that we have taken from the BI framework that will optimize their operations are as follows:

**1. Data Sources**

**External Data:** Information that comes from sources outside the company, including the market, customers, or the public. **Operational Data:** Information produced in-house by the activities of the company, such as databases and transaction systems.

**2. ETL (Extraction, Transformation, Loading)**

ETL is a crucial procedure that gathers unprocessed data from many sources, converts it into a format that can be used, and then loads it into a centralized storage system.

**3. Data Warehouse**

In our project, data warehousing played a pivotal role in implementing complex queries derived from various data sources over time. This approach proved particularly suitable for our client, BTS, as the organization collects data from different airline companies in varying levels of granularity. Consequently, data warehousing served as a crucial tool for retrieving historical data from diverse subjects and sources, including suppliers, vendors, and regulatory authorities. A data warehouse represents an integrated, subject-oriented, time-variant, and non-volatile collection of data that supports management’s decision-making processes.

Given the large volume of data, the integrated nature of data warehousing provided a unified view of all airline elements, ensuring a common definition and representation for all business units of airline companies. The subject-oriented aspect of the data warehouse facilitated multiple perspectives of the data. For instance, flights could be analyzed by division, region, manager, or airline company. Furthermore, data warehouses are time-variant, allowing us to include a time dimension in our data analytics. This capability enabled us to perform various time-based comparisons, which were integral to the development of our first dashboard.

Lastly, the non-volatile nature of data warehousing ensured the stability of stored data. In our case, once the data was stored (typically on a monthly basis), no changes were permitted, reinforcing the reliability and consistency of the data warehouse. This characteristic further underscored the suitability of data warehousing for our project, as it enabled efficient and accurate data analysis over time.

**4. Data Analytics**

Data analysis to produce insights. Advanced analytics methods including statistical analysis, conjoint analysis, and predictive modeling may fall under this category.

**5. Data Visualization**

The visual presentation of data in the form of charts, graphs, and dashboards, to make insights easily understandable and actionable. With the descriptive power of BI, we aim to analyze the data to tell what happened in the past and this helps BTS to understand how airline companies in U.S. are performing by providing context to help airline companies make informed decisions.

Data visualization helped us to answer what happened, when, who and it encompasses reporting (using KPIs), dashboards, scorecards, automated monitoring and alerting.

**6. Monitoring and Alerting**

Monitoring and alerting are systems that provide real-time or near real time tracking of the key metrics, with the ability to alert users.

**7. Data Governance**

Data governance involves managing the extent of access to data within an organization. In other words, it answers critical questions about who has access to specific information and at what level. In the context of our project, data governance determines which individuals—such as managers, cabin crew, employees, or administrative staff—are authorized to access particular portions of information and at what level of detail. This structured approach ensures that data is used appropriately, securely, and effectively across the organization.

In our project, given the vast volume of data, data governance plays a critical role. Specifically, we aim to ensure that the right people have access to the right data at the right time. For example, statistics should not be accessible to individuals who are not responsible for them. Instead, we propose that a successful implementation of data governance will limit access to required individuals, thereby reducing workload and improving data maintenance.

As such, our approach emphasizes that not all data needs to be accessible to everyone. Operational dashboards are designed to serve employees, while tactical dashboards are intended for airline company managers. Importantly, we recommend that airline managers be informed only through dashboards that aggregate and present insights from all airline data. This approach ensures that managers focus on tactical dashboards to understand general market trends and outcomes, facilitating informed decision-making without unnecessary data overload.

**9. People and Processes**

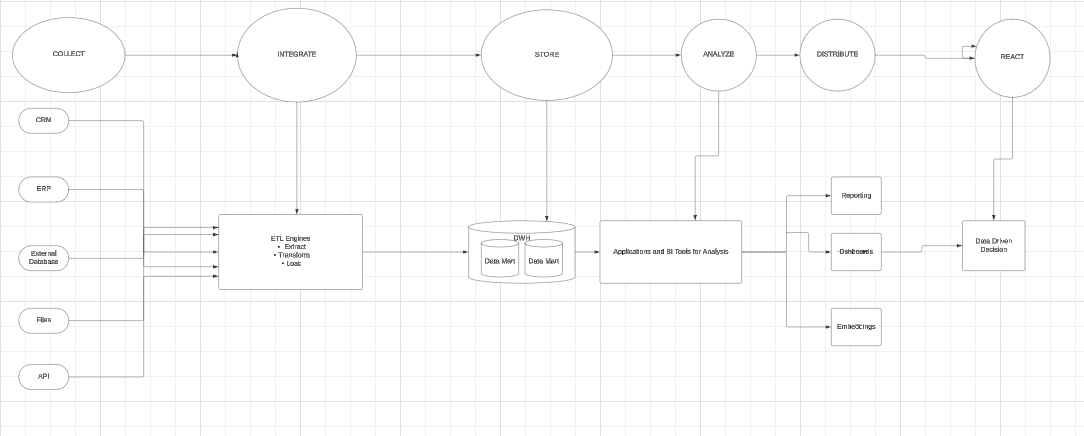
The framework emphasizes that BI solutions are not just technical systems but involve **People:** Users and stakeholders who interact with the BI system. **Processes:** Workflow and practices for using BI effectively. These components work together to enable organizations to turn raw data into actionable insights, supporting data-driven decision-making.

**Role and Value of these components.**

When we refer the role and value of the BI solution first comes the external and the operational data sources where the BI solution gathers data from external and internal resources, the value it provides is a comprehensive view of business operations by integrating data from multiple sources. Coming to the next component which is the Extraction, Transformation, and Loading (ETL) which collects processes, cleans and transforms data from various sources, then loads it into a centralized repository which is the data warehouse. There the value created is to ensure data quality and its consistency is ready for analysis. Now comes the Data Warehouse and Data Mart which serves as a centralized repository for storing structured, historical data. This is used to facilitate efficient data storage, quick querying, and supports decision-making with relevant data analysis. Query and Reporting helps the users to create queries, generate reports, and access the required information. Monitoring and Alerting helps track key performance indicators (KPIs) and give the stakeholders necessary information about the changes or anomalies. Data Analytics enhances decision-making by enabling predictive and prescriptive analytics. Data Visualization converts raw data into the visual representation which makes the data accessible to people, managers who do not have technical knowledge about the data.

**Our BI Solution for The Bureau of Transportation**

Below is the chart that we created as a proposed BI framework for the Bureau of Transportation. ( To view the chart the link is in the reference):



Our project aims to improve the Bureau of Transportation Statistics (BTS) BI framework by providing a robust, custom-designed BI solution framework to streamline data acquisition, processing, and analysis for more effective decision-making. Our solution to the Bureau of Transportation Statistics (BTS) begins with the collection of data from various sources, including CRM systems for stakeholder interactions, ERP systems for operational and transactional data, external databases for specialized transportation datasets, structured and unstructured files like CSVs and JSON, and APIs for real-time data fetching. This diverse data is then extracted, loaded, and transformed (ELT) in our centralized system, ensuring seamless integration of structured and unstructured formats. During this process, our framework performs rigorous data cleaning and enrichment to ensure accuracy, consistency, and completeness. The processed data is then transferred to a state-of-the-art data warehouse, designed by us to provide a unified repository for storing and organizing information efficiently. From the data warehouse, the data flows seamlessly into our advanced BI tools for comprehensive analysis, enabling enhanced reporting, dashboarding, and embedding capabilities tailored to the BTS’s needs. Insights generated through our framework empower BTS with predictive and preventive analytics, facilitating data-driven decisions that address critical challenges, identify trends, and support strategic initiatives. By implementing our custom BI solution framework, we aim to optimize BTS's operations, improve transportation outcomes, and enable proactive decision-making that meets their mission objectives.

# Section 4: Implementation

**Introduction to the BI System for the Bureau of Transportation Statistics**

To address complexities of modern aviation and improve the efficiency of flight operations, we’ve developed a Business Intelligence (BI) system for the Bureau of Transportation Statistics (BTS) in the U.S. This system leverages large datasets like flight delays caused by weather, overall cancellations and delays, and airline reviews to uncover actionable insights. The goal is to equip decision-makers with the tools they need to reduce disruptions and enhance passenger satisfaction.

The BI system is designed around two core dashboards: Operational Dashboard: Focused on analyzing the impact of weather on flight delays and cancellations. Tactical Dashboard: Dedicated to understanding passenger satisfaction and identifying opportunities for service improvement. Each dashboard serves a unique audience while working together to provide a comprehensive view of operational challenges and customer-centric solutions. Below, we’ll walk you through each dashboard in detail.

**Operational Dashboard Datasets**

For Operational Dashboard, our team decided to create a visualization that highlights the impact of weather on flight operations, with a specific focus on delays and cancellations. We utilized two datasets sourced from Kaggle: “Flight Delay due to Weather” and “Delay Causes.”

The “Flight Delay due to Weather” dataset focuses on flight cancellations and delays in the United States between 2019 and 2023. It provides insights into how weather conditions impact flight operations over this period. The “Delay Causes” dataset dives deeper into the specific reasons for delays, such as security issues and carrier-related problems. We used Tableau Prep to consolidate these datasets into one cohesive dataset in order to streamline the dashboard creation process. This integration allowed us to efficiently prepare the data and lay a solid foundation for developing an insightful and user-friendly dashboard.

**Operational Dashboards key performance indicators (KPIs)**

Our dashboard features Five key performance indicators (KPIs) to analyze the impact of weather on flight operations:

1. Maximum Cancellations by Airline
2. Maximum Cancellations by State
3. Maximum Flight Cancellations by Month/Year
4. Delay Reasons
5. Weather Distribution Peaks

#### **Overview:**

* Top State for Cancellations: Texas emerges as a hotspot, with 3,319 cancellations, highlighting it as a priority for mitigation strategies.
* Airline with Most Cancellations: SkyWest Airlines, with 25,593 cancellations, reveals significant operational vulnerabilities.
* Peak Cancellation Month: April 2020 recorded the highest spike in cancellations, driven by the widespread impact of COVID-19, underscoring the interconnectedness of global events and airline operations.

**Dashboard Visualizations and Insights**

The dashboard includes four visualizations designed to effectively analyze and communicate key performance indicators. A stacked area chart showcases cancellation trends by airline, allowing stakeholders to identify patterns and prioritize improvements. Airlines such as SkyWest and Southwest Airlines dominate the chart, indicating higher cancellation rates, while smaller carriers experience relatively fewer disruptions. This visualization provides a clear comparison of airline performance regarding cancellations.

A color-coded map of the United States highlights regions most affected by flight disruptions, with Texas emerging as a notable hotspot. This pattern is likely due to the state's high volume of flights combined with its susceptibility to severe weather conditions. The map provides a geographic perspective, helping to pinpoint areas requiring targeted interventions.

The dashboard also includes a bar chart that compares non-weather-related delay causes, such as air traffic control delays, maintenance problems, and carrier-specific challenges. This visualization highlights which airlines are disproportionately affected by these issues, offering insights into potential operational improvements and areas for further investigation.

Finally, a dual line graph illustrates trends in weather-related delays and cancellations over the years 2019 to 2023. The graph effectively highlights notable anomalies, such as the sharp spike in cancellations in April 2020, which is likely attributable to the COVID-19 pandemic. This surge in cancellations led to a decrease in delays as the reduced flight volume eased pressure on the system. Together, these visualizations offer a comprehensive overview of flight disruptions and provide actionable insights to enhance operational efficiency.

**Operational Dashboard: Understanding Weather-Related Flight Disruptions**

The Operational Dashboard is designed to assist the Office of Airline Information (OAI), a division within the Bureau of Transportation Statistics (BTS), in understanding the impact of weather patterns on flight operations. The OAI is responsible for analyzing airline operations and addressing key industry questions, such as:

* Which airlines experience the highest number of cancellations, and why?
* Are certain states or regions more prone to weather-related disruptions?
* How do flight cancellations vary across different months and years?
* What specific weather conditions are responsible for delays and cancellations?

#### **Key Visualizations for Deeper Analysis:**

The dashboard includes interactive filters that allow users to explore flight data by flight type (domestic or international), airline, specific time periods, and geographical regions. These features enable granular analysis and provide actionable insights, making the dashboard an invaluable tool for operational planning and decision-making.

**Tactical Dashboard: Customer Satisfaction Analysis**

For the Tactical Dashboard, our team concentrated on understanding customer satisfaction levels based on various operational factors in the airline industry. This dashboard aims to uncover key insights about passenger experiences and satisfaction to inform service improvements. Using datasets from internal and external repositories, we established visualizations dealing with satisfaction trends by class, baggage handling, age group, flight distance, and delays. This tactical approach allows airlines to enhance customer experience strategies. Our focus in the tactical dashboard was to focus on customer satisfaction as one of the reasons for choosing a particular airline.

**Datasets Used**

For this Tactical Dashboard, our team used one dataset from Kaggle focusing on customer feedback and operational metrics related to satisfaction. The data include:

1. **Customer Feedback Data:** Information on customer satisfaction levels categorized by loyalty status, class of travel (Business, Economy, and Eco Plus), and baggage handling.
2. **Flight Operations Data:** Metrics on delays, flight distances, and their impact on customer sentiment.

**Key Performance Indicators (KPIs)**

The Tactical Dashboard analyzes the following five KPIs to assess the determinants of customer satisfaction:

1. **Customer Satisfaction by Travel Class:** Evaluates satisfaction levels among Business, Economy and Eco plus passengers.
2. **Impact of Delays on Satisfaction:** Analyzes the effect of departure delays on loyal and disloyal customer satisfaction.
3. **Satisfaction by Baggage Handling:** Highlights the count of satisfied and dissatisfied customers based on their baggage handling experience.
4. **Satisfaction by Age Group and Flight Distance:** Explores satisfaction levels across different age groups and varying flight durations.
5. **Breakdown of Service Ratings:** Provides an overview of customer satisfaction across various service touchpoints, including in-flight services, legroom, and seat comfort.

**Comprehensive Overview**

The first chart shows the talk about the breakdown of service rating by satisfaction where the graph is divided into two parts. Dissatisfied and satisfied. Where the measure that we have considered are food and drink, in-flight entertainment, in-flight services, leg room services, on-board service and seat comfort. In the dissatisfaction category the most was inflight services which means people were dissatisfied most with the inflight services. The first chart gives us Class wise satisfaction where we can see that Business-class passengers have the highest satisfaction levels with 8,686 being the highest satisfaction number. While the number of satisfied passengers chose the same category in-flight service, and the total result was 45,350.

The second pie chart gives us the visualizations of the impact of delays on customer satisfaction, segmented by loyal and disloyal customers. Where 39.25% of loyal customers were satisfied despite delays. 42.28% of loyal customers are neutral or dissatisfied due to delays, showing a significant impact of delays on their satisfaction. 4.65% of disloyal customers are satisfied despite delays, indicating lower resilience to delays. 13.82% of disloyal customers are neutral or dissatisfied, representing a smaller group overall compared to loyal customers. Insights: There we can see that Loyal customers form the majority of both satisfied and dissatisfied segments, which suggests us that they are more impacted by delays compared to disloyal customers.

The third graph illustrates how baggage handling affects customer satisfaction, revealing that respondents are more unhappy than satisfied. With 11,403 satisfied customers and 14,573 unhappy ones, luggage handling stands out as a significant problem. Resolving this issue could raise customer happiness and enhance the overall customer experience. This emphasizes how crucial luggage handling is in influencing passengers' opinions. Insights: Customers are more likely to report displeasure with baggage handling than satisfaction, indicating that it has a significant impact on consumer satisfaction. Improving luggage handling procedures may result in some customers changing their ratings from "Dissatisfied" to "Satisfied," which would raise overall service scores.

Lastly the fourth chart, the "Satisfaction by Age Group and Flight Duration" chart shows how age groups, flight distance, and customer satisfaction (satisfied vs. unhappy) relate to one another. With noticeable peaks in unhappiness at specific distances, such 862 miles, it shows patterns in satisfaction levels throughout various trip lengths. Airlines can identify operational or service problems on flights of different lengths and target improvements appropriately by employing visualization tools that analyze satisfaction trends for demographics, such as age group filters.

**Key Insights of the Dashboard**

**Class-Based Satisfaction:** Business-class passengers have the highest satisfaction levels (8,686), while Economy passengers show the highest dissatisfaction (9,322).

**Loyalty and Delays:** Neutral or dissatisfied loyal customers make up 42.28% of total delay-affected passengers, whereas only 13.82% of satisfied loyal customers experience delays, emphasizing the importance of mitigating delays.

**Baggage Handling:** Dissatisfaction is highest for customers who faced baggage handling issues, with 14,973 dissatisfied compared to only 11,308 satisfied passengers.

**Age and Flight Distance Trends:** Younger passengers (18-40 age group) show higher dissatisfaction rates for shorter flights, while satisfaction levels are more evenly distributed for longer flight durations.

**Service Ratings**: Dissatisfaction levels are highest in key service areas, such as in-flight food and beverages and seat comfort, suggesting targeted improvements in these domains.

**Managerial Questions**

* How satisfied are customers across different flight classes, age groups, and travel types?
* How do delays and cancellations impact loyalty versus first-time travelers?
* What specific services, like baggage handling or in-flight entertainment, contribute to overall satisfaction levels?
* Which areas of service (e.g., in-flight food, legroom, baggage handling) have the most significant impact on customer satisfaction?

**Why This BI System Matters**

The integration of the Operational Dashboard and the Tactical Dashboard provides a comprehensive view of the challenges faced by airlines and their customers. The Operational Dashboard focuses on addressing weather-related disruptions and optimizing flight schedules, while the Tactical Dashboard enhances the overall travel experience for passengers. Together, these tools enable airlines to minimize the financial and logistical impacts of cancellations and delays, improve customer loyalty by addressing pain points, and make data-driven decisions that benefit both airlines and passengers. By transforming raw data into actionable insights, this BI system empowers stakeholders at BTS and airlines nationwide to make smarter, faster, and more impactful decisions. Ultimately, it represents a critical step toward creating a more reliable, efficient, and customer-centric aviation industry.

**Data Analysis: Conjoint Analysis**

The two use cases demonstrated that addressing business needs from a business-oriented perspective was fundamental to the successful implementation of BI systems. Instead of focusing on mass markets and impersonal transactions, we emphasized direct customer interaction, which fosters longer customer lifetime value. Rather than prioritizing the profitability of individual tickets, we analyzed the profitability of customers for each airline company we collaborated with.

While brand equity is undeniably important, we aimed to ensure that BTS achieved a significant share of customer equity. To better understand passenger decision-making regarding airline selection, we decided to conduct a customer preference analysis. Despite the availability of alternative approaches, such as "Next Best Offers," we opted for Conjoint Analysis to gain deeper insights into customer preferences.

**What is Conjoint Analysis?**

Conjoint Analysis is a market research technique used to understand how individuals make decisions based on specific features of a product or service. This method deciphers customers’ purchasing behaviors, helping predict how a product or service might perform in the market. Additionally, it provides a powerful tool to optimize the selection of attributes for a product or service. Conjoint Analysis serves two primary objectives: (1) identifying which factors are most important to customers, and (2) determining which levels of those factors are most/least preferred.

**Why did we choose to conduct Conjoint Analysis?**

Conjoint Analysis is useful for BTS because the airline business is inherently complex, involving numerous factors that influence decision-making. Airlines must navigate challenges such as creating attractive services, determining optimal pricing, scheduling flights at the right times, assigning customers to planes, managing in-flight services, and addressing weather conditions and regulatory issues. In this highly competitive environment, many managers rely on educated guesses to appeal to passengers effectively.

By using Conjoint Analysis, BTS and its partner airline companies can identify the most appealing features and set the right prices to attract more passengers. Drawing insights from existing literature, we see similar practices in the hospitality industry, where hotels and resorts adjust their facilities and service levels to cater to specific target markets, such as business travelers or luxury vacationers. Likewise, BTS can use Conjoint Analysis to predict which factors matter most to passengers, enabling airlines to target their market more effectively. Ultimately, appealing to passengers’ preferences can significantly increase their likelihood of repurchasing tickets, enhancing long-term customer loyalty.

**How did we design the conjoint analysis? (7 rules of running experiments)**

The first step in designing our Conjoint Analysis was to define its objectives. Given the complexity of the airline industry, we identified the attributes we wanted to analyze and predict. To do this, we reviewed existing literature and case studies from other airline companies to understand the factors influencing customers' booking behavior. Our research revealed that ticket flexibility is a major driver of booking habits, followed by delays and cancellations, and baggage allowance.

Since delays and cancellations were already prioritized in our dashboards, we focused on determining the levels and attributes for Conjoint Analysis. Based on our data, we finalized the attributes as **seat selection**, **ticket change flexibility**, and **baggage allowance**. The objectives of the analysis were twofold:

1. To identify which attribute is most important to passengers.
2. To determine the most and least preferred levels within each attribute.

|  |  |
| --- | --- |
| **Attribute** | **Levels** |
| Seat Selection | Window seat |
| Middle seat |
| Aisle seat |
| Ticket Change Flexibility | Non-refundable |
| Refundable with fee |
| Fully flexible with no fee |
| Baggage Allowance | Only carry-on |
| One checked bag |
| Two checked bags |

Second, we gathered data by creating a survey using Qualtrics. Passenger preferences were captured through survey questionnaires employing a 1 to 10 Likert scale, where 1 indicated "least preferred" and 10 indicated "most preferred." This project utilized non-experimental quantitative research, following a causal research methodology.

To conduct the Conjoint Analysis, we combined each attribute's levels, resulting in 18 possible combinations. Participants were asked to rate each combination based on their preferences. To ensure a sufficient number of responses, we distributed the survey to students in the MIS584 class, allowing us to reach a broader participant base.

|  |  |  |
| --- | --- | --- |
| Flight Option | Combination | Rating 1 to 10 (10=most preferred, 1=least preferred) |
| 1 |  |  |
| 2 | Non-refundable ticket on window seat with two checked bags |  |
| 3 | Non-refundable ticket on middle seat with one carry on |  |
| 4 | Non-refundable ticket on middle seat with two checked bags |  |
| 5 | Non-refundable ticket on aisle seat with one carry on |  |
| 6 | Non-refundable ticket on aisle seat with two checked bags |  |
| 7 | Refundable ticket with a fee on window seat with one carry on |  |
| 8 | Refundable ticket with a fee on window seat two checked bags |  |
| 9 | Refundable ticket with a fee on middle seat with one carry on |  |
| 10 | Refundable ticket with a fee on middle seat with two checked bags |  |
| 11 | Refundable ticket with a fee on aisle seat with one carry on |  |
| 12 | Refundable ticket with a fee on aisle seat with two checked bags |  |
| 13 | Fully flexible ticket with a fee on window seat with one carry on |  |
| 14 | Fully flexible ticket with a fee on window seat with two checked bags |  |
| 15 | Fully flexible ticket with a fee on middle seat with one carry on |  |
| 16 | Fully flexible ticket with a fee on middle seat with two checked bags |  |
| 17 | Fully flexible ticket with a fee on aisle seat with one carry on |  |
| 18 | Fully flexible ticket with a fee on aisle seat with two checked bags |  |

**Results**

We received responses from 36 participants during the one-week data gathering period and imported the raw data into an Excel file. First, we calculated the average rating for each combination and included these values in our analysis. Next, we manually coded the data using 0s and 1s for each combination to facilitate the analysis.

For ticket change flexibility, we selected **fully flexible ticket** as the baseline. For seat selection, the baseline was **aisle seat**, and for baggage allowance, it was **two checked baggage items**. Regression coefficients for these baselines were assumed to be zero.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Average Preference | Non-Refundable Ticket | Refundable Ticket with a fee | Window Seat | Middle Seat | Only one carry-on |
| 5.07 | 1 | 0 | 1 | 0 | 1 |
| 6.11 | 0 | 1 | 0 | 1 | 0 |
| 6.54 | 0 | 1 | 0 | 0 | 1 |
| 7.15 | 0 | 1 | 0 | 0 | 0 |
| 7.35 | 0 | 0 | 1 | 0 | 1 |
| 8.07 | 0 | 0 | 1 | 0 | 0 |
| 6.59 | 0 | 0 | 0 | 1 | 1 |
| 7.12 | 0 | 0 | 0 | 1 | 0 |
| 7.3 | 0 | 0 | 0 | 0 | 1 |
| 7.67 | 0 | 0 | 0 | 0 | 0 |
| 6.73 | 1 | 0 | 1 | 0 | 0 |
| 3.74 | 1 | 0 | 0 | 1 | 1 |
| 4.89 | 1 | 0 | 0 | 1 | 0 |
| 5.56 | 1 | 0 | 0 | 0 | 1 |
| 6.96 | 1 | 0 | 0 | 0 | 0 |
| 6.58 | 0 | 1 | 1 | 0 | 1 |
| 7.65 | 0 | 1 | 1 | 0 | 0 |
| 5.89 | 0 | 1 | 0 | 1 | 1 |

**Analysis**

We conducted the conjoint analysis using Excel’s analysis tools. The **R Square** and **Adjusted R Square** metrics were used to evaluate how well the regression model predicted the outcomes. An R Square value of 1 indicates a perfect fit. Our analysis yielded an R Square of 0.91, indicating that the regression line fits the data points well and the results are reliable.

The third table in our analysis showed the coefficients associated with the regression. These coefficients (weights) represent the ß values for each level of the analysis. Additionally, the table included p-values, which indicate whether a coefficient is statistically significant in predicting the output. A p-value lower than 0.05 suggests that the level is a good predictor of the rating scores for different combinations of attributes. Conversely, p-values above 0.05 indicate a lack of significance.

In our analysis, all levels had p-values smaller than 0.05, except for the window seat level. This suggests that the window seat option may not be a strong predictor of rating scores for different attribute combinations in flights.

For interpreting the coefficients, we analyzed each level. Regarding **ticket change flexibility**, if a booking is fully flexible and everything else is held equal, the rating would increase by 0.69 units. For a **refundable ticket with a fee**, the rating would increase by 1.85 units compared to a fully flexible ticket. The difference in the average rating between non-refundable tickets and fully flexible tickets is calculated as **1.85 - 0.69 = 1.16 units**. Thus, for ticket change flexibility, the least preferred attribute is a **fully flexible ticket**, while the most preferred is a **non-refundable ticket**. This result indicates that cost played a hidden role in the participants' decisions. Despite the **fully flexible ticket** offering several advantages, participants were more inclined to choose the cheaper **non-refundable ticket**. This suggests that, in the background, the higher cost of the flexible ticket influenced their choices, leading them to prefer the less expensive option. These results align with one of our objectives: predicting the level of preference for various attributes. The rest of the analysis is demonstrated below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
| Intercept | 8.144444444 | 0.23338756 | 34.8966519 | 1.9555E-13 | 7.635936635 | 8.65295225 | 7.63593663 | 8.65295225 |
| Non-Refundable Ticket | -1.858333333 | 0.23338756 | -7.9624352 | 3.9454E-06 | -2.366841143 | -1.3498255 | -2.3668411 | -1.3498255 |
| Refundable Ticket with a fee | -0.696666667 | 0.23338756 | -2.9850206 | 0.01137909 | -1.205174476 | -0.1881589 | -1.2051745 | -0.1881589 |
| Window Seat | 0.045 | 0.23338756 | 0.19281233 | 0.85033068 | -0.46350781 | 0.55350781 | -0.4635078 | 0.55350781 |
| Middle Seat | -1.14 | 0.23338756 | -4.8845791 | 0.0003756 | -1.64850781 | -0.6314922 | -1.6485078 | -0.6314922 |
| One carry-on | -0.858888889 | 0.19056014 | -4.5071801 | 0.00071763 | -1.274083777 | -0.443694 | -1.2740838 | -0.443694 |

|  |  |  |
| --- | --- | --- |
| Attribute | Least Preferred | Most Preferred |
| Ticket Change Flexibility | Fully flexible ticket | Non-refundable ticket |
| Seat Selection | Middle seat | Window seat |
| Baggage Allowance | Two checked bags | One carry-on |

To achieve our second objective—predicting which attributes matter most and least to passengers—we performed calculations to determine the relative importance of each attribute. Specifically, we subtracted the minimum coefficient from the maximum coefficient for each attribute. The results of our analysis showed that **ticket flexibility** is the most important factor for passengers, while **baggage allowance** is the least important factor.

|  |  |  |
| --- | --- | --- |
|  | **RATING** | **Percentage** |
|  | (Max-Min) |  |
| **Ticket Change Flexibility** | 1.8583 | 47.62% |
| **Seat Selection** | 1.1850 | 30.37% |
| **Baggage Allowance** | 0.8589 | 22.01% |
|  |  |  |
| **Total** | 3.9022 |  |

Based on the analysis, we predicted the new preference ratings for each combination by using the intercept and individual coefficients. For example, to calculate the new rating for a **non-refundable ticket** with a **window seat** and **one carry-on**, we performed the following calculation: **8.15 - 1.8583 + 0.045 - 0.8589 = 5.47**. This demonstrates the predictive behavior of conjoint analysis for new passengers.

|  |  |
| --- | --- |
|  | **Predicted New Customer Ratings** |
| Non-refundable ticket on window seat with one carry-on | 5.4722 |
| Refundable ticket with a fee on middle seat with two checked bags | 6.3078 |
| Refundable ticket with a fee on aisle seat with one carry-on | 6.5889 |
| Refundable ticket with a fee on aisle seat with two checked bags | 7.4478 |
| Fully flexible ticket with a fee on window seat with one carry-on | 7.3306 |
| Fully flexible ticket with a fee on window seat with two checked bags | 8.1894 |
| Fully flexible ticket with a fee on middle seat with one carry-on | 6.1456 |
| Fully flexible ticket with a fee on middle seat with two checked bags | 7.0044 |
| Fully flexible ticket with a fee on aisle seat with one carry-on | 7.2856 |
| Fully flexible ticket with a fee on aisle seat with two checked bags | 8.1444 |
| Non-refundable ticket on window seat with two checked bags | 6.3311 |
| Non-refundable ticket on middle seat with one carry-on | 4.2872 |
| Non-refundable ticket on middle seat with two checked bags | 5.1461 |
| Non-refundable ticket on aisle seat with one carry-on | 5.4272 |
| Non-refundable ticket on aisle seat with two checked bags | 6.2861 |
| Refundable ticket with a fee on window seat with one carry-on | 6.6339 |
| Refundable ticket with a fee on window seat with two checked bags | 7.4928 |
| Refundable ticket with a fee on middle seat with one carry-on | 5.4489 |

**Implications to BTS**

In essence, conjoint analysis has provided a snapshot of each passenger's decision-making process, creating a statistical model that quantifies the preferences influencing their booking behavior. The potential applications for **BTS** involve several key strategies:

Our analysis revealed that passengers value **ticket change flexibility** the most. Therefore, BTS could recommend to airline companies that they reduce the cost of fully flexible tickets, which were found to be the least preferred option. This adjustment may increase the likelihood of fully flexible tickets being purchased, ultimately boosting the profitability of the airline companies in the long term. By considering various customer segments, BTS could offer customized travel **packages** or bundles tailored to specific passenger needs. For example, business travelers, who prioritize flexibility, could be offered premium options with more flexible ticket change policies. Meanwhile**, leisure travelers** may prefer cheaper, non-refundable tickets with fewer change options. This targeted approach could not only increase the appeal of fully flexible tickets but also highlight their advantages to passengers.

**Similarly, BTS could adjust the pricing for seat selection, offering higher prices for preferred seating options (such as window or aisle seats) based on demand. This strategy would help maximize revenue by aligning pricing with passenger preferences and attracting new passengers.**

# Section 5: Implementation

The ultimate goal of our project is to implement a BI solution at the BTS. However, it is important to note that the extent of the benefits from this solution will differ across various airline companies, as BTS serves as a hub for multiple carriers, each with its own unique dimensions and Key Performance Indicators (KPIs). Despite these differences, the value of the BI solution can be significant when the vision and direction are driven by BTS itself, serving as a central reference point for airline business strategies.  
 Each year, BTS can provide all airline carriers with concise, three-page reports, mainly visual data analytics. Currently, BTS publishes an **air travel consumer report** on its website every month, which contains a vast amount of information. However, these reports are overwhelming for airline managers, as they are long and filled with too much detail. This often creates an extra burden for managers who need to read, understand, and implement the information.

To address this challenge, **BTS can introduce shorter, user-friendly dashboards**. Instead of reading through lengthy reports, airline managers can access **interactive dashboards** that present key data in a digestible format, allowing them to focus on the most relevant information. By doing so, BTS can save airline companies time and resources while ensuring that crucial data is easily accessible. Managers would only need to refer to these dashboards once a year, instead of having to sift through extensive tables or manually filter data.

**Managerial Implications**

Data warehouses hold immense potential to drive transformative changes in organizational structures and operational processes. However, in the case of the **Bureau of Transportation Statistics (BTS)**, defining and measuring the benefits of such an implementation poses a unique challenge (Watson et al., 2001). Our analysis indicates that the benefits realized by each airline company are closely tied to their alignment with the proposed **Business Intelligence (BI)** framework.

To better view the BI implementation from the business perspective, Kotter’s eight steps to transform the organization plays a crucial role. Within Kotter’s eight steps, users are able to communicate quite clearly why the warehouse and BI is in place and how it supports airline companies’ general needs for data acquisition (Watson et al., 2001).

|  |  |
| --- | --- |
| Step | Action |
| Create a Sense of Urgency | Fragmentation of booking data from different airline companies around U.S. |
| Form a Guiding Coalition | Present the new BI technology to different airline companies' managers (across U.S.) to receive their support, hire BI analyst to help analyze the data for each of the airline companies |
| Create a Vision | Over the next two years, the company aims to inform employees, managers, staff, and passengers about delay reasons and passenger satisfaction while making informed decisions to minimize passenger loss from unexpected cancellations |
| Communicate the Vision | The goals can be communicated with all employees (in different departments) in terms of feasibility and applicability |
| Remove the Obstacles | Focus on obstacles that presented by each airline company which belong to different states, and associated time zones |
| Create Short-Term Wins | Give discounts or benefits to loyal customers to improve customer retention in regardless of their states |
| Build on the Change | Use predictive models/ BI tools to detect which customer is likely to prefer factors affecting their booking decision such as baggage allowance, ticket flexibility or seat selection |
| Embed the Change into Culture | Make every airline company part of all processes, automate the systems that make them the culture. Predictive BI tools should be airline company’s culture |

**Technical Implications**

To assess and maximize the quality of its statistics, BTS adopts the Framework for Data Quality published by the Federal Committee on Statistical Policy (FCSM). The FCSM Data Quality Framework provides a common foundation upon which federal agencies can make decisions about the management of data products throughout their lifecycle by identifying and mitigating key data quality threats, evaluating trade-offs among different quality dimensions where necessary, applying accepted methods at an appropriate level of rigor, and accounting for and reporting on the quality of data products and outputs. The framework identifies three domains of data quality:

1. The first domain is utility which refers to the usefulness of the data to the intended users’ needs. It involves relevance, accessibility, timeliness and granularity.

2. The second is objectivity which refers to whether the data are accurate, reliable, and unbiased and presented in a clear, unbiased, and accurate way.

3. The third is integrity. Integrity refers to protection of information from manipulation or unauthorized access and keeping to rigorous scientific standards. Integrity assesses scientific integrity, credibility and computer and physical security.

**Ethical implications**

Privacy is highly context-dependent, and the **Bureau of Transportation Statistics (BTS)** must address potential privacy issues to ensure passenger rights are protected. A review of BTS’s **Confidentiality Policy**, as stated on their website, highlights several measures in place to safeguard data privacy (Bureau of Transportation Statistics, 2024):

* **Confidentiality Reviews**: The **BTS Disclosure Board** reviews all confidential information before public dissemination to ensure data confidentiality is preserved.
* **Microdata Sharing**: BTS occasionally releases microdata, such as individuals’ responses, after removing unique identifiers. However, this occurs only with respondent consent and under a written agreement signed by the BTS Director. Recipients of confidential information are bound by strict confidentiality pledges, and violations are subject to penalties.
* **Use of Data**: The website emphasizes that BTS collects and uses information solely for statistical purposes.

While these policies demonstrate a commitment to privacy, we recommend further actions to strengthen ethical practices:

* **Third-Party Data Sharing**: Case studies in the airline industry reveal that personal information is often shared with travel-related companies such as hotels or transportation services (e.g., Uber). However, BTS must adhere to the **Confidential Information Protection and Statistical Efficiency Act (CIPSEA)** to avoid sharing passenger data with **third-party international organizations** (**Art.44**), especially if customers are from regions like Europe, which have stricter regulations.
* **Compliance with U.S. Privacy Laws**: According to the **California Consumer Privacy Act (CCPA)**, there should be strict limits on the use of personal information. BTS’s current policy, which permits data sharing for statistical purposes, could potentially conflict with such regulations.
* Passengers who connect their devices to airplane Wi-Fi and do not wish to share their data should have their information erased upon request. This aligns with the **Right to Erasure (Art.17)** of the **General Data Protection Regulation (GDPR)**, which mandates the right for individuals to request the deletion of their personal data

Moreover, BTS has strong penalties in place for breaches of confidentiality. According to their website, employees, contractors, and agents who knowingly disclose confidential information face felony charges, including up to five years in prison and/or a $250,000 fine. While these measures are commendable, stricter oversight and enforcement mechanisms could further enhance data protection. By strengthening privacy policies and adhering to international and domestic regulations, BTS can maintain the highest ethical standards while safeguarding passenger trust.

# Section 6: Summary and Conclusion

In this course project, we implemented a business intelligence framework for our client company, the Bureau of Transportation Statistics (BTS). BTS is a government office that compiles, analyzes, and publishes information on the nation’s transportation systems across various modes. Our project specifically focused on airline information managed by BTS’ Office of Airline Information, which publishes regular reports on airline performance in the United States.

The primary business problem identified was the fragmentation of data at BTS. Since BTS serves multiple airline companies across the U.S., data transmission patterns are inconsistent, particularly considering the variety of booking behaviors in the airline industry. This fragmentation creates challenges in consolidating and analyzing data effectively. To deepen our understanding of potential solutions, we reviewed case studies from All Nippon Airways and American Airlines, which provided valuable insights into addressing similar challenges using business intelligence tools.

Using datasets obtained from Kaggle, we defined key performance indicators to measure airline performance over time. These indicators were then used to develop two dashboards. The first dashboard focuses on flight delay information, emphasizing operational insights based on real-time data. The second dashboard highlights passenger satisfaction data, summarizing the factors that contribute to satisfaction or dissatisfaction with airline services. To further validate our findings, we conducted a conjoint analysis to identify which factors passengers consider most and least important when making booking decisions.

The power of business intelligence allows BTS to provide all airline companies with more digestible data analytics, enabling them to institutionalize changes that lead to organizational success. Through this project, we demonstrated how data-driven solutions can address fragmented data systems-from diverse airline companies- and improve decision-making processes in the airline industry at United States.

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# Acknowledgment

We, team 2, Project title: The Bureau of Transportation, would like to express our heartfelt gratitude to Professor Nima Kordzadeh for providing us with this incredible opportunity to work on this project. The journey has been immensely enriching, allowing us to deepen our understanding of Business Intelligence concepts and their real-world applications.

Throughout this project, we gained valuable insights into data-driven decision-making, the design and implementation of BI solutions, and the critical role of data analytics in modern organizations. The experience has not only enhanced our technical knowledge but also improved our teamwork and problem-solving skills.

Once again, we sincerely thank Professor Nima Kordzadeh for his guidance, encouragement, and the chance to apply our learning to such a meaningful endeavor. It has been an invaluable learning experience, and we are truly grateful for his support.