Final Integrated for Draig Airlines

ISQA 4100 – 850 Information Systems Architecture & Organization

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Introduction to the IT Architecture Effort

Developing robust IT architecture is a cornerstone for achieving an organization's operational and strategic objectives. For Draig Airlines, this initiative aims to design a secure, scalable, and efficient framework that supports growth while enhancing customer satisfaction and operational performance. By implementing cohesive IT architecture, Draig can streamline processes, improve decision-making, and lay the groundwork for future innovations, ensuring a competitive edge in the dynamic airline industry.

An essential aspect of this effort involves integrating currently stand-alone systems into a unified architecture. These disparate systems, while functional on their own, create inefficiencies and silos that hinder the flow of information and limit operational cohesion. Draig Airlines can enable seamless communication across departments, improve overall efficiency, and reduce redundancies by consolidating these systems into an integrated framework.

Specific Objectives for Draig Airlines

Operational Efficiency

A key purpose of this effort is maximizing performance through distributed systems. This integration will allow communication and synchronization between multiple functions to decrease latency and enable smarter decisions. By implementing workflow improvements and integrating data across various divisions, Draig Airlines will enhance its business reliability and performance, ensuring long-term viability.

Customer Experience

One significant area of concern is customer experience. The design will incorporate advanced features like instant booking, personalized alerts, and customized services. Such capabilities will give customers a seamless online experience that addresses changing demands and encourages brand loyalty. By focusing on the customer at the forefront of its digital transformation, Draig Airlines will have a platform that can compete in the arena of superior service.

Scalability and Security

Assimilation and security are also key areas of this IT architecture initiative. Using cloud-based hybrid systems will help ensure the infrastructure can sustain increased demands as the airline scales. In addition, secure data will be stored, and industry regulations will be enforced to protect the company's reputation and the customers' trust.

Intended Outcomes and Benefits

The intended outcomes of this IT architecture creation process are diverse. Achieving operational agility and delivering better decision-making will help drive organizational efficiency. Customers will enjoy a better, more personalized experience, increasing customer satisfaction and retention. Further, architecture will provide long-term cost savings and revenue opportunities by enabling creative, technology-driven solutions. Integrating the previously stand-alone systems will be critical in eliminating inefficiencies, enhancing collaboration, and ensuring that all business functions work cohesively. These results will mean Draig Airlines can thrive in a fiercely competitive global marketplace.

Information Technology Strategy

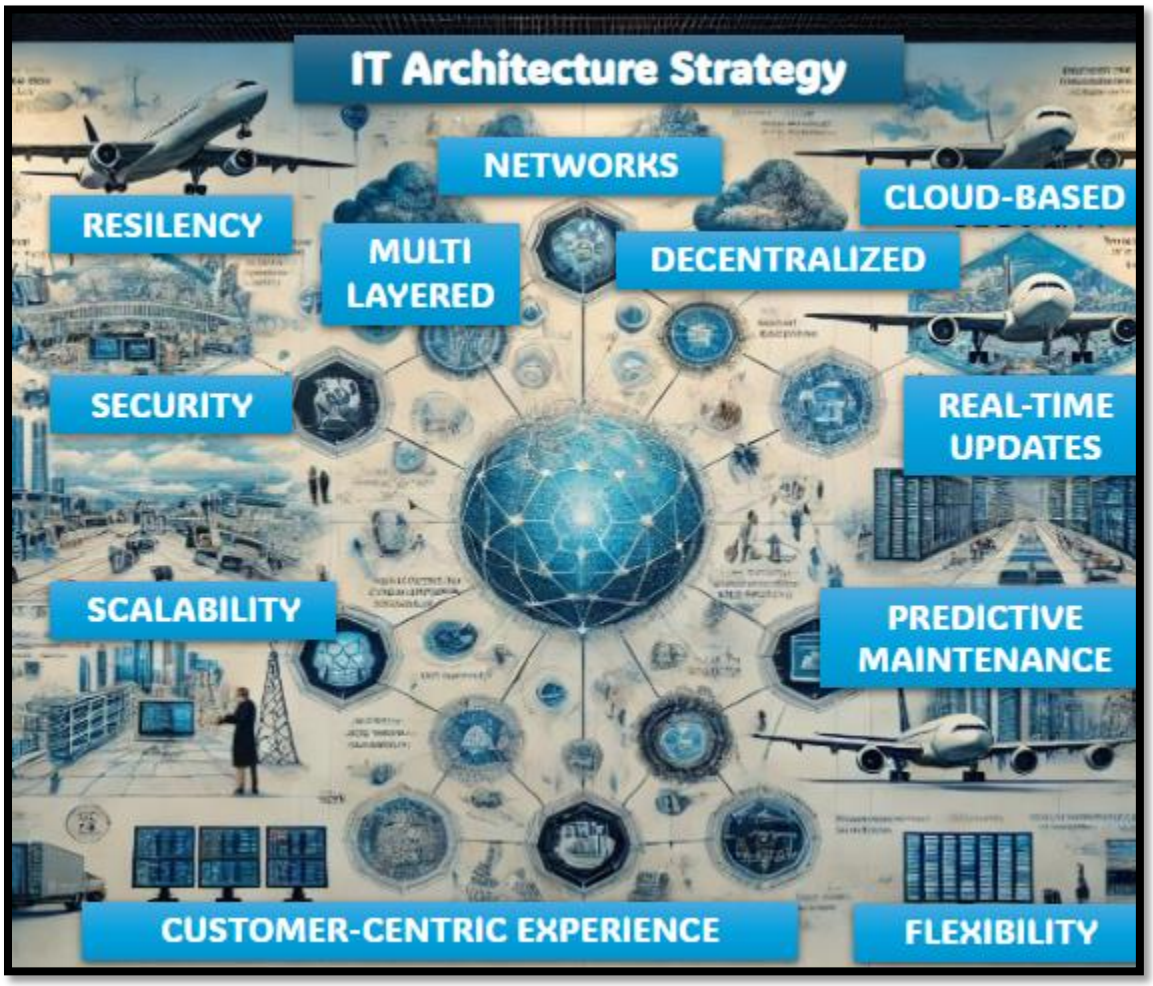

Image: AI-generated via Pilot, text added by Daun Kim, 09/10/2024

Vision

The vision is to create a secure, scalable, integrated IT architecture that facilitates operational efficiency, customer experience, and sustainable growth, leveraging continuous innovation in Draig Airlines. We seek to promote the interaction with internal and external stakeholders such as customers, partners, and regulatory bodies by unifying business processes emanating from geographically disparate locations and supporting front-line and back-office operations.

Strategy to Achieve the Vision

Organizational and Technical Goals

Organizational Goals

Improve Operational Efficiency

The aim is to streamline flight scheduling, ticket booking, and baggage handling processes. The document covers integrating cloud-based platforms, microservices, and API integration to enhance real-time data management and operational processes.

Enhance Customer Experience

The objective is to improve customer interactions through technology, which includes real-time updates, automated notifications, and personalized services. As described in the document, AI and automation significantly optimize customer service and provide a better overall experience.

Support Growth and Innovation

The strategy focused on leveraging technology to support growth, such as integrating advanced features like AI-driven chatbots and personalized marketing. This goal ties into the document's mention of using predictive analytics and machine learning to optimize operations and create competitive advantages.

Technical Goals

Scalability and Reliability

Outline the use of cloud computing and microservices to ensure systems can scale based on demand, which aligns with the intention of achieving reliable and scalable IT architecture.

Integration of Systems and Data

Discussion of API integration supports the goal of integrating data systems across touchpoints. API integration enables different systems and applications to work together seamlessly, ensuring data flows smoothly between customer service, booking, and maintenance functions.

Security and Compliance

Discuss cybersecurity's importance and integration with regulatory bodies like the FAA and TSA. Ensuring secure transactions and compliance with regulations is crucial for the IT architecture.

Constituencies Served

Internal Users

Airline Staff

Operational Efficiency: Cloud-based platforms using AWS integrated with microservices give access to real-time data and seamless communication across these departments. This reduces the creation of delay times while enhancing decision-making processes.

Smoothened communication: AI and other automation tools facilitate communication between various locations and services using Smart Gating and Amazon SageMake. This ensures that the workers can handle operations without problems, as narrated in this document, which emphasizes AI and automation for smoothening operations.

Improved Maintenance: Inbuilt processes with aircraft manufacturers for MRO services facilitate timely aircraft maintenance, reduce aircraft downtime, and improve safety. Engaging after-sales services to maintain operational efficiency.

External Users

Customers

Improved Customer Experience: AI in real-time updates, automated notifications, and personalized services contributes to better customer experiences. This is one of the major organizational objectives, and customer experiences using technology are highly regarded.

Efficient Service Delivery: Cloud integration ensures customer requests are processed instantly, thus improving the booking process, flight scheduling, and baggage handling. This, therefore, goes well with the strategy in the document on operational efficiency and enhancing customer interaction.

Seamless Interaction: The API integrations ensure real-time information on flight schedules, prices, and seat availability that is available to the customer for enhanced interaction with the airline. This focus on API integration ensures the real-time data flow amongst the stakeholders.

Third-party service providers include baggage handling, security, and hospitality

Better Integration and Coordination: APIs will let providers access real-time data for seamless coordination with Draig Airlines. They will also allow communication between internal and external systems.

Automated Processes: Automate inventory management and operational suppliers' order placement to deliver timely service with minimum manual errors; focus on integrating operations through technology.

Regulatory Bodies (FAA, TSA, DOT, NTSB)

Compliance and Reporting: Immediate integrations into regulatory systems ensure compliance, timely report submissions, and quick access to updates, which are well captured in the document for secure connections with regulatory bodies.

Improvement in Safety and Security: The security related to the data exchange with the FAA, TSA, etc., for immediately monitoring and assisting with security questions provides the exact intent of the document for integrating security measures.

Benefits for Various Stakeholders

Internal Users (Staff): It grants them earlier access to accurate information, alleviates bottlenecks in operations, and eases the workflow towards a more efficient working environment—the focus on operational efficiency and reliability of communication.

External Users (Customers and Partners): Improved service quality, real-time information availability, and smooth integration with the airline's systems will guarantee customers and partners a far better experience, generating greater loyalty and satisfaction. Enhancing the customer experience and, finally, fostering external collaborations.

Integration of Business Processes

Draig Airlines operates in geographically distributed locations across the country. This makes it difficult to keep operations running smoothly, share real time information, and provide consistent service quality across all locations. Integration of business process through technologies can address these challenges.

Cloud-based platform

The problem is the potential for poor communication between Draig Airlines' locations that can result in inconsistent service and delays in making decisions.

Integrating AWS cloud technology can address Draig Airlines' communication challenges by providing a centralized platform. AWS enables real-time data handling that allows for customer requests through the mobile app, website, or in person to be processed instantly improving customer experience (Dimitrova, 2022). The system also allows real-time monitoring of flight schedules, baggage handling, and ticketing processes. This can help all locations and staff to access the same real-time information. This will provide consistent communication that will result in staff retrieving the correct information faster and quick decision making that will reduce delay times. Draig Airlines will have the trusted security, regulatory requirements, and reliability that AWS provides (Dimitrova, 2022).

Microservice

The problem is in a geographically distributed environment having independent systems can create communication gaps between different services of the operation. This can result in information not flowing smoothly between departments and slowing down decision making.

Integrating AWS's microservice architecture can improve Draig Airlines' communication breakdowns between locations. systems, and staff. Breaking down specific services such as flight scheduling, baggage tracking, and customer relationship management into microservices can help in operating each service smoothly and communicate efficiently. This approach allows Draig Airlines with the ability to scale individual services up or down based on demand without disrupting the entire system (AWS, 2019). Also, allows real-time data to flow between different departments and locations allowing them to have communication between staff and systems. Additionally, this approach is cost efficiency that allows Draig Airlines to only pay for the resources used. The fault-tolerance of microservices ensures that if one service has an issue, it does not bring down the entire system (AWS, 2019). This will give the system operational resilience and communication reliability throughout the system.

Artificial Intelligence & Automation

The problem is that Draig Airlines needs a way to streamline communication across all locations to reduce inefficiencies in operations and improve customer services.

AI and automation can help Draig Airlines address communication challenges by predicting and flagging issues before they escalate and communicate them to staff. This can be done by implementing technologies such as Smart Gating, HEAT, or Amazon SageMake to streamline operations and bridge communication gaps between staff and systems (American Airlines Newsroom, n.d.). Using AI to analyze real time flight data enables Draig Airlines to optimize maintenance schedules, staff assignments, and fight routes. It also allows communication between customers and Draig Airlines through automation to reduce human error and provide a favorable customer experience.

API Integration

The problem is that Draig Airlines' operations are spread across different locations, and this leads to information being isolated in separate systems. This makes it hard for departments to communicate efficiently.

Employing APIs in Draig Airlines IT architecture can address communication challenges by integrating different systems and applications across departments, partners, and suppliers. APIs are a bridge that enables internal and external communication and allows sharing of real-time data between stakeholders (TheStartupFounder.com, 2023). This real-

time data flow allows Draig Airlines to make informed business decisions. APIs also allow developers to access and integrate real-time flight data into applications. This allows staff, partners, suppliers, and even customers to have real-time information that enables Draig Airlines IT architecture to have consistent collaboration and communication, be flexibility and responsive (TheStartupFounder.com, 2023).

Connections to External Organizations

Federal Aviation Administration (FAA)

Draig Airlines would connect to FAA systems for real-time updates on regulations, airspace information, and flight plan filings (FAA Flight Planning Information | Federal Aviation Administration, 2022).

Transportation Security Administration (TSA)

Draig Airlines will integrate with TSA systems to share passenger data that allows for faster passenger screening (Dhs-Tsa, 2023). Driag Airlines will be able to get notifications on threats or unusual passenger.

Department of Transportation (DOT)

Draig Airlines will connect to DOT to provide the necessary reporting such as customer complaints (File a Consumer Complaint | US Department of Transportation, n.d.). Also, will allow Draig Airlines to stay current with any regulation changes.

National Transportation Safety Board (NTSB)

Draig Airlines will connect to NTSB to provide the necessary incident reports with flight data (Report an Aircraft Accident to the NTSB, n.d.). Stay up to date with being compliant and being proactive on safety.

Airport System

Driag Airlines will be connecting to airport system to access and share data that will affect the operations of Draig Airlines such as gate schedule and baggage handling.

Air Traffic Control

Driag Airlines will be connecting to air traffic controller. This will provide Draig Airlines with real-time instructions and advisories from the air traffic controller. As well as the pilot to be able to communicate with air traffic controller. They can also get real-time data that allows Draig Airlines to make decisions on flight schedules, routes, and staffing.

Weather Services

Driag Airlines will be connecting to weather services. This is the best way to get real-time and forecasted weather across the country. This will allow Draig Airlines to make decisions on flight schedules, routes, and staffing.

Aircraft Manufactures

Draig Airlines will connect to their aircraft supplier health management system. This will allow the monitoring of the aircraft's health and status, including software updates. This will allow for the automation of reporting issues and maintenance (Boeing AHM - Airplane Health Management - Boeing Services, n.d.). Connecting to aircraft suppliers can provide Draig Airlines with some analytic solutions for reducing fuel consumption, costs, and emissions.

After-sales services, maintenance, repair, and overhaul (MRO)

Draig Airlines will connect to after-sales services providers by managing inspections, parts inventory, placing orders, tracking shipments, and making payments (MAA_Nick, 2022). This allows Draig Airlines to prevent maintenance issues and delays and keep the aircraft in the air.

Ticket Sellers

Draig Airlines will connect to ticket sellers. This will expand their market reach to multiple ticket selling platforms such as online travel agencies or global distribution systems such as Amadeus and Sabre (Altexsoft, 2019). Draig Airlines can monitor the sales of the flight tickets and ticket sellers can have real-time pricing and seat availability.

Financial Services

Draig Airlines will connect to banks. This will allow the monitoring of their financials and activities.

Operational Suppliers

Draig Airlines will connect to their fuel providers. This will provide Draig Airlines with the ability of automation to schedule, order, and pay for fuel. Also allows Draig Airlines to have real-time data on the fuel pricing that can provide Draig Airlines with the ability to change fuel procurement strategy.

Draig Airlines will connect to their caterer providers. This will provide Draig Airlines with the ability to customize their menu for each location and customer dietary and allergy needs. This will also provide Draig Airlines with the ability to automate inventory, order, delivery, and pay for the meals.

Draig Airlines will connect to consumables and office supplies suppliers. This will reduce costs by having up-to-date prices on supplies and having a just in time strategy. Draig Airlines will be able to order, track shipments, and make payments.

Draig Airlines will connect with external organizations through APIs that are secure to exchange data.

Growth Path of the IT Architecture

Draig Airlines adopted the administrative systems of the airlines they brought up even though these systems are outdated and inefficient, they provide basic functions for operations and managing the airline. The investors have made it a priority to replace these old stovepipe-style systems with modern information technology architecture with an emphasis on integration, communication, and efficiency.

These changes will be made in phases and stages while still maintaining the functionality of the airlines, like the architecture of a building, “one room at a time”. This will help with change management and retain the operationality of the airline while change is ongoing.

Phase 1

Foundational Capabilities: The initial phase focus is on establishing core functionalities that are essential for the airline's operations. An enhanced ticketing and booking system is very important as it lays the foundation for customer interaction and revenue generation. Features like online booking, dynamic pricing, real-time flight scheduling, and seat/meal management are essential to improve customer experience and operational efficiency (Daft et al., 2021). Having a functional and secured payment gateway to provide transaction options and a fraud detection system is important in maintaining customer and regulation compliance with financial regulations as well as data infrastructure setups such as centralized databases and data pipelines to ensure data integrity. This will also serve as a groundwork for future analytics and machine learning initiatives (Li et al., 2018)

Phase 2

Operational Enhancements: Once the foundational capability is established, attention should be shifted to enhancing operational efficiency, such as the human resource management system that takes care of payroll, shift scheduling, employee onboarding, and ensuring labor regulations are maintained. Furthermore, having an asset management and maintenance system is crucial to reducing aircraft downtime and ensuring safety (Li et al., 2018). Integration of advanced predictive analytics and reporting tools allows for data-driven decision-making that will improve operations like predicting demand and analyzing customer behavior. Developing a mobile app enhances convenience, and accessibility, increasing customer engagement and satisfaction (Daft et al., 2021).

Phase 3

Competitive Advantages: In this phase, the focus is on creating competitive advantages through innovative features such as integrating artificial intelligence and machine learning like chatbots and personalized marketing strategies, improving customer experience while predictive analytics can optimize pricing and seat allocation (Fatyanosa & Aritsugi, 2021). Improving personalizing rewards and loyalty programs, even with partners, can differentiate Draig Airlines from competitors. According to Andreev et al. (2023), this type of innovative element in an organization fosters long-term customer relationships (Andreev et al., 2023). Also, customer feedback and sentiments, inflight services, and entertainment systems with personalized options and connectivity should not be overlooked as decision-making based on real-time customer feedback could help improve customer satisfaction and retention (Jain, 2023; Huang et al., 2019). This can also be a key differentiator in the competitive airline industry.

Technologies to Adopt

Phase 1: Foundational Capabilities

At the foundational stage, the goal is to establish a robust infrastructure to support core functionalities like booking, ticketing, and payment systems. The technologies adopted should enable reliable and secure operations, laying the groundwork for future enhancements

Cloud Platforms

Cloud computing platforms like AWS, Microsoft Azure, or Google Cloud provide Draig Airlines with a flexible and scalable infrastructure. This technology allows the airline to adjust its resources based on demand, particularly during peak travel seasons, without incurring significant upfront hardware costs. The advantages of cloud computing include high availability, disaster recovery capabilities, and the ability to scale operations seamlessly, which are essential for maintaining service continuity and customer satisfaction during high-demand periods (Saydam et al., 2022).

An API-first architecture

This enables Draig Airlines to integrate easily with third-party services, including global distribution systems (GDS), payment providers, and loyalty partners. This approach fosters agility in adopting new services and facilitates faster integration with partners, which can significantly enhance the airline's go-to-market strategies for new business initiatives. By exposing services to external parties (Tyan et al., 2021). Draig Airlines can innovate more rapidly and respond to market changes effectively.

Phase 2: Operational Enhancements

Once foundational capabilities are in place, the airline can shift its focus to operational efficiency. The technology should now support more advanced functions such as predictive analytics, human resource management, and mobile customer engagement.

Artificial intelligence (AI) and machine learning (ML)

Technologies can be leveraged for various applications, such as predicting customer preferences, optimizing pricing strategies, and forecasting flight delays. The implementation of AI-driven chatbots for customer service can enhance customer satisfaction by providing immediate assistance and personalized offers. Furthermore, predictive analytics can improve operational efficiency by optimizing resource planning, such as staffing and aircraft maintenance, thereby reducing operational costs (Hengxuan et al., 2020).

A Customer Data Platform (CDP) and Big Data

Enables Draig Airlines to collect and unify customer data from multiple sources, providing a comprehensive view of customer interactions. Utilizing big data technologies such as Hadoop and Apache Spark allows for the analysis of vast amounts of data in real-time. This capability allows for the personalization of marketing efforts and customer service, driving customer satisfaction and loyalty. By tailoring offers and services to individual preferences, the airline can enhance the overall customer experience and foster long-term relationships (Zineb et al., 2021)

Phase 3: Competitive Advantages

At this phase, Draig Airlines will leverage cutting-edge technologies to create competitive advantages and differentiate itself from rivals. The focus should be on enhancing customer experience and operational flexibility through innovation and data-driven insights.

Cybersecurity and Blockchain

Technology offers a secure and transparent method for managing ticket transactions and loyalty programs. By creating immutable records of transactions, in an era where data breaches are increasingly common, robust cybersecurity measures are critical for protecting customer data and ensuring secure transactions. Additionally, blockchain can facilitate innovative loyalty programs that allow customers to redeem tokenized loyalty points across a network of partners, further differentiating the airline in a competitive market (Kafy et al., 2022; Belgaum et al., 2021). Draig Airlines can enhance the security and transparency of its operations, which is particularly important in the airline industry, where customer trust is paramount.

Advanced AI and Machine Learning for Personalization

As the airline enters the competitive advantage phase, AI and ML should be utilized to implement highly personalized customer experiences. This includes integrating AI-driven personalized marketing, optimizing pricing models, and using predictive analytics to enhance in-flight services and entertainment. By leveraging customer feedback in real-time, AI can help Draig Airlines tailor services that enhance customer satisfaction and loyalty.

Expertise Required

Enterprise Architects

Research has shown that enterprise architects play a crucial role in the design and integration of IT systems across organizations, ensuring alignment with business goals and future scalability (Simon, 2016).

Data Engineers

With the growth of big data technologies, data engineers are essential in managing and processing large datasets, especially in real-time environments (Jagadish, 2020). Their expertise ensures data pipelines are efficient and scalable.

Cybersecurity Experts

Given the aviation industry's reliance on sensitive customer information, the role of cybersecurity experts is paramount. They ensure the protection of critical data and compliance with regulations like GDPR (Gade & Reddy, 2021).

Cloud Infrastructure Specialists

The scalability and security of cloud systems are key to maintaining operational efficiency in large organizations. Studies have highlighted the need for skilled cloud specialists to manage infrastructure in highly regulated industries (Tariq et al., 2020).

AI/ML Experts

Machine learning and artificial intelligence are increasingly being used to optimize operational processes and decision-making. Predictive models can help organizations better manage resources and anticipate customer needs (Goodfellow et al., 2016).

Application Developers

Essential for building and maintaining Draig’s software applications, ensuring that all systems are optimized for both internal users and external stakeholders. (Smith & White, 2020)

Big-Picture IT Strategy

Draig's IT strategy focuses on driving sustainable growth through operational efficiency, scalability, and security while embracing innovation as a catalyst for long-term success. By adopting cutting-edge technologies like AI, cloud computing, and big data analytics, Draig will ensure continuous improvement in customer service, resource management, and operational processes. Innovation will be strategically integrated to create new opportunities, improve competitiveness, and maintain flexibility in a rapidly evolving industry, without compromising the airline's commitment to sustainable, steady growth.

The guiding principles will be:

Agility

The concept of agile methodologies in IT strategies has been well-documented, allowing businesses to rapidly adapt to new technologies and market changes. Agile processes lead to improved efficiency and better alignment with business objectives (Highsmith, 2010).

Scalability

Scalable IT systems allow companies to handle growing data volumes and user demands without a decrease in performance. Scalable architecture is key to sustaining business growth (Kumar, 2019).

Security

Security is critical, especially in industries dealing with sensitive data. Compliance with industry standards, such as ISO 27001, ensures that IT systems are secure and trusted (Wang & Lu, 2019).

Integration

Seamless integration of internal and external systems is vital for organizations aiming to streamline operations and enhance collaboration with partners. Research emphasizes the importance of interoperability and system integration to enable smooth information flow (Boehm, 2017).

Measurable Success Metrics

Operational Efficiency

The reduction of system downtime and improved operational efficiency have been shown to increase business productivity. Organizations that focus on optimizing IT systems experience fewer delays and smoother operations (McAfee, 2018).

Customer Satisfaction

Higher customer satisfaction can be measured through improved net promoter scores and reduced complaints. IT systems that prioritize user experience lead to increased customer loyalty (Klaus & Nguyen, 2013).

Revenue Growth

Research supports the idea that companies leveraging IT to enhance customer experiences tend to see significant revenue growth, especially when these systems optimize the booking and transaction processes (Grewal et al., 2020).

Innovation Index

Companies that introduce new technologies and services often gain a competitive edge. Innovation-driven IT strategies are closely linked to better business outcomes and market leadership (Christensen, 2016).

By following this strategic approach, Draig can build an IT architecture that meets current needs and positions the company for future growth and innovation.

Technical Architecture Strategy

Introduction

The IT architecture for Draig Airlines is designed to align with the company's goals of improving operational efficiency, enhancing customer satisfaction, and supporting future growth. The key strategies that drive this architecture are **scalability**, **security**, **integration**, and **innovation**. The architecture focuses on integrating distributed operations, automating back-office tasks, and leveraging emerging technologies to enhance both customer-facing and internal processes.

Assumptions

- Draig Airlines operates in a distributed environment with locations across the country, requiring a centralized data platform to unify operations.
- The architecture must accommodate future growth, both in terms of increased customer base and service expansion, by being flexible and scalable.
- Security and compliance with industry regulations are critical, given the sensitive nature of customer data and the operational risks in the airline industry.

Network Diagram

Below is a high-level representation of the proposed IT architecture, including integrating key functional areas.

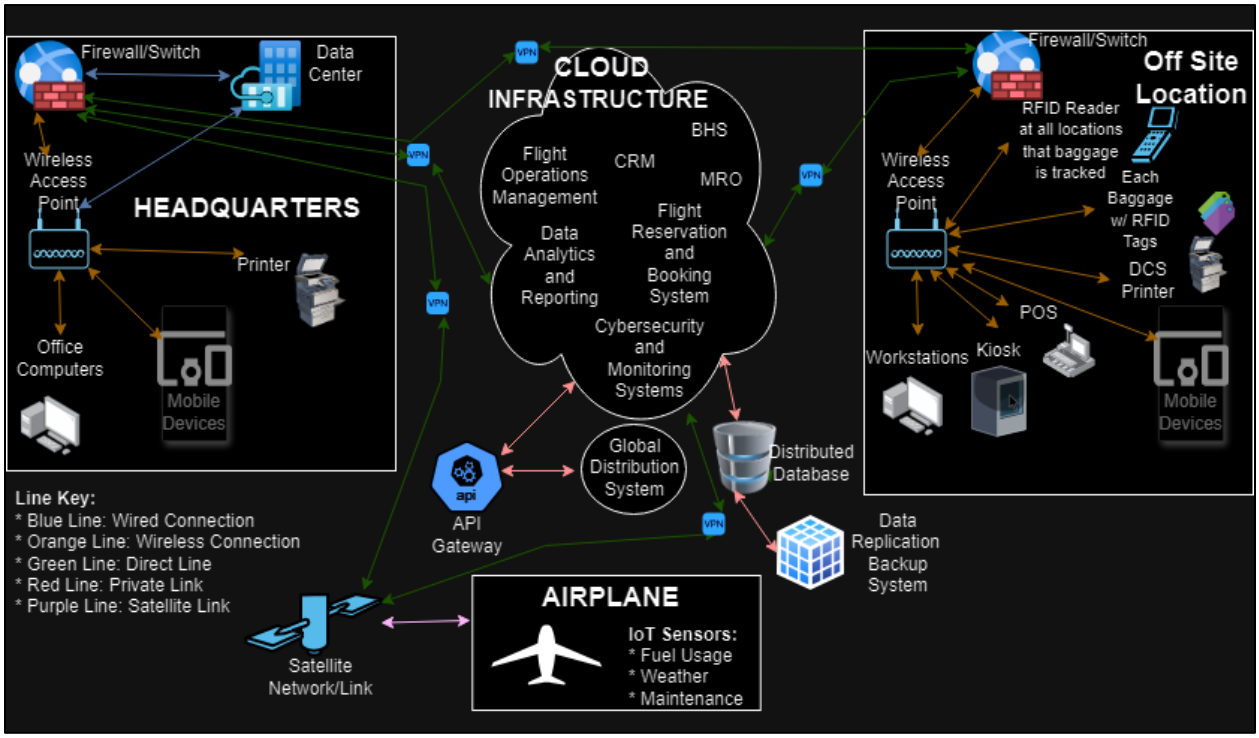

Figure 1. High-level network diagram of Draig Airline IT architecture. Diagram created by Team 2 using Draw.io, 2024.

Component Specifications

Hardware

Terminals & Workstations

Function: Draig Airlines' team can access the Driag Airlines' systems through various devices, including office computers, POS systems, mobile devices, and kiosks. These devices need to be equipped with powerful hardware such as multi-core processors, high RAM capacity, and SSD storage to handle high demand. Customers can use kiosks or mobile devices to check in, print boarding passes, and access real-time flight information. POS systems help process customer payments. Mobile devices allow the Draig Airlines' team to perform tasks and communicate efficiently in real-time. Additionally, these devices require reliable cloud access to integrate with Draig Airlines' systems for seamless operations.

Purpose: Managing these devices through Mobile Device Management (MDM) provides security, remote troubleshooting and real-time communication between devices and systems, ensuring efficient operations (Ghosh, 2024).

Servers

Function: Servers are the backbone of Draig Airlines' IT infrastructure. They handle all the main tasks that keep Draig Airlines' applications running for both Draig Airlines' team and customers. On-premises servers are used for high-security tasks like managing employees and financial data (Keeports, n.d.). These servers need to be powerful to meet the Draig Airlines' operational demands. Cloud servers are used for tasks such as booking, customer relationship management (CRM), real-time data access, and data storage (Keeports, n.d.). Using cloud servers allows Draig Airlines to easily scale its systems depending on Draig Airlines' demands.

Purpose: The servers at Draig Airlines are keeping their systems running smoothly. It does not matter if a server fails or is in high demand the server needs to keep the system running. Draig Airlines' team and customers need real-time access to the data. On-premises servers handle this by securely managing sensitive information like employee and financial data. Cloud servers offer flexibility, allowing the airline to scale up or down depending on demand. This setup is also cost-effective because Draig Airlines only pays for the resources it uses, avoiding the need to invest in extra physical infrastructure.

Networking Equipment

Function: Routers and switches are the hardware that help devices such as terminals, workstations, POS systems, and servers connect and communicate across Draig Airlines' different locations and with cloud services. They need to support high bandwidth to handle Draig Airlines' demands. Wireless access points allow mobile devices and Draig Airlines' team to connect to Draig Airlines' network. This enables real-time updates and interaction with the Draig airline's systems (Datar, 2023). Additionally, Virtual Private Networks (VPNs) provide secure and private access for Draig Airlines' team or partners to connect to the airline's systems from anywhere.

Purpose: Routers and switches help all systems at Draig Airlines connect and share real-time data. Both customers and the Draig Airlines' team always have the most up-to-date information (Datar, 2023). This enables smooth operations and better service. Additionally, secure remote access is provided, allowing the Draig Airlines' team and partners to collaborate from anywhere, ensuring safety and privacy (Datar, 2023).

Storage Systems

Function: On-premises storage, such as network access storage (NAS), is used by Draig Airlines to keep sensitive data secure and to store backups for high-security tasks. It is also used for operational tasks that require quick access with low latency (What Data Storage

Method Is Best for Your Business?, 2021). This storage needs to have a large capacity, fast network connectivity, and support for RAID to ensure data reliability. Cloud storage provides Draig Airlines with scalable storage for storing customer information, flight details, and other data. It also ensures data redundancy (What Data Storage Method Is Best for Your Business?, 2021). It keeps data secure and accurate. This makes cloud storage the Draig Airlines primary storage solution.

Purpose: The storage hardware at Draig Airlines is designed to back up data, keep data secure, and have access to the data when needed (What Data Storage Method Is Best for Your Business?, 2021). Cloud storage allows Draig Airlines to grow by providing scalable storage for data as Draig Airlines grows. This provides flexibility to store customer information and operational data efficiently. This setup provides data to be protected and available. Allowing Draig Airlines to scale up storage as required.

Internet of Things (IoT)

Function: Internet of Things (IoT) sensors will be placed on Draig Airlines' planes, computers, and devices to constantly collect and share data across Draig Airlines' network. These sensors help monitor important parts of the planes and can alert Draig Airlines' team when something needs fixing before it becomes a bigger issue (Joshi, 2024). Draig Airlines can reduce delays and keep flights running smoothly. These devices will also help with tasks like tracking fuel usage, weather, and maintenance. This data will be stored on Draig Airlines' network.

Purpose: Using IoT at Draig Airlines is to improve both the customers' experience and Draig Airlines' operations. IoT can make flying more convenient with things like personalized in-flight entertainment, real-time baggage tracking, and quicker boarding for customers. IoT will help Draig Airlines save fuel, manage air traffic, and keep cargo safe. Draig Airlines will be able to grow more efficiently by integrating IoT (Joshi, 2024).

Gate and Baggage Handling Systems

Function: Draig Airlines' baggage handling systems (BHS) help move luggage from check-in to pick up (Mercan, 2021). This keeps track of each bag in real time. These systems use conveyors and sorters connected to the Draig Airlines's systems to show the location of baggage as it moves. Gate systems also help manage customers, assist with boarding, and update flight statuses so everyone stays informed (Mercan, 2021). By connecting with Draig Airlines' systems, these devices reduce mistakes and make the whole process smoother and faster.

Purpose: BHS helps Draig Airlines with check-in, boarding, and handling baggage faster and more accurately. Real-time tracking helps keep things organized, reducing delays and mistakes. Draig Airlines can manage large numbers of customers and keeping track of

luggage and flights, giving customers a smooth experience and keeping operations efficient (Mercan, 2021).

Peripheral Devices

Function: These devices help provide fast and efficient customer service by connecting to Draig Airlines' Departure Control System (DCS) and the cloud. They handle tasks like printing boarding passes, scanning baggage tags, and processing payments in real-time. All customer information is updated instantly with the DCS. These printers can handle large amounts of printing and are designed for airport use (Boarding Pass & Bag Tag Printer, n.d.). This setup makes the whole process smoother by automating tasks, reducing mistakes, and quickly giving customers what they need.

Purpose: These devices help make the check-in, boarding, and baggage handling processes more efficient by automating flight document generation and connecting to the cloud (Boarding Pass & Bag Tag Printer, n.d.). This improves processing, reduces errors, and better coordination. Draig Airlines can track and manage customer activities in real-time providing smooth operations.

Security

Function: The hardware at Draig Airlines, such as firewalls, intrusion detection and systems (IDS), helps keep customers and Draig Airlines' data secure (Terekhov, n.d.). Firewalls and IDS stop unauthorized access and catch any security problems. Encryption keeps the communication between Draig Airlines' systems and their partners secure. These tools work together to protect data from threats and make sure everything stays secure when information is shared (Terekhov, n.d.).

Purpose: Draig Airlines makes sure customer and company data is secure by following important rules and using strong security tools. They maintain secure connections between Draig Airlines' systems and their partners. Sensitive information stays protected when it's shared or transferred. This helps prevent any data from being exposed to threats (Terekhov, n.d.).

Software

Enterprise Resource Planning

AWS Cloud-based platform.

Function: Centralizes and integrates critical internal business processes, such as finance, human resources, and inventory management.

Purpose: The AWS cloud platform provides real-time data access, improving decision-making, operational efficiency, and scalability. It allows Draig Airlines to support geographically distributed teams, ensuring consistent communication and workflow

across locations. This system enhances the ability to manage resources and operations seamlessly (Dimitrova, 2022).

Customer Relationship Management

AI-driven analytics integrated with Amazon SageMake and Smart Gating.

Function: Manages customer interactions, tracks customer preferences, and integrates with the booking system.

Purpose: Enhances customer satisfaction and loyalty by providing personalized services and automated responses. AI tools such as SageMake analyze real-time customer data to optimize customer service, generate targeted marketing strategies, and improve overall customer engagement (American Airlines Newsroom).

Booking and Ticketing System

Integration with Global Distribution Systems (GDS) like Amadeus and Sabre.

Function: Manages flight reservations, seat allocations, and ticket issuance while integrating with third-party sales channels.

Purpose: Provides real-time updates on seat availability, booking confirmations, and dynamic pricing. This ensures smooth booking processes, reduces the risk of overbooking, and expands the airline's market reach through third-party platforms like Amadeus and Sabre (Altexsoft, 2019).

Integration Layer (API Management)

API-first Architecture.

Function: Connects the ERP, CRM, and ticketing systems with external entities (for example, FAA, TSA, and ticket sellers).

Purpose: Ensures real-time communication between internal and external systems, minimizing data silos and enhancing data consistency. The API management system facilitates secure, seamless data exchange, supporting real-time updates and collaborative functionality across partners (Tyan et al., 2021).

Artificial Intelligence and Automation Platform

Amazon SageMaker and Smart Gating.

Function: Automates routine tasks like customer service interactions, predictive maintenance, and operational scheduling.

Purpose: Reduces human error, improves operational efficiency, and enhances decision-making. AI and automation predict potential issues and optimize scheduling, ensuring

smooth customer service and minimizing downtime due to maintenance or operational bottlenecks (American Airlines Newsroom).

Data Management and Analytics

Big Data Platforms such as Hadoop and Apache Spark.

Function: Centralizes data collection, processing, and storage for operational and customer-related data.

Purpose: Supports real-time reporting, predictive analytics, and business intelligence. The use of Hadoop and Spark allows for handling large volumes of data, enabling Draig Airlines to derive actionable insights for optimizing both operations and customer experience (Zineb et al., 2021).

Network

Cloud-Based Network Infrastructure

A virtual private cloud (VPC) connected to regional data centers ensures secure and fast access to the airline's critical systems.

Function: Supports global connectivity and data synchronization.

Purpose: Enables geographically distributed teams and customers to access centralized resources securely (Gartner, 2023).

API Gateway

An API gateway connects internal systems (flight operations, baggage tracking, customer service) and external partners (GDS, regulatory bodies, service providers).

Function: Facilitates secure, real-time data exchange.

Purpose: Ensures seamless integration with external organizations and services (IATA, 2023).

Database

Distributed Database Systems

The architecture employs a hybrid approach with cloud databases (e.g., Amazon RDS) and local relational databases at key locations to store sensitive data securely. A hybrid approach will help in managing sensitive data. With rapid advance in technology, there is need for the development of distributed database systems that can efficiently manage large volume and complex data across multiple locations. The hybrid approach which

combines cloud-based and local database systems offers an adaptable framework for organizations like Draig airlines that require extensive security and flexibility in their data management processes.

Architecture of Hybrid Distributed Database Systems

Overview of Hybrid Architecture Hybrid

Distributed database systems combine the advantages of both cloud and local databases. Cloud databases, like Amazon RDS, offer scalability, high availability, and managed services, while local databases provide better security and control over sensitive information. The architecture generally includes Cloud Databases: These databases are hosted on cloud platforms and accessible via the Internet. They come with features such as automatic backups, scaling options, and disaster recovery solutions (Avira et al., 2023). Local Relational Databases: These databases are set up on-premises or at designated locations. They are utilized for storing sensitive data that demands strict security measures and adherence to data protection regulations (Yue et al., 2021).

Data Flow and Management

In a hybrid architecture, data flow is regulated through a clear protocol that guarantees synchronization between cloud and local databases. The system may utilize: Data Replication: Important data is replicated across both cloud and local databases to ensure redundancy and availability (Gao, 2023). Data Partitioning: Sensitive data can be divided and stored locally, while less sensitive information can be kept in the cloud to enhance performance and reduce costs (Yang et al., 2021). Data Encryption: Data encryption is applied both at rest and in transit to protect sensitive information from unauthorized access (Feng et al., 2011).

The Functionality of the Hybrid System

Managing Flight Records

Flight records is essential for Draig airlines and aviation authorities. The hybrid system enables

Real-time Data Access

Local databases can store real-time flight data, providing quick access to operational needs (Yang, 2022).

Historical Data Analysis

Cloud databases can archive historical flight records for analysis and reporting, taking advantage of the scalability of cloud storage (Ali et al., 2020).

Customer Data Management

Customer data, which includes personal information and preferences, is sensitive and must be managed carefully. The hybrid architecture supports Secure Storage: Sensitive customer data can be kept in local databases, ensuring compliance with data protection regulations like GDPR or CCPA (Avira et al., 2023).

Enhanced Customer Experience

Cloud databases can analyze customer data to offer personalized services while maintaining security (Ren, 2022).

Financial Transactions

Financial transactions demand a high level of security and integrity. The hybrid system facilitates transaction processing and Local databases can manage real-time transaction processing, ensuring low latency and high reliability (Gao, 2023).

Audit Trails

Cloud databases can keep detailed logs of transactions for auditing and compliance purposes (Tomar, 2023).

Purpose of the Hybrid Approach

Data Redundancy

Data redundancy is a vital aspect of distributed database systems. By replicating data across both cloud and local databases, organizations can ensure that critical data remains accessible even if one of the systems fails. This redundancy improves data durability and reliability (Han, 2023).

Scalability

The hybrid architecture allows organizations to adjust their data storage and processing capabilities based on their needs. Cloud databases can be easily scaled up or down according to demand, while local databases can be expanded as needed to accommodate growing data (Calheiros et al., 2010).

Regulatory Compliance

Compliance with data protection regulations is paramount for organizations handling sensitive data. The hybrid approach enables data localization and sensitive data can be stored locally to comply with regulations that mandate data residency (Avira et al., 2023). Controlled access is maintained when local databases allow for stricter access controls, ensuring that only authorized personnel can access sensitive information (Yue et al., 2021).

Data Analytics Platform

In today's world, where technology is advancing rapidly and data is being generated at an unprecedented rate, the airline industry is tasked with effectively utilizing this data to

enhance operational efficiency and improve customer satisfaction. A data analytics platform that harnesses big data technologies can offer predictive analytics capabilities, enabling airlines to obtain real-time insights into various operational facets. A big data solution for predictive analytics, enabling real-time insights into flight performance, customer preferences, and operational efficiency.

Architecture of the Data Analytics Platform

Overview of the Platform

The data analytics platform is constructed on a solid architecture that integrates diverse data sources and analytical tools. Key components include:

Data Ingestion Layer

This layer gathers data from various sources, such as operational databases, customer relationship management (CRM) systems, and external data feeds (e.g., weather data, market trends) (Avira et al., 2023).

Data Storage Layer

By utilizing cloud storage solutions and data lakes, this layer provides scalable and flexible storage for both structured and unstructured data (Yue et al., 2021).

Data Processing Layer

This layer uses big data processing frameworks like Apache Hadoop and Apache Spark to conduct batch and real-time data processing (Gao, 2023).

Analytics Layer

Advanced analytics tools and machine learning algorithms are applied to the processed data to produce predictive insights (Yang et al., 2021).

Visualization Layer

Dashboards and reporting tools present the insights in a user-friendly format for stakeholders, promoting data-driven decision-making (Feng et al., 2011).

Data Flow and Management

The data flow within the platform is structured to ensure smooth integration and processing of data. Key processes include:

Data Collection

Ongoing data collection from diverse sources ensures that the platform remains updated with the latest information (Yang, 2022).

Data Cleaning and Transformation

The raw data undergoes cleaning and transformation processes to guarantee accuracy and consistency prior to analysis (Ali et al., 2020).

Predictive Modeling

Machine learning models are created and trained using historical data to predict future trends and behaviors (Ren, 2022).

Real-time Analytics

The platform enables real-time data processing, allowing airlines to swiftly adapt to changing conditions and customer demands (Tomar, 2023).

Functionality of the Data Analytics Platform

Flight Performance Analysis

The platform allows airlines to track flight performance metrics, including on-time arrivals, delays, and cancellations. By examining historical flight data, airlines can Identify Patterns: Detect trends in flight performance, enabling proactive strategies to reduce delays (Han, 2023). Optimize Scheduling based on predictive insights to enhance operational efficiency (Calheiros et al., 2010).

Customer Preference Insights

Grasping customer preferences is vital for improving the passenger experience. The platform supports: Personalized Services: By analyzing customer data, airlines can customize services and offers to match individual preferences, boosting customer satisfaction (Vinokurova, 2019). Market Segmentation: Understanding customer behavior allows airlines to effectively segment their market and target specific groups with relevant promotions (Nguyen et al., 2012).

Operational Efficiency Enhancement

The platform enhances operational efficiency by offering insights into various facets of airline operations.

Resource Allocation

Predictive analytics can streamline crew scheduling and aircraft usage, reducing operational costs (Tomter & Yu, 2021).

Maintenance Forecasting

By analyzing maintenance data, airlines can better predict and manage maintenance needs. Airlines can forecast when aircraft will need servicing, which helps reduce downtime and boosts fleet availability (Broniarczyk & Griffin, 2014).

Purpose of the Data Analytics Platform

Supporting Decision-Making Processes

The main goal of the data analytics platform is to aid informed decision-making throughout the airline. By offering real-time insights and predictive analytics, the platform allows stakeholders to make data-driven choices that improve operational efficiency and customer satisfaction (Tseng et al., 2022).

Future Planning

The platform is also essential for future planning with Strategic Forecasting and Predictive models which assist airlines in anticipating market trends and customer needs, guiding long-term strategic planning (Shen & Ball, 2011). Risk Management: By pinpointing potential risks and challenges, airlines can create contingency plans to lessen negative impacts on operations (Chang & Yang, 2011).

Conclusion

The adoption of a data analytics platform as a big data solution for predictive analytics marks a significant leap forward for the airline industry. By providing real-time insights into flight performance, customer preferences, and operational efficiency, this platform facilitates informed decision-making and strategic planning. As airlines continue to operate in a competitive environment, the ability to effectively utilize data will be crucial for improving operational efficiency and customer satisfaction.

Design Explanation

The design is built around **cloud computing** to facilitate the integration of geographically distributed operations and ensure scalability. Cloud platforms like AWS or Azure offer flexibility and cost-efficiency, allowing Draig to manage data, run applications, and scale resources based on demand (Gartner, 2023). The **API gateway** ensures that internal systems communicate with external partners such as GDS providers, enabling real-time coordination of bookings, baggage management, and flight schedules (IATA, 2023).

The choice of **distributed databases** supports both operational efficiency and security, balancing centralized data storage with local data centers for critical operations (PwC, 2023). The use of predictive analytics, powered by a data analytics platform, enables the company to anticipate and address operational challenges, improving on-time performance and customer service (Accenture, 2023).

Conclusion & Recommendations

In conclusion, this IT architecture supports Draig Airlines' operational goals of improving efficiency, enhancing customer service, and enabling long-term growth. The architecture is scalable, secure, and designed for integration across both internal and external systems.

Recommendations:

1. **Adopt Cloud Infrastructure**: Implement cloud-based services for data storage and real-time processing to ensure scalability and flexibility.
2. **Integrate Predictive Analytics**: Utilize predictive analytics to forecast operational challenges and customer needs, reducing delays and improving service.
3. **Prioritize Security and Compliance**: Ensure that all data processing and storage comply with industry regulations, particularly for customer and financial data.
4. **Invest in API-Driven Integrations**: Establish API-based connections with external partners for seamless integration of services and real-time data exchange.

By following these recommendations, Draig Airlines can establish an IT architecture that not only meets current operational requirements but is also positioned to support future innovations and expansions.

Data Architecture Strategy

Introduction to Draig's Data Architecture

Introduction to Data Analytics

Data analytics plays a critical role in empowering Draig Airlines to harness its vast data resources for strategic advantage. Rather than simply collecting and storing data, effective analytics allows the airline to gain actionable insights that drive operational efficiencies, predict customer needs, and enhance overall performance. The focus of Draig Airlines' data analytics strategy is to leverage historical and real-time data for predictive modeling, customer segmentation, and demand forecasting. By doing so, the airline can make more informed decisions, improve customer satisfaction, and remain agile in a competitive market (Davenport & Harris, 2017).

Role of Cloud Platforms

Cloud platforms are instrumental in supporting Draig Airlines' data architecture, particularly in enabling scalable, real-time data processing and analytics. While transactional data often originates from traditional on-premise systems, it can be seamlessly integrated into the cloud for real-time analysis. This capability enables Draig Airlines to process large volumes of data rapidly, facilitating up-to-the-minute insights into key operations such as flight scheduling, maintenance, and customer management. By storing and processing data in the cloud, the airline benefits from enhanced scalability, cost efficiency, and flexibility in its analytics initiatives (McKinsey & Company, 2021).

Shifting Transactional Data to Traditional Data Management

To support this flow, transactional data—collected from reservations, ticketing systems, and flight operations—should be housed in traditional data management platforms. These platforms offer structured storage and data governance, ensuring data integrity and compliance. Once transactional data is processed and cleaned, it can be used for more complex analysis within the cloud environment, feeding into predictive models and customer insights. By separating the storage and governance of transactional data from its analytical use, Draig Airlines can build a more robust, secure, and flexible data architecture (Gartner, 2022).

Building on Data Analytics

Once transactional data is processed, Draig Airlines can apply advanced data analytics techniques such as machine learning algorithms, predictive maintenance models, and customer segmentation analysis. Predictive maintenance, for example, enables the airline to anticipate and prevent technical failures, minimizing downtime and maximizing fleet availability (IATA, 2023). In addition, customer segmentation allows for the personalization of services, such as targeted offers or tailored in-flight experiences, thereby enhancing customer loyalty and satisfaction (SITA, 2022).

Traditional Data Model and Entity-Relationship Diagram

Overview of Traditional Data for Draig

Draig Airlines maintains complex transactional data, including reservation information, customer profiles, flight schedules, and employee allocations. These are critical in driving the actual operations of scheduling, customer interaction, and invoicing. A key theme is the development of operational efficiency and the customer experience through automation, APIs, and real-time access to data.

Entity-Relationship Diagram (ERD)

SEE ATTACHED JPEG DOCUMENT FOR ERD

Figure 1. Entity-Relationship Diagram of Draig Airline IT architecture. Diagram created by Team 2 using Draw.io, 2024.

Clarification of Key Entities and Relationships

Key Entities

Person

The central entity that contains demographic and contact information for individuals. The Person table serves as a foundation for both Customer and Passenger entities, which link directly to Bookings, Reservations, and Tickets.

Customers

Holds customer details, including frequent flyer and contact information, allowing customers to make reservations for themselves or for other passengers. This separation allows flexibility in booking and billing.

Passengers

Represents the individual travelers, capturing details such as contact information and preferences. This separation from Customers allows for cases where a customer might purchase tickets for multiple passengers.

Reservations

Manages booking details, linking customers to flights and organizing ticket issuance and seat assignments for passengers. Each reservation may contain multiple tickets, enabling group bookings and flexibility in passenger management.

Flights

Represents individual flight instances, including specific departure/arrival times, routes, and aircraft assignments. This entity connects to Flight_Schedule for recurring flights and includes employee assignments for crew roles.

Flight Schedule

Defines recurring flight details, setting the schedule structure for Flights. It includes information on planned departure and arrival times, route, and frequency, making it a template for flight instances.

Aircraft

Contains information about the airline's fleet, including model and capacity. Each aircraft is linked to Flights for assignment and Aircraft_Maintenance for upkeep records.

Aircraft Maintenance

Tracks maintenance records for each aircraft, including start and end dates, maintenance types, and associated details. This ensures the airline maintains a history of repairs and routine servicing for compliance and safety.

Usage Record

Documents the usage of parts and services during maintenance events. This entity supports tracking parts used and quantity in each maintenance event, enabling efficient inventory management.

Employees

Captures details of airline staff, including pilots, cabin crew, and maintenance personnel. Each employee is assigned a Role and a Department, with flight-specific assignments managed via EmployeeFlights.

Employee Flights

Records the assignments of employees to specific flights, detailing each employee's role on that flight. This entity allows flexibility in crew management, enabling multiple roles per flight.

Departments

Represents organizational units within the airline, such as ground staff, maintenance, and cabin crew. This division organizes employees by their functional areas within the airline.

Roles

Defines specific roles within the airline, such as Pilot, Flight_Attendant, and Maintenance_Technician. Each role clarifies the responsibilities and qualifications associated with an employee's position.

Baggage

Tracks each passenger's luggage, including baggage type, tag numbers, and status, supporting baggage management and handling. Baggage records link passengers with flights, ensuring accurate handling and tracking for each flight instance.

Billing

Stores information on payments associated with reservations. This includes details of the amount, payment method, and status, linking back to the reservation to ensure accurate billing records.

Booking

Manages high-level booking records, linking them to Customers and Billing for transaction processing. This entity captures details of each booking, such as total amount, status, and payment status, helping consolidate transaction history for each customer.

Airports

Holds details about airports served by the airline, including code, name, and location. This entity supports route management and scheduling for flights.

Tickets

Represents individual tickets issued for passengers on flights. Each ticket includes details on the ticket type, price, and status, linked to specific flights and passengers.

Loyalty Program

Tracks loyalty program details for frequent customers, including points earned and redeemed. This allows for managing customer rewards and redemptions based on loyalty status.

Inventory

Manages items such as spare parts, inflight supplies, and equipment. Each item is linked to suppliers for restocking and procurement tracking, ensuring the airline has necessary supplies and maintenance parts.

Suppliers

Captures information about vendors providing goods and services for the airline's inventory. This entity is linked to orders and items to track where each inventory item is sourced.

Order

Manages procurement orders made to suppliers for inventory items. Each order details the items and quantities purchased, providing a link between suppliers and inventory restocking.

Order Item

Details the specific items within each order, including quantities and links to parts. This entity supports inventory tracking by capturing each part in procurement activities.

Parts

Lists all parts that may be used in aircraft maintenance. This entity helps manage each item's details, connecting to Inventory and Orders to ensure availability for maintenance activities.

Payroll

Tracks employee payroll records, including salary, bonuses, and payment dates. Each payroll record helps to maintain a historical record of employee compensation.

Key Relationships

Customers make Bookings

Each Customer (through Customer_ID) can make multiple Bookings. Each booking captures details like date, status, and total amount, forming the basis for the financial transactions and linking to payment and reservation systems.

Bookings generate Billing Records

Each Booking is linked to a Billing record, capturing the amount, payment method, and status. This relationship provides a complete history of payment transactions for every booking, supporting accounting and financial tracking.

Bookings contain Reservations

A single booking can have multiple Reservations, especially for group travel. This structure allows customers to book seats for themselves and other passengers under a single transaction, maintaining simplicity in management and billing.

Reservations are issued Tickets

Each Reservation links to one or more Tickets, representing actual boarding passes for the flights. This ensures that every reservation is directly tied to a specific flight instance, passenger, and seat.

Passengers hold Tickets

The Passenger entity has a direct relationship with Tickets, ensuring that each passenger is tracked by flight and seat assignment, supporting accurate manifest creation and travel history.

Flights use Aircraft

Each Flight is assigned to a specific Aircraft, and multiple flights can use the same aircraft at different times. This relationship is central to fleet management, scheduling, and ensuring that each flight has an assigned aircraft.

Flights are managed through Flight Schedules

FlightSchedule acts as a template for creating multiple Flight instances. This relationship facilitates recurring routes, allowing for efficient scheduling of repeated flights (daily or weekly).

Aircraft undergo Maintenance

Aircraft is linked to AircraftMaintenance, capturing all maintenance activities, start and end dates, types, and statuses. This relationship ensures compliance with safety standards and enables tracking of each aircraft's service history.

Employees are assigned to Flights with specific Roles

Through the EmployeeFlights entity, employees are assigned to flights with specific roles (Pilot, Cabin Crew). This supports detailed crew scheduling and role management for each flight instance.

Employees are organized by Departments

Each Employee is associated with a Department, categorizing staff by function (Ground Staff, Maintenance, Cabin Crew) for better workforce management and operational clarity.

Employees have defined Roles

Each employee's specific responsibilities are defined in the Roles entity, clarifying job expectations and qualifications associated with different positions within the airline (Pilot, Technician, Attendant).

Passengers check in Baggage

Each Passenger can have multiple Baggage records, linked to specific reservations and flights. This relationship enables the tracking and handling of luggage, supporting the management of each passenger's belongings across flights.

Flights carry Baggage

The Baggage entity is also linked to Flights, ensuring that each piece of luggage is associated with a specific flight instance, aiding in accurate baggage management.

Inventory is sourced from Suppliers

Each inventory item in Parts Inventory is linked to a Supplier, establishing a clear source for each part and supply item. This relationship aids procurement and maintains a reliable source chain for maintenance and operations.

Loyalty Program tracks Customer Rewards

The LoyaltyProgram entity manages customer rewards, tracking points, and loyalty levels for each Customer. This relationship fosters customer retention by rewarding frequent flyers and personalizing service offerings.

Tickets are issued for specific Flights

Each Ticket is linked to a specific Flight, allowing for precise tracking of passenger details on each flight, including ticket type, seat assignment, and ticket status.

Flight Schedules generate Flights

Each FlightSchedule serves as a foundation for generating individual Flight instances, allowing recurring flights to be created based on a predetermined timetable and route structure.

Orders include Order Items

Each Order from a supplier consists of multiple OrderItem entries, detailing specific parts ordered, quantities, and links to inventory. This supports efficient procurement and inventory management by tracking each part within each order.

Usage Records link Parts to Maintenance Events

Each UsageRecord details the parts used during maintenance events, linking specific quantities of parts to AircraftMaintenance. This relationship enables tracking of inventory consumption and helps manage maintenance-related inventory needs.

Payroll tracks Employee Payments

Each Employee has a Payroll record detailing salary, bonuses, and payment dates. This relationship supports compensation tracking and maintains a historical record of employee earnings.

Clarification of Key Entities and Relationships

Employees have Multiple Payroll Records

Over time, each Employee may have multiple Payroll records, providing a complete history of salary and bonus payments. This relationship ensures comprehensive financial records for employee compensation.

Passengers belong to Reservations

Each Passenger is associated with a specific Reservation, which connects them to flights, tickets, and seat assignments. This relationship supports accurate tracking of each traveler's journey and seat allocation.

Customers participate in Loyalty Program

Each Customer can enroll in the LoyaltyProgram, earning points based on reservations and booking frequency. This relationship manages frequent flyer rewards and loyalty benefits, enhancing customer satisfaction and retention.

Suppliers provide Parts Inventory

Each Supplier is connected to specific parts or items in Parts Inventory through orders, ensuring the airline has a documented source for each item. This relationship streamlines procurement and enables tracking of inventory origins.

Bookings and Customers

Each Booking is explicitly associated with a Customer, who may book flights for themselves and/or other passengers, supporting various booking scenarios and payment handling.

Orders track Procurement of Parts Inventory

Orders detail the acquisition of parts for inventory, ensuring that maintenance and operational supplies are adequately sourced and managed. The OrderItem relationship within Orders allows for granular tracking of each part in procurement.

Flight Schedules associate Flights with Airports

Each FlightSchedule includes details about departure and arrival airports, defining the flight's route and supporting accurate scheduling for regular routes.

Order Items to Inventory

Each OrderItem specifies the quantity of inventory items within an Order, linking it to Parts Inventory to aid in restocking processes and inventory level management.

Non-Traditional Data Exploitation

Importance of Non-Traditional Data for Draig Airlines

Non-traditional data contains unstructured or semi-structured data. This data does not fit well into the traditional structured databases. This data needs more advanced methods to process and analyze.

Draig Airlines will use non-traditional data because it helps to stay ahead of the competition and perform better. Draig Airlines can gather this data from different sources such as aircraft sensors, customer reviews, social media posts, mobile app and website, weather updates, and documents. Draig Airlines can provide better service to customers and passengers by using this type of information allowing for informative decisions.

Draig Airlines Can Exploit Non-Traditional Data

Document-based Data

Draig Airlines has turned paper-based records into digital files and stores and manages them in a cloud-based Document Management System (DMS). Compliance, regulatory, and operational reporting data such as Draig Airlines' crew reports, safety inspections, incident reports, and operational reports/logs will be collected from employees' mobile devices and workstations. This provides real-time data collection, storage, retrieval, and sharing that allows streamlined access across Draig Airlines' teams (eQuorum, 2024). This will result in staff being able to securely access and update reports, and report to regulatory bodies when needed from any location. DMS will also ensure that with version control, documents remain consistent and up to date. This will reduce the risk of discrepancies in data and reports.

It can be challenging in collecting data from document-based data when the internet or the cloud service provider is having issues. This will prevent staff from accessing or updating reports in real-time and it will affect operations. Draig Airlines will need to monitor and comply with storing regulatory reports and sensitive information.

API-Driven Integrations

Draig Airlines will collect data from many sources using APIs. APIs will be used to gather data from third-party systems, such as weather services, flight traffic management systems, and airport systems (Anyanwu et al., 2024). For example, weather data from external sources can be added to the airline's operational systems that allow schedules and routes to be adjusted based on current weather conditions. API driven integrations allow data to flow across platforms. This will provide real-time informative decision-making and operational efficiency.

It can be challenging in collecting third-party service providers data because they often update or change their APIs. This can break existing integrations and cause issues if they are not managed. Draig Airlines will need to continuously monitor these APIs for changes, updates, and security.

Internet of Things (IoT)-Based Data

Draig Airlines will collect data from IoT sensors that are on aircrafts and operational equipment such as baggage systems. These sensors will continuously be transmitting data through wireless networks to cloud based systems. This data consists of equipment performance, system health, and customer interactions. This data can be used by all employees to improve reliability and customer satisfaction (Anyanwu et al., 2024).

Draig Airlines will collect maintenance data such as engine performance, fuel system, aircraft equipment, and wear on parts through the aircraft sensors. This will allow Draig Airlines to monitor the condition of aircraft parts in real-time. This maintenance approach allows Draig Airlines to identify issues before they cause equipment failure, and this will help to reduce unexpected downtime (Joshi, 2024).

Additionally, Draig Airlines will collect weather data using IoT systems. This weather station's data will work alongside information from third-party sources through APIs. Together, these sources will help Draig Airlines make real-time changes to flight schedules and routes. This will ensure safer and efficient planning based on up-to-date weather conditions (Anyanwu et al., 2024).

The challenge in collecting this data is latency and security. It can be hard to make sure the data is transmitted and processed without delays due to busy operational times or when the network is slow. Also ensuring that this data is being collected following regulatory standards.

Clickstream Data

Draig Airlines will collect data and track customer interactions on Draig Airlines' website and mobile app. Clickstream data is collected using tools and tracking systems that monitor user behavior in real time (IBM Streams Flows Extension for Microsoft Visual Studio Code, 2021). These systems will capture each interaction and send the data to cloud-based system. Tracking customer interactions such as browsing patterns, flight searches, and booking behaviors can provide insights into customer preferences. Analyzing clickstream data allows the Draig Airline to personalize the user interface and provide targeted marketing strategies.

Challenges in gathering this data is being sure that Draig Airlines follows data privacy regulations. Draig Airlines must ensure that customer data is collected with clear permission from customers to collect their data and protect data from unauthorized

access. Another challenge is ensuring that the clickstream data is accurate and complete because this will affect the quality of insights.

Social Media Data

Draig Airlines will collect social media data through social media platforms. This data includes customer comments, reviews, likes, shares, and hashtags that are related to Draig Airlines. Draig Airlines will use social media listening tools or APIs to gather this information in real time. The data will then be analyzed to assess customer sentiment, brand perception, and market trends (Anyanwu et al., 2024).

Challenges in gathering this data will be ensuring that social media data is collected following privacy regulations rules. Draig Airlines needs to organize this data in a way that can be analyzed and get insights.

Multimedia Data

Draig Airlines will collect photos, videos, and audio content through social media platforms, customer feedback on websites and apps, or third-party review sites, survey responses, email communications, and conversations with customers on the phone. This multimedia data will be collected using specialized tools or APIs that can extract and store this content (Alphaidze & Renart, 2024). This data will be analyzed using machine learning algorithms. This will allow Draig Airlines to spot trends, recurring issues, improve customer experience, and improve service quality.

Challenges in gathering this data will be ensuring that multimedia data is collected following privacy regulations rules and consent rules. Draig Airlines needs to organize this large amount of data in a way that can be analyzed and get insights.

Recommendations for Exploiting Non-Traditional Data

Draig Airlines will use non-traditional data such as IoT sensors, digital document records, website activity, and social media to improve their operations and the way they serve customers and passengers. Draig Airlines will use a cloud-based Content Management System (CMS). The CMS will store, organize, and analyze large amounts of data from different sources. It will use tags and other tools to make it easy for staff to search for data. This system will make the data available in real time and accessible from multiple locations and be flexible to grow with Draig Airlines' needs.

CMS will also work with APIs to ensure data flows across platforms. It will help Draig Airlines get real-time insights from outside sources, customer interactions, and operational data. This will allow Draig Airlines to make informative decisions. Also, using machine learning and data analytics will allow reviewing customer feedback, reviews, and multimedia like photos and videos. These tools will help Draig Airlines spot trends and common issues and find ways to improve services.

As part of Draig Airlines' strategy Content Management System (CMS) and a Document Management System (DMS) will be used for indexing and categorizing data through metadata tagging, document types, timestamps, and source identification. This will allow documents, multimedia content, or IoT sensor data to be easily found and organized. The DMS will specifically handle document-based data. AI-driven search tools in DMS and CMS will enable natural language queries, metadata filtering, and contextual searches, helping staff locate data more quickly. Draig Airlines will also implement policies for data archival and retrieval, ensuring that frequently accessed data is available while older data is securely archived (Square 9, 2024).

Data Analytics Infrastructure and Recommendations

Draig Airlines will implement a comprehensive data analytics strategy to maximize the use of its vast data resources. The goal will be to extract actionable insights that will help improve decision-making, optimize operations, and enhance customer satisfaction. The airline will leverage both traditional and non-traditional data, with a strong focus on predictive modeling, customer segmentation, and forecasting. The following steps outline the future approach to Draig Airlines' data analytics infrastructure.

The aviation industry generates vast amounts of heterogeneous data daily, which, if effectively integrated, can substantially improve operational performance and safety (Keller et al., 2016). Research indicates that effective safety management systems rely heavily on accurate data collection and analysis to prevent accidents and incidents (Kalemba & Planas, 2019; Su et al., 2023). By leveraging data analytics, airlines can enhance their safety protocols and operational resilience, thereby improving overall performance and customer trust (Kabashkin, 2024).

Recommended Data Analytics Approach

It is essential to explore the relevance and effectiveness of data collection and preparation, data warehousing solutions, data analysis and processing, business intelligence (BI) tools, and machine learning platforms within the airline industry. Each of these technologies plays a critical role in enhancing data management capabilities, ensuring data quality, and supporting strategic decision-making to build a robust system that will support its strategic decision-making and enhance operational efficiency.

Recommended Tools and Technologies

Data Collection and Preparation

Draig Airlines will focus on collecting data from multiple sources, including flight reservations, customer feedback, and aircraft performance logs. To ensure data accuracy and quality, the airline will use tools such as Python or Trifacta for data cleaning and

preparation. This step will be essential to eliminate errors and inconsistencies, which will improve the reliability of the analysis (Dasu & Johnson, 2003). Properly prepared data will ensure that all insights derived from it are accurate and actionable.

Data Warehousing

Implementing a data warehouse solution like Snowflake or Google BigQuery is vital for supporting large-scale data analysis in the airline sector. These platforms allow for the integration of diverse data sources, enabling airlines to perform complex queries and generate insights that drive operational improvements. Studies highlight that effective data warehousing enhances the ability to analyze historical performance data, which is essential for forecasting and strategic planning (Chakrabarty, 2019). The use of data warehousing also supports compliance with regulatory requirements by ensuring that data is stored securely and can be accessed efficiently for audits and reporting (Ashraf, 2020).

Data Analysis and Insights

Draig Airlines will perform several types of data analysis to extract insights from the collected data. Descriptive analytics will be the starting point, helping Draig Airlines review historical data such as flight booking trends and customer preferences. This will give the airline a clear picture of past performance and provide a solid foundation for more advanced analyses. Descriptive analytics will allow Draig Airlines to understand its operations better, preparing the way for predictive models (Chen et al., 2012).

Predictive analytics will then be used to forecast future trends. By employing machine learning algorithms, Draig Airlines will be able to anticipate customer demand, optimize flight schedules, and improve pricing strategies. Predictive analytics will enable Draig Airlines to make informed predictions based on historical data, improving resource allocation and operational efficiency (Shmueli & Koppius, 2011).

In addition to this, prescriptive analytics will be used to suggest specific actions based on data insights. For instance, Draig Airlines will be able to adjust flight schedules based on forecasted demand or plan maintenance to prevent potential equipment failures. Prescriptive analytics helps organizations optimize outcomes by providing clear, actionable recommendations, further enhancing decision-making capabilities at Draig Airlines (Bertsimas & Kallus, 2020).

Business Intelligence (BI) Tools

Once the data is analyzed, Draig Airlines will utilize Business Intelligence (BI) tools like Tableau or Power BI to visualize the results. These tools empower Draig Airlines management to visualize trends, monitor key performance indicators (KPIs), and make informed decisions based on data-driven insights. Research has shown that effective data visualization can significantly enhance decision-making processes in the airline industry, leading to improved customer satisfaction and operational efficiency (Ha, 2023).

Machine Learning Platforms

Leveraging machine learning platforms like AWS SageMaker for predictive analytics can provide airlines with a competitive edge by enabling them to analyze customer behavior and optimize operational efficiency. Machine learning algorithms can process large datasets to identify patterns and predict future trends, which is particularly valuable for demand forecasting and resource allocation (Lin, 2023; Chakrabarty, 2019). Additionally, the integration of machine learning with existing data management systems enhances the overall effectiveness of data governance initiatives by providing deeper insights into operational performance (Fetais et al., 2020).

Costs and Benefits of the Proposed Approach

Regarding the costs and benefits of the proposed approach for Draig Airlines regarding cloud infrastructure and data governance tools, it is essential to analyze existing literature that discusses the financial implications and operational efficiencies associated with these technologies in the airline industry.

Costs of Proposed Approach

The initial investment in cloud infrastructure and data tools can be significant. Budd et al., (2020) highlight that the airline industry operates on low margins and high-cost bases, making any disruption to operations financially impactful (Budd et al., 2020). This suggests that the upfront costs associated with adopting cloud services and data management tools must be carefully considered, especially for Draig airlines, where cash flow is critical. Ongoing costs related to API integration, storage, and data processing are also notable. Mhlanga discusses how operational costs can significantly influence airline performance, indicating that the integration of new technologies must be managed to avoid exacerbating existing financial pressures (Mhlanga, 2019). Additionally, the need for continuous investment in data management and processing capabilities can strain resources, particularly for airlines already facing financial challenges (Abate et al., 2020).

Benefits of Proposed Approach

The benefits of implementing cloud-based infrastructure and advanced data tools are substantial. Improved operational efficiency through real-time data analysis is a key advantage. Research shows that airlines leveraging cloud technologies can enhance their operational responsiveness and efficiency, leading to better management of resources and reduced delays (Mallikarjun, 2015; Lee et al., 2020). Enhanced customer satisfaction through personalized experiences is another critical benefit. By utilizing data analytics and machine learning, airlines can tailor services to individual customer preferences, thereby improving overall customer engagement and loyalty. Moreover, the integration of machine learning platforms for predictive analytics can lead to significant operational improvements. For instance, airlines can predict maintenance needs before failures occur,

thereby reducing downtime and associated costs (Mangortey et al., 2020). This proactive approach not only enhances safety but also contributes to long-term cost savings, as highlighted by the findings of Huang et al., which indicate that strategic resource allocation can lead to improved efficiency and profitability in the airline sector (Huang et al., 2021).

Comprehensive Overview of Specific Costs and Benefits in 2024

To provide a comprehensive overview of the costs associated with cloud infrastructure and data analytics tools for airlines in 2024, it is essential to analyze various factors that contribute to these expenses. The costs can be categorized into initial investments, ongoing operational expenses, and potential hidden costs associated with data management and analytics.

Initial Investment Costs

The initial investment in cloud infrastructure can be substantial. According to Gupta (2024), the transition from traditional IT infrastructure to cloud computing involves significant capital expenditures, including costs for cloud services, data storage, and analytics tools (Gupta 2024). For Draig airlines, this could mean investing in platforms such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud, which can range from tens of thousands to millions of dollars depending on the scale of operations and specific requirements (Munhoz, 2023). Additionally, the integration of data analytics tools, such as Tableau or Power BI, adds to the initial setup costs, which may include licensing fees, training, and implementation services (Amajuoyi, 2024).

Ongoing Operational Costs

Ongoing costs for cloud services typically include subscription fees for cloud storage, data processing, and API integrations. These costs can vary based on usage patterns and the volume of data processed. For instance, AWS and Azure charge based on the amount of data stored and the computational resources used, which can lead to monthly expenses ranging from a few thousand to several hundred thousand dollars for larger airlines (Fragiadakis, 2023). Furthermore, as highlighted by Cho et al., (2023) organizations must also consider costs related to maintaining data quality and compliance with regulatory requirements, which can incur additional expenses for data governance and security measures (Cho et al., 2023).

Hidden Costs

Beyond the direct costs of cloud infrastructure and analytics tools, airlines may face hidden costs associated with data breaches, compliance failures, and the need for ongoing technical support. Research indicates that the average cost of a data breach can exceed $8 million, which underscores the importance of investing in robust security measures (Nguyen & Sondano, 2023). Additionally, as noted by Alwan, the need for continuous

training and development of staff to effectively utilize these technologies can also contribute to overall costs (Alwan, 2024).

Benefits Justifying the Costs

Despite the significant costs associated with cloud infrastructure and data analytics tools, the benefits can outweigh these expenses. Improved operational efficiency through real-time data analysis can lead to substantial cost savings by optimizing resource allocation and reducing delays (Amajuoyi, 2024). Enhanced customer satisfaction through personalized experiences can drive revenue growth, as Draig airlines leverage data analytics to tailor services to customer preferences can improve loyalty and retention (Moses, 2023).

Moreover, predictive maintenance enabled by data analytics can reduce downtime and maintenance costs, providing a competitive edge in a challenging market (Amajuoyi, 2024). While the costs of implementing cloud infrastructure and data analytics tools for Draig airlines can be significant, the potential benefits in terms of operational efficiency, customer satisfaction, and competitive advantage provide a strong justification for these investments. Airlines must carefully evaluate their specific needs and budget accordingly to maximize the return on investment in these technologies.

Conclusion

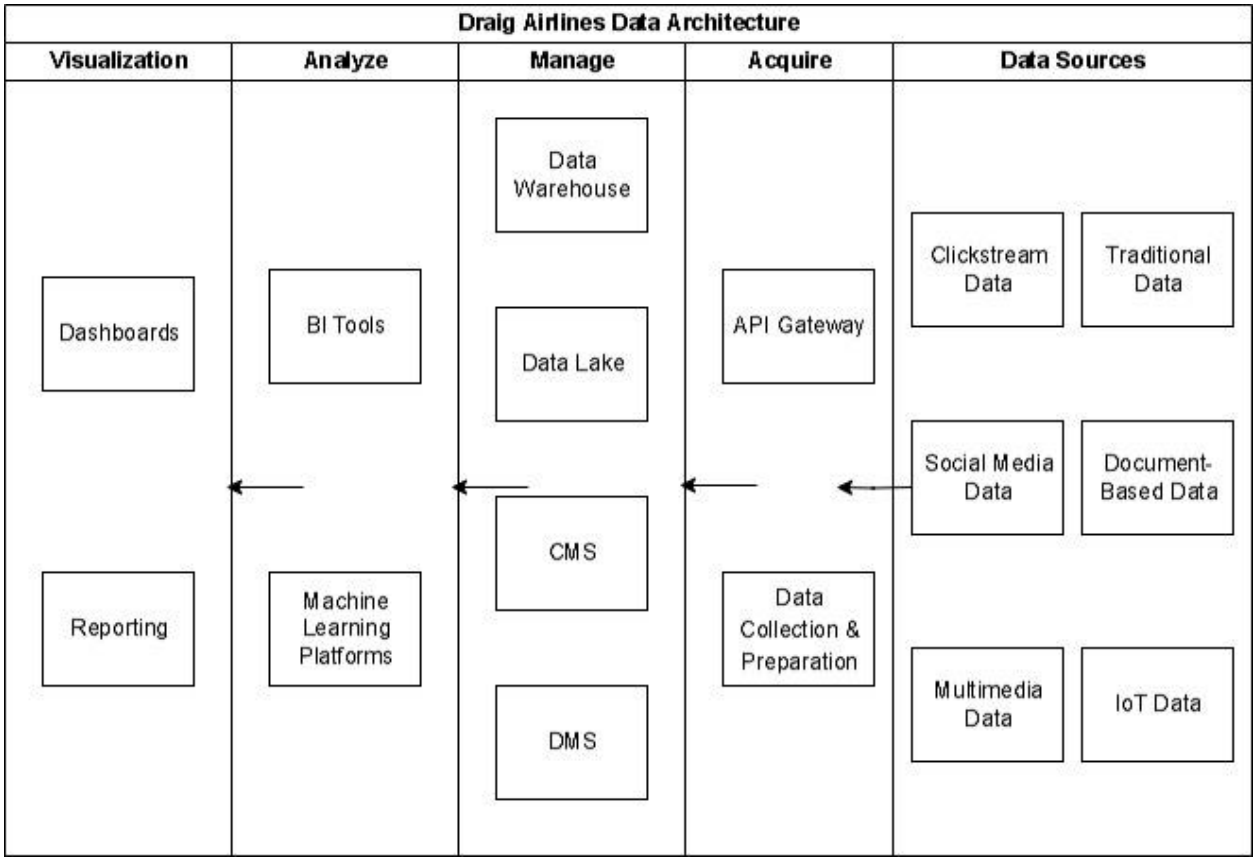

Figure 2. Data Architecture Diagram of Draig Airline IT architecture. Diagram created by Team 2 using Draw.io, 2024.

Draig Airlines' data architecture is essential for supporting its overall organizational strategy, enhancing operational efficiency, and improving customer experience. By utilizing both transactional and analytical data, the company can optimize key operations like flight scheduling and inventory management while gaining valuable insights into customer preferences and market trends. This balanced approach to data usage allows Draig Airlines to provide a seamless and personalized experience for its customers, helping it remain competitive in the fast-paced aviation industry. The airline sector has increasingly adopted data-driven solutions to improve decision-making, optimize routes, and boost operational efficiency.

Draig Airlines follows this trend by tapping into both traditional and non-traditional data sources. Traditional data, such as customer bookings and flight schedules, is crucial for daily operations. Meanwhile, non-traditional data from IoT sensors, social media, and customer interactions helps the airline maintain its competitive advantage by offering real-time insights, enabling predictive maintenance, minimizing downtime, and strengthening customer relationships.

Draig Airlines' data architecture is not only important for operational needs but also plays a significant role in its broader IT strategy. It aligns with the company’s objectives for scalability, integration, and security. By ensuring that data is readily accessible across various platforms through API-driven integrations and cloud-based systems, Draig enhances its capacity to make informed, real-time decisions. Strong security measures are also critical, protecting sensitive customers and operational data.

The airline’s thorough approach to data management, which encompasses both traditional and non-traditional data sources, underscores its dedication to continuous improvement. Whether through IoT-enabled maintenance systems, clickstream data for analyzing customer behavior, or real-time feedback from social media, Draig is committed to leveraging data for better outcomes. Draig Airlines is building a data-centric culture that emphasizes agility, efficiency, and personalized customer experiences.

Information Technology Architecture for Draig Airlines' Online Reservation Design

Introduction

This document details the architecture for Draig Airlines' new online reservation system, designed to provide a streamlined booking experience for customers while enhancing operational efficiency for the airline. The system's primary functionalities include allowing users to search flights, make bookings, manage reservations, and handle payments securely. This reservation platform will also facilitate flight modifications and cancellations, integrating seamlessly with Draig's internal database to manage passenger, reservation, and payment information in real time.

System Scope

The scope of this reservation system includes customer interactions from searching for available flights through to booking, modifying, and canceling reservations. Key back-end functions include data integration with the airline's database and secure handling of payment transactions. This design encompasses essential security measures for handling personal and financial data, as well as a user-friendly interface to improve customer experience.

Assumptions

1. Customers access the reservation system primarily through a web-based interface, accessible from desktops and mobile devices.
2. The system will be integrated with Draig's internal database to manage real-time passenger, booking, and payment records.
3. Payment processing will be handled securely through a third-party provider, complying with industry standards.
4. Both logged-in users and guest users can browse flights, but only registered users may finalize bookings.
5. Airline staff can access specific administrative functions within the system, including booking management and reporting.

Use Case Diagrams

User Systems

Focuses on defining the roles of users interacting with the system. It identifies two primary actors: the Customer and the Passenger. The Customer is the individual who searches for flights, books tickets and manages reservations, while the Passenger is the person who travels. There can be instances where these roles overlap (a Customer booking a flight for themselves as a Passenger) or remain distinct (a Customer booking a flight for someone else). The use case establishes a hierarchy with the general entity "Person" to encapsulate shared actions while allowing specific functionalities for each role. (Figure 1).

Reservation System

Encompasses all user interactions related to flight reservations. With logging in via the authentication server, users can access critical functionalities such as searching and selecting flights, creating bookings, viewing reservation details, updating reservations, checking flight statuses, managing baggage check-in, changing flights, checking in, and viewing booking histories. The system integrates with various components, including the database for data management, the payment gateway for transaction handling, and the notification server for sending updates and confirmations. The point management server also tracks and updates registered users' loyalty points. This comprehensive system supports seamless interactions, real-time updates, and secure operations, ensuring a user-friendly and efficient experience for customers and passengers (Figure 1).

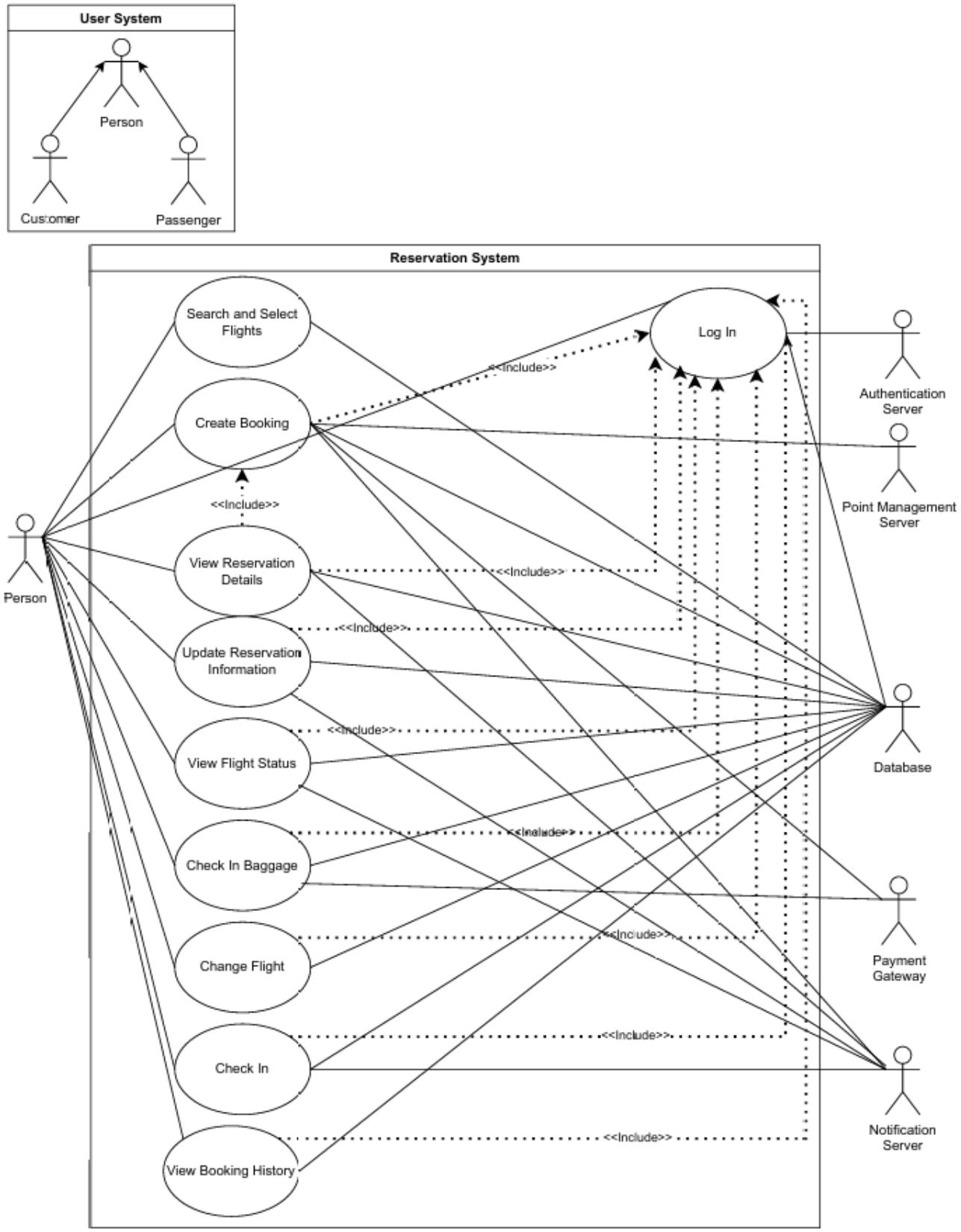

Figure 1. Diagram made with Draw.io by Team 2

Login

Outlines the steps a "Person" takes to access the application. The process begins when the user navigates to the login page, where they are prompted to enter their credentials (username and password). These credentials are authenticated by the authentication server, ensuring they match the stored data in the database. Once authenticated, the user is granted access to the application. Additionally, the login process includes an extension for resetting passwords. If users forget their credentials, they can initiate the password reset process, which allows them to recover or change their password securely. This use case ensures a secure and user-friendly login experience, emphasizing access control and flexibility for users needing assistance. (Figure 2).

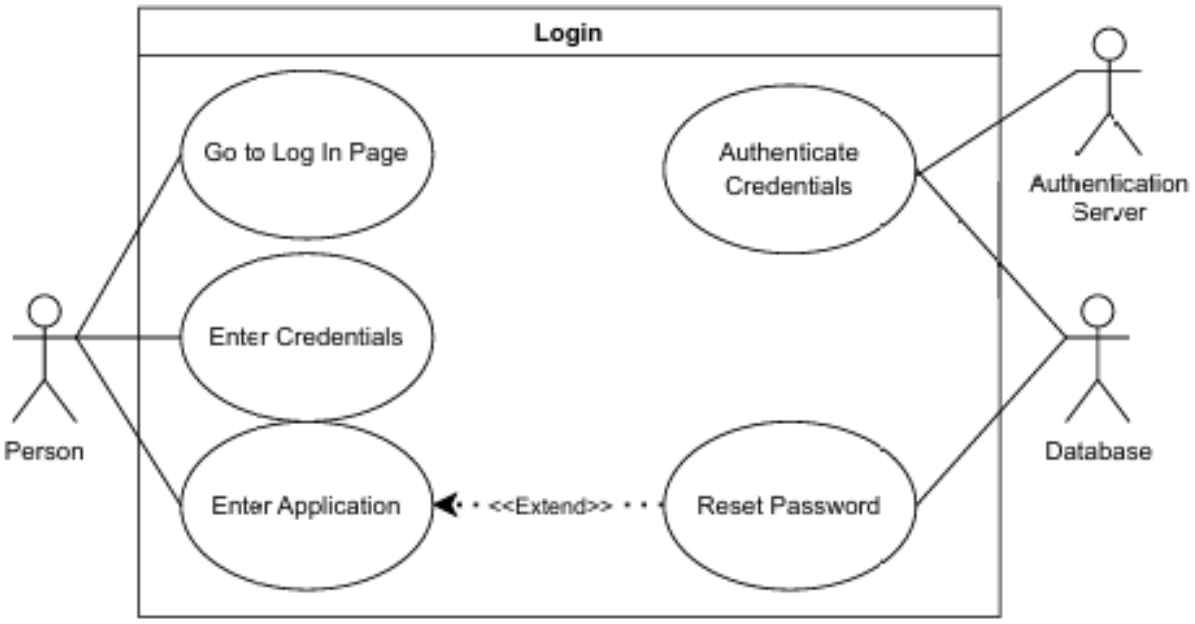

Figure 2. Diagram made with Draw.io by Team 2

Search and Select Flights

Describes the process a "Person" follows to find and choose a flight. It begins with the user entering search criteria such as trip type (one-way or round-trip), travel class, departure and destination locations, and travel dates. This input is used to query the database and display relevant flight options. Once the search results are shown, the user can filter them based on various factors, such as price, flight duration, layovers, and travel class, to narrow down the options. After reviewing and filtering, the user selects the most suitable flight, which becomes the foundation for subsequent actions like booking. This case ensures that users can efficiently search for and select flights tailored to their preferences, providing a seamless and user-friendly experience. (Figure 3).

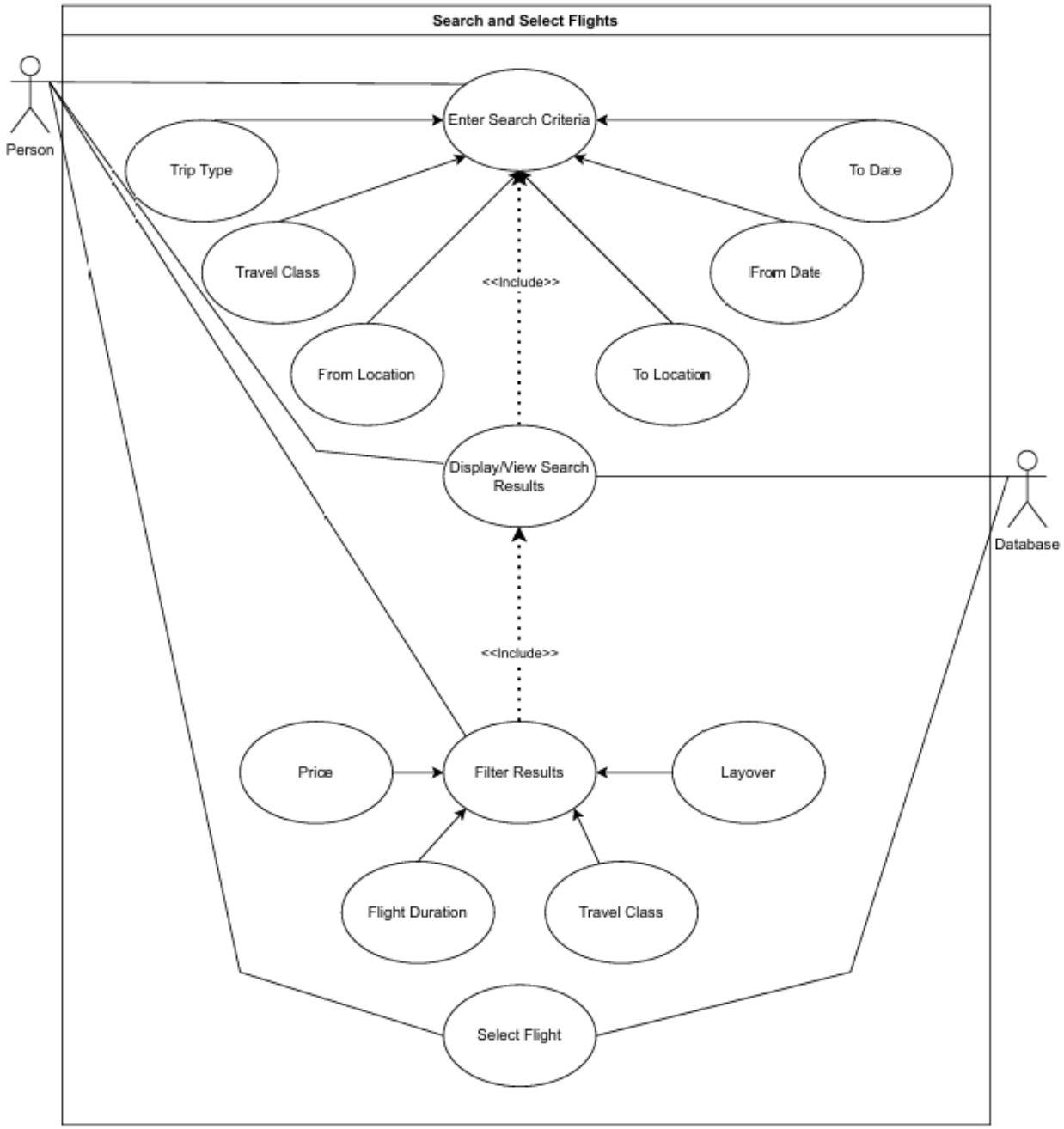

Figure 3. Diagram made with Draw.io by Team 2

Create Booking

Outlines the process for a "Person" to complete a flight booking. The workflow starts with the user searching for and selecting flights and retrieving flight details from the database. Once a flight is chosen, the user provides or updates traveler information, such as passenger names and contact details stored in the database. The process then moves to payment, where the user selects a payment method and processes the transaction securely through the payment gateway. After the payment, the system updates the user's loyalty program status by adding points to their account through the point management server. Finally, the system sends notifications, such as booking confirmation or payment receipts, to the user via the notification server. This case demonstrates the integration of various components to ensure a seamless and user-friendly booking experience while maintaining security and accuracy in data handling. (Figure 4).

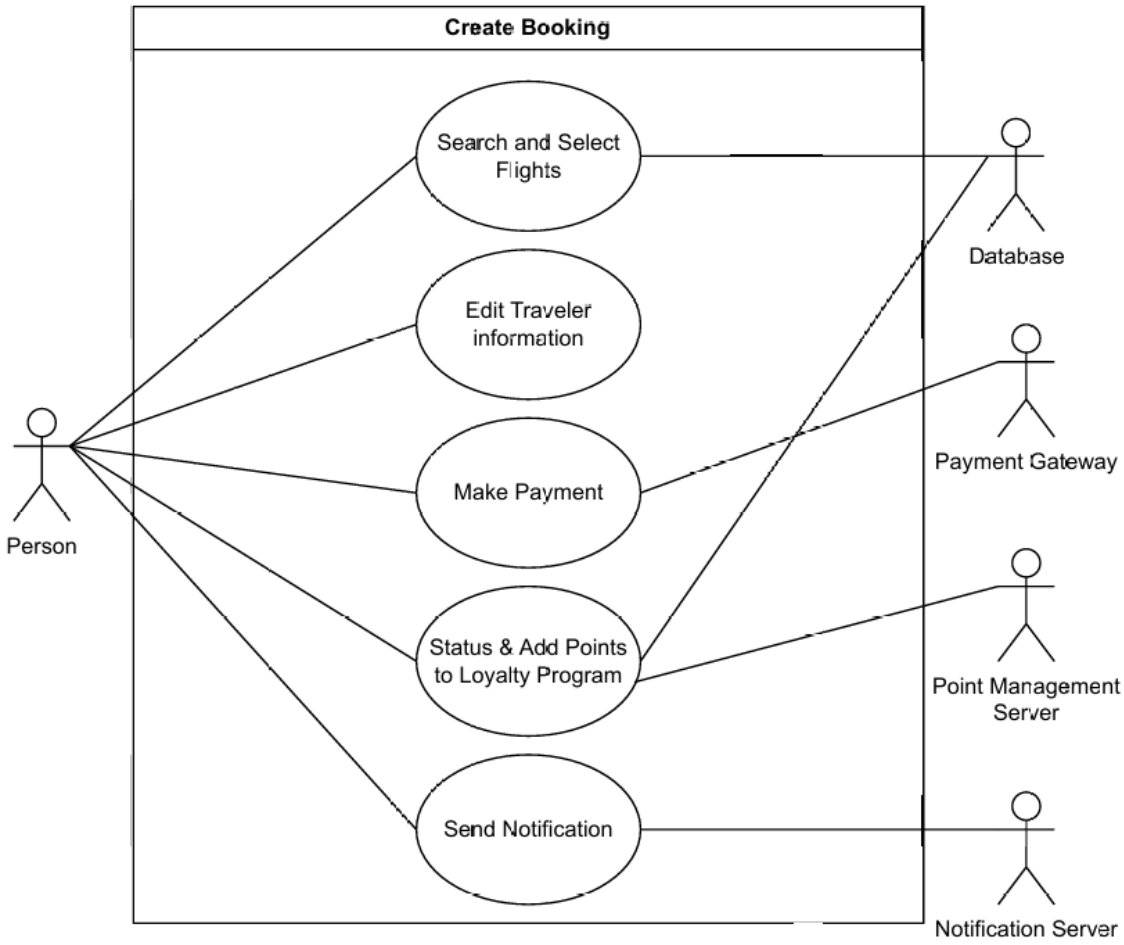

Figure 4. Diagram made with Draw.io by Team 2

View Reservation Details

This section describes how a "Person" retrieves and reviews their reservation information. The user accesses reservation details from the database, which include essential booking information such as flight times, seat assignments, or payment status. If needed, the user can extend this process by sending messages (inquiries or support requests) via the notification server for additional assistance or confirmation of details. (Figure 5).

Cancel Reservation

This section focuses on the steps required to cancel an existing booking. The user retrieves their reservation details from the database, confirms the intent to cancel, and completes the cancellation process. This ensures that the reservation is removed and associated updates (refunds or notifications) are managed within the system. (Figure 5).

Change Reservation Information

It provides flexibility for users to modify their existing bookings. Users can review their reservation details and make various updates, such as changing flights, modifying seat assignments, editing traveler information, or adding baggage. These updates involve retrieving data from the database, processing any required payments through the payment gateway, and finalizing the changes in the system. This case supports the dynamic management of reservations, ensuring a user-friendly and adaptive experience for travelers. (Figure 5).

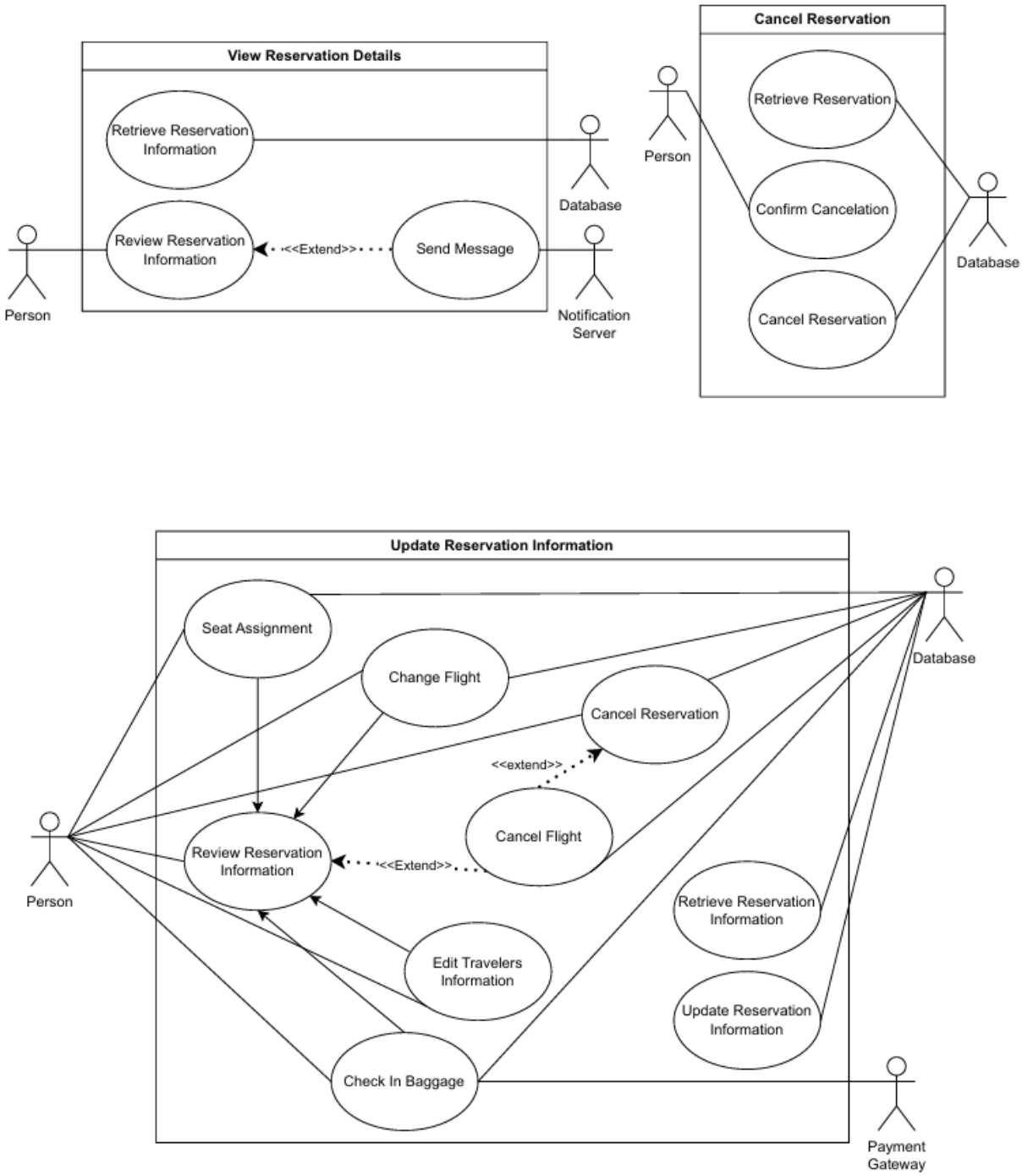

Figure 5. Diagram made with Draw.io by Team 2

Seat Assignment

Describes how a "Person" interacts with the system to select or update their seat. The process begins with the display of a seat map, allowing the user to view available seating options. The system checks seat availability in real time through the database. The user can then select a seat and confirm the assignment, which will be updated in the database for future reference or modifications. (Figure 6).

Send Message

It involves an agent interacting with the system to provide reservation details, create a message, and send it to the user via the notification server. This process may include extensions, such as the agent contacting the user directly for additional support. The use case highlights the system's ability to facilitate communication between agents and users to resolve issues or confirm changes. (Figure 6).

Change Flight

Allows a "Person" to modify an existing flight reservation. The user begins by navigating to the change flight page, where the system verifies if the ticket is eligible for changes. The user can search for new flight options, confirm the selected flight details, and finalize the changes. This may involve canceling the previous flight and processing additional payments through the payment gateway. Once completed, the system updates the flight change in the database. This use case highlights the system's flexibility in accommodating users' evolving travel needs. (Figure 6).

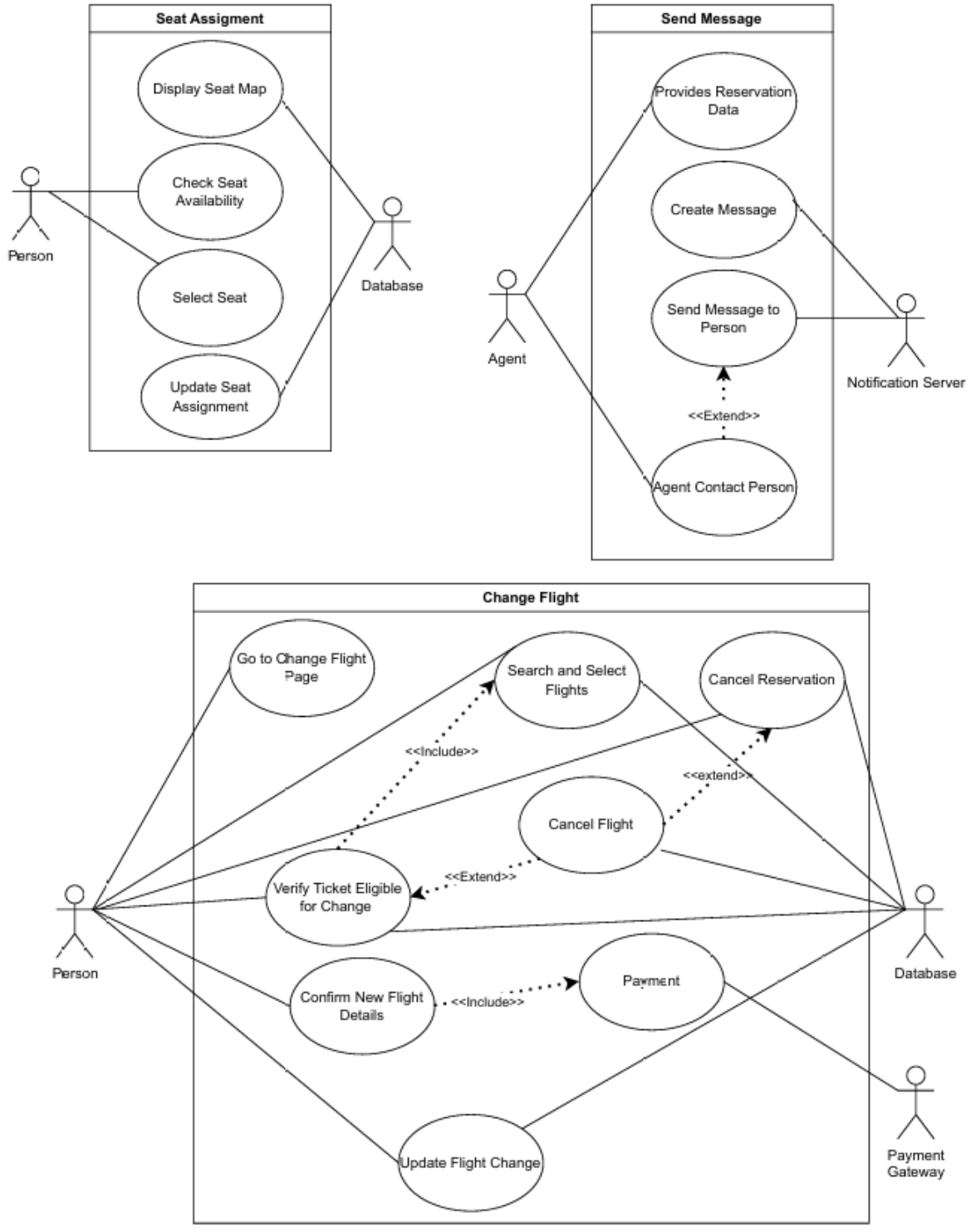

Figure 6. Diagram made with Draw.io by Team 2

Make Payment

Describes the process a "Person" follows to complete a payment for a service or booking. The process starts when the user initiates the payment and selects their preferred payment method—credit or debit. Depending on the user's choice, the user enters the corresponding card information and provides their billing details. Before finalizing the transaction, the user must agree to the terms and conditions, ensuring compliance with legal and policy requirements. The payment is then processed through the payment gateway, which securely completes the transaction. This use case highlights a streamlined and secure workflow, ensuring user convenience and system reliability during financial transactions. (Figure 7).

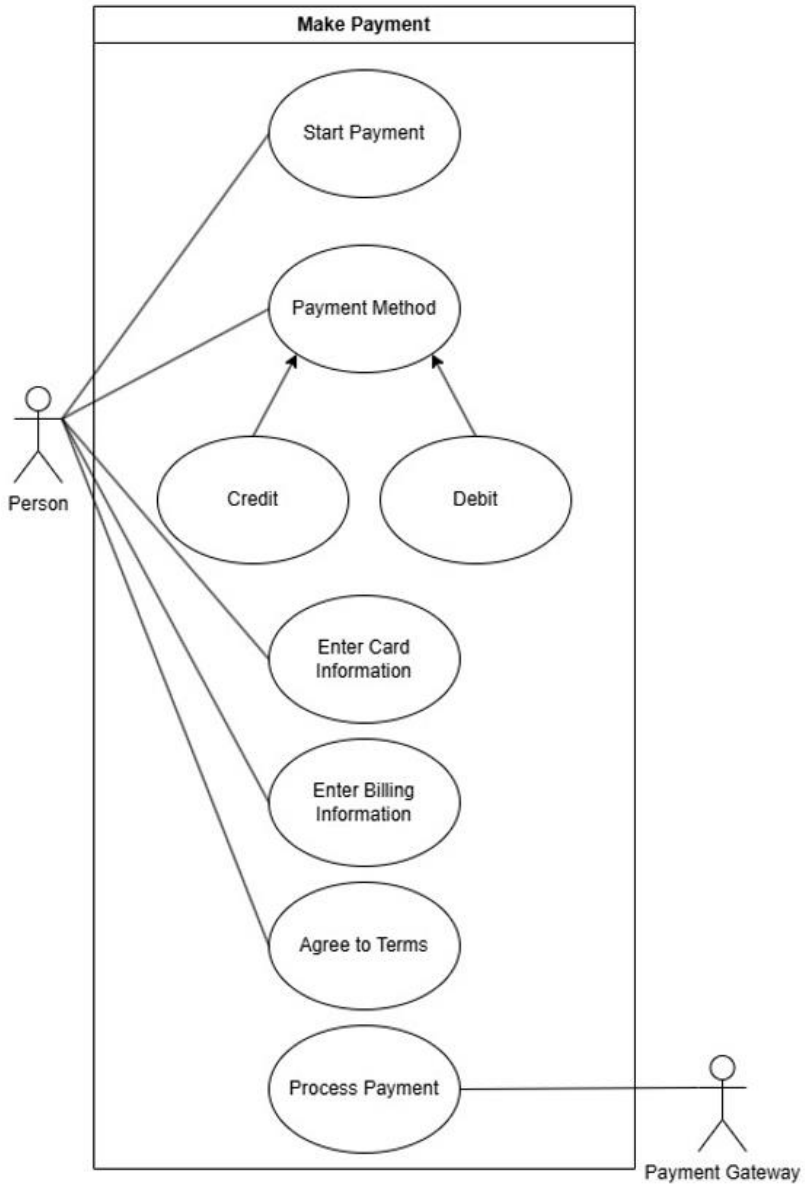

Figure 7. Diagram made with Draw.io by Team 2

Check-In Baggage

Outlines the steps a "Person" follows to check in their luggage. The process begins by accessing the baggage section and selecting the type of baggage they are checking in. The user specifies the number of baggage pieces and confirms the baggage details and associated fees. The system interacts with the database to validate the details and calculate the cost. If applicable, the process includes payment, handled through the payment gateway, ensuring all expenses are settled before completing the check-in. (Figure 8).

Baggage

It allows a "Person" to view and track their checked luggage. Users can access the baggage section to view their baggage details, including location and status, by retrieving data from the database. This ensures transparency and reassurance for travelers regarding their belongings during transit (Figure 8).

View Flight Status

Describes how a "Person" checks the current status of a flight. The process starts with the user entering a reservation or flight number, which the system uses to retrieve flight status from the database. The user can view detailed flight information clearly, including updates or delays. If required, the system can extend this functionality to include rebooking options in case of flight disruptions. Notifications about flight status are sent via the notification server, ensuring the user stays informed. This case emphasizes real-time updates and user communication. (Figure 8).

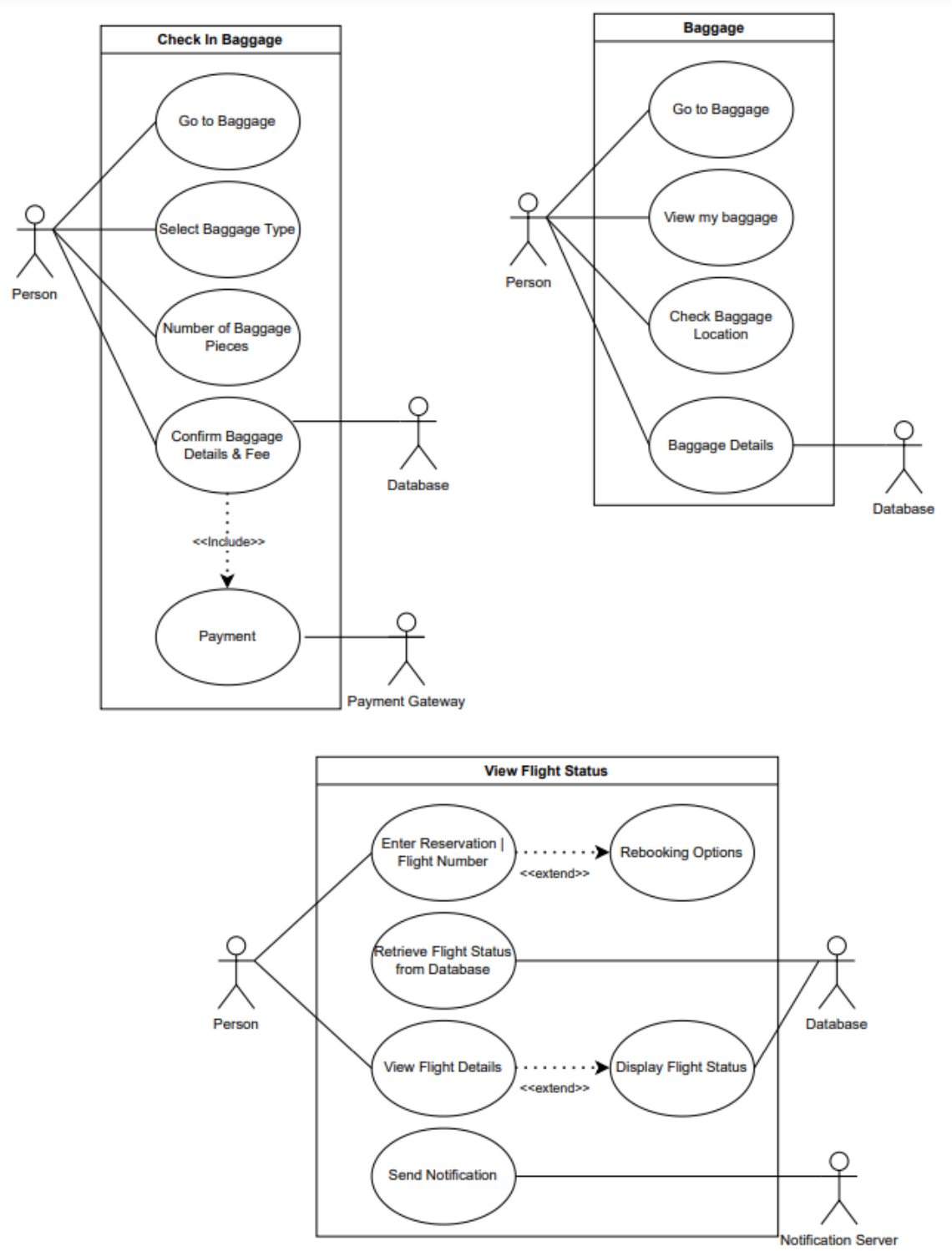

Figure 8. Diagram made with Draw.io by Team 2

Status & Add Points Loyalty Program

Allows a "Person" to manage their loyalty points. Users can check their current point balance, calculate points earned from recent transactions, and add them to their accounts. The system interacts with the database for real-time updates and the point management system to ensure accurate rewards for frequent travelers. (Figure 9).

Check-In

It enables a "Person" to complete the pre-flight check-in process. The system retrieves flight details from the database, and users can view flight information, check in baggage, and change their check-in status. Additionally, the system generates a boarding pass through the pass generator and provides options to send messages or updates via the notification server, ensuring smooth and efficient check-in (Figure 9).

View Booking History

It allows users to access past bookings. The system retrieves booking history from the database, enabling users to review previous trips. This feature enhances record-keeping and provides an easy way for passengers to access historical booking details (Figure 9).

Request Special Assistance

It enables a "Person" to submit requests for additional help, such as mobility or medical assistance. The user selects the needed assistance type, retrieves passenger details from the database, and confirms the request. The system saves assistance requests and sends notifications to the ground or flight crew via the notification server to ensure timely support (Figure 9).

Select Meal Preferences

Allow a "Person" to choose their meal options for an upcoming flight. Users can view available meal options, retrieve passenger details, and select a meal. Once confirmed, the system stores the preference in the database and sends a confirmation notification via the notification server, ensuring a personalized travel experience. (Figure 9).

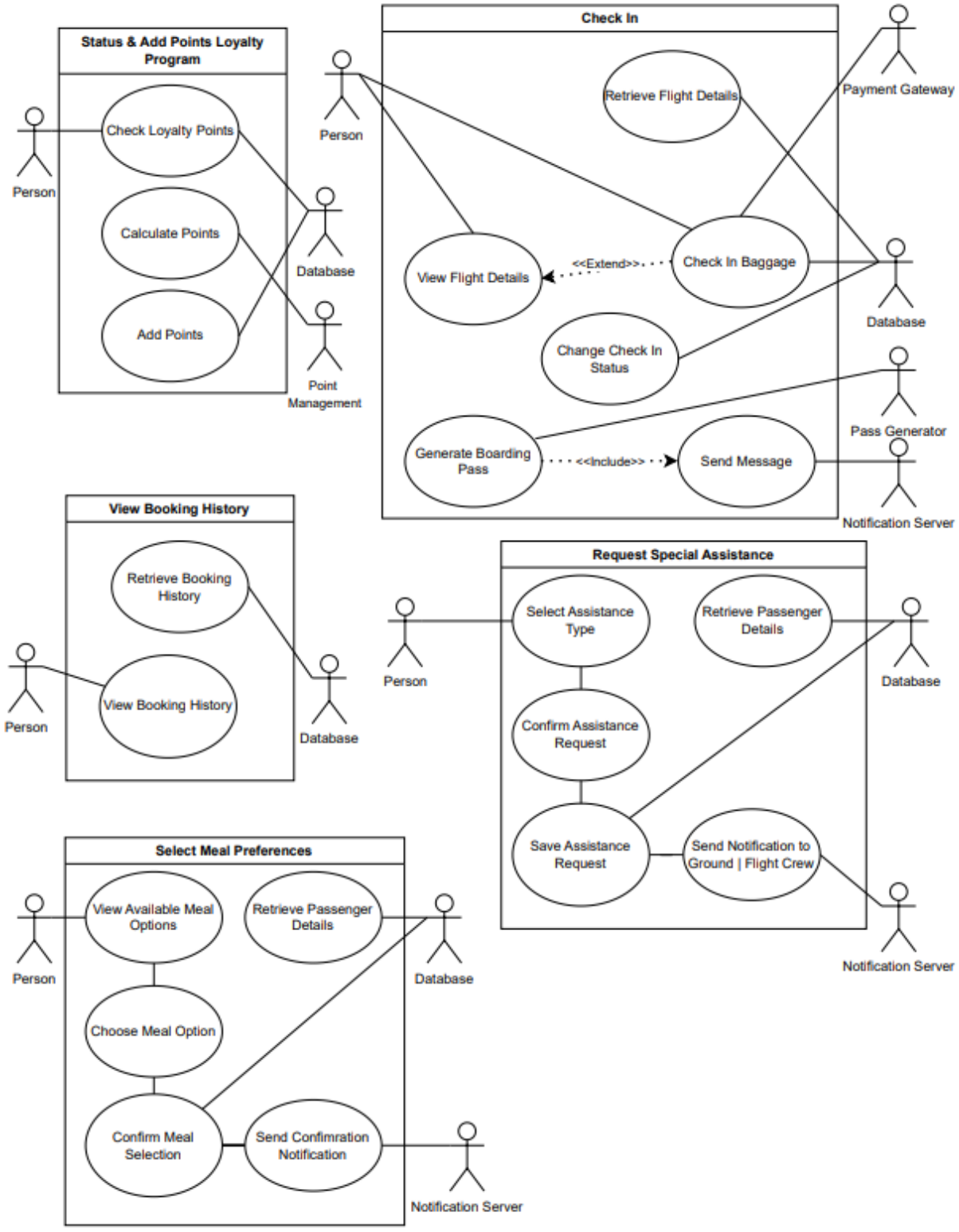

Figure 9. Diagram made with Draw.io by Team 2

Sample Web Pages

Home/Search Flights Page

The Home or Search Flights page serves as the primary entry point for users engaging with the Draig Airline reservation system. Positioned at the top, the page includes essential navigation options, such as links to log in, sign up, or access user profiles, accompanied by the airline's logo for brand consistency. Centrally located, a search interface allows customers to input key travel parameters, including departure and destination locations, travel dates, and flight class. Directly below, a prominently displayed "Search" button initiates the search process, providing a seamless entry into the booking experience. Additional filters, such as airline preference, number of stops, flight duration, and price range, allow for tailored search results. Featured travel offers and promotional destinations are showcased above the search bar, encouraging users to explore popular or discounted options at a glance.

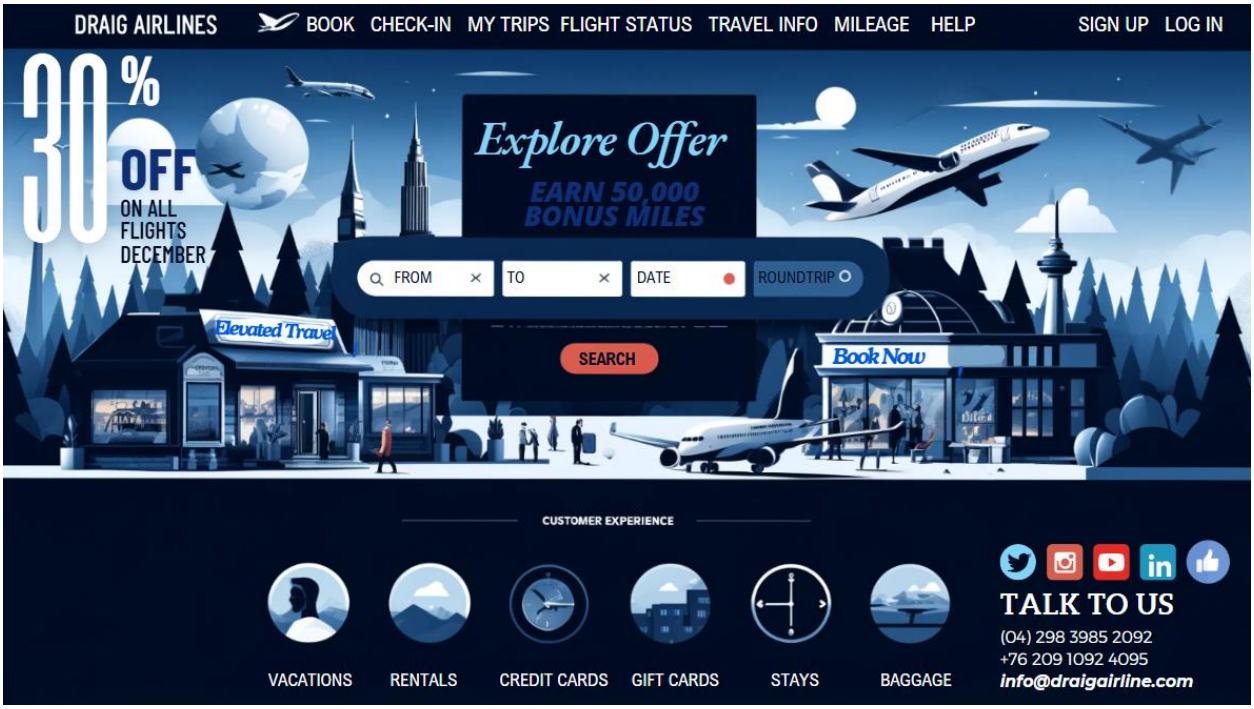

Figure 10. Sample Website made using Canva.com by Team 2

Flight Details & Booking Page

Following the selection of a flight, users are directed to the Flight Details and Booking page, which provides comprehensive information about the chosen itinerary. Key flight details such as departure and arrival times, total travel duration, and layover specifics are displayed to aid in decision-making. An interactive seat map is included, enabling users to select their preferred seating arrangement. A passenger information form collects essential travel details, such as name, date of birth, and passport number, facilitating a secure and personalized booking process. Options to add extra baggage are presented, with a clear breakdown of any associated fees. A summarized payment section at the bottom of the page details the fare, taxes, and any additional charges, followed by a “Proceed to Payment” button guiding users to the transaction stage.

Figure 11. Sample Website made using Canva.com by Team 2

User Profile & Account Management Page

The User Profile and Account Management page provides a dedicated space for users to manage their personal and account information. This page includes sections for updating personal details, such as name, contact information, and address, each with an “Edit” option for easy modification. Users can also adjust their communication preferences, allowing them to opt in or out of notifications via email or SMS. Users may also select their in-flight meal or disability mobility assistance if needed. The page displays accumulated points, status, and available benefits for customers enrolled in the loyalty program, with a “Redeem Points” option for those wishing to utilize rewards. A booking history section also lists past reservations, enabling users to view details of previous flights or request invoices, thereby enhancing record-keeping and post-travel management.

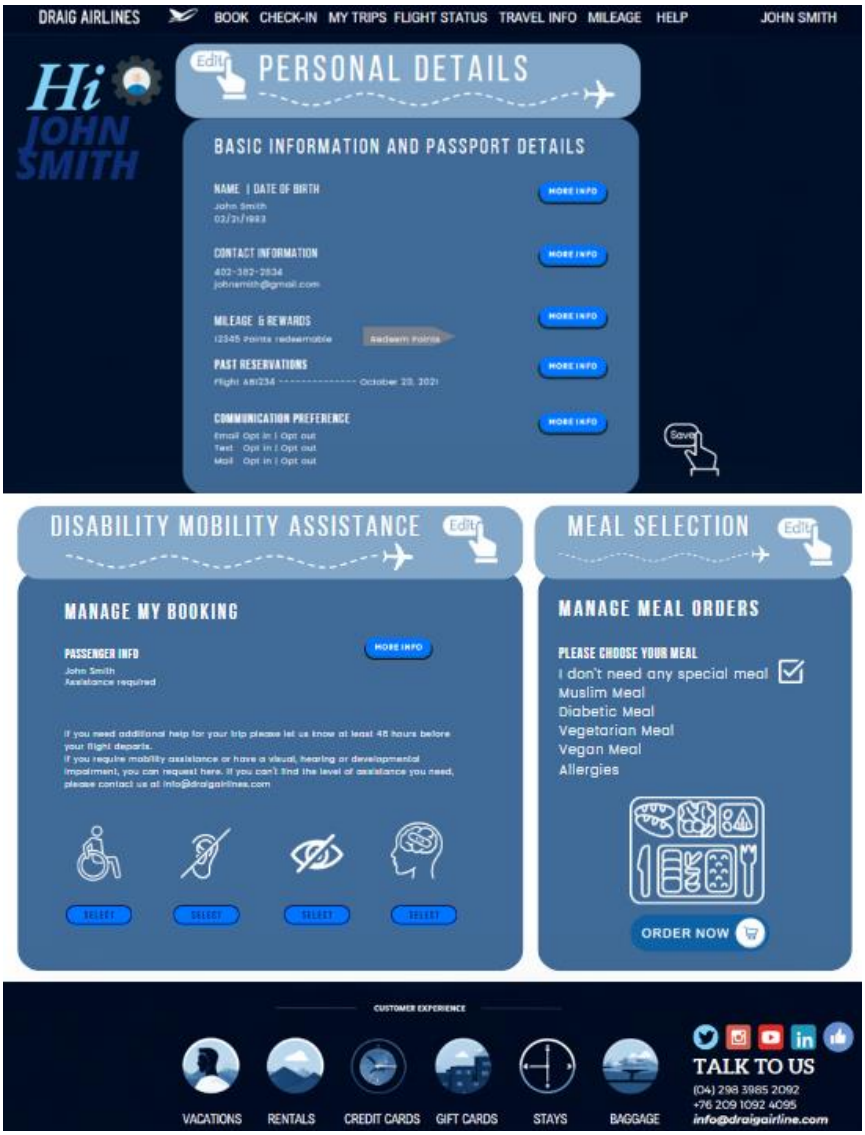

Figure 12. Sample Website made using Canva.com by Team 2

Check-In Page

The Check-In page streamlines the pre-departure process, allowing passengers to confirm travel details and generate a digital boarding pass. Initial sections of the page display pertinent flight information, such as departure time, terminal, and gate assignment. An easy-to-complete check-in form permits users to confirm seat selection and update baggage requirements if necessary. Upon completion, users can click a button to generate their digital boarding pass, with email or SMS delivery options to facilitate on-the-go access. Additional features allow passengers to request specific meal preferences or extra baggage, aligning with diverse passenger needs and enhancing the overall travel experience.

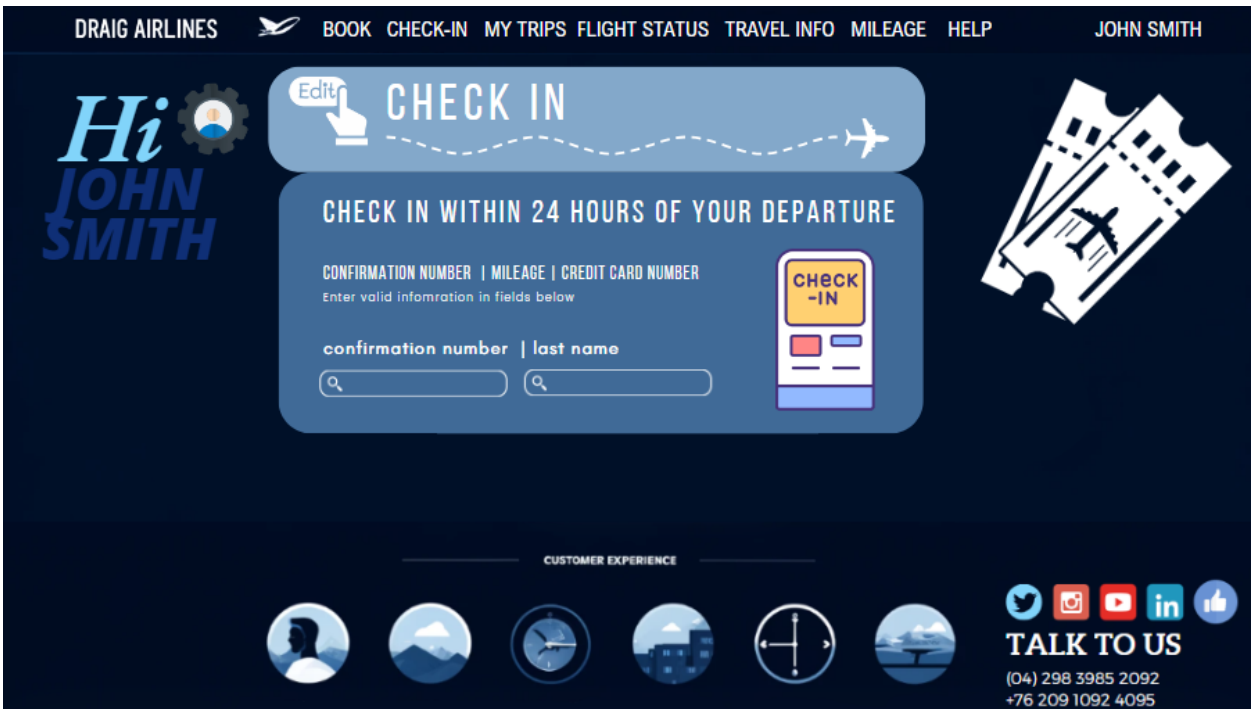

Figure 13. Sample Website made using Canva.com by Team 2

Conclusion

The Draig Airlines online reservation system is a strong, user-oriented web application designed to improve the customer experience of travel while making the internal process for the airline smoother. By integrating flight search, booking management, and secure payment processing into core functionalities to include personalized features like meal preferences and special requests for assistance, the system caters to diverse passenger needs. Such updates in real-time, loyalty program integrations, and smoothness of the user

interface drive customer satisfaction and engagement. To the airline, the system affords reservation management, flight status monitoring, and passenger issue resolution with the security of data and conformity to the set industry standards. This comprehensive solution cements Draig Airlines' position as a leader in modern travel technologies, meeting current demands while anticipating future industry challenges.

Specification Using the Zachman Framework

Introduction

The Zachman Framework is a schema that helps organize enterprise architecture artifacts that bridge the gap between an organization's business goals and the IT systems and processes that support them. It does this by helping organize and make sense of the different perspectives and components of business strategies and IT solutions. The Zachman Framework uses 36 categories organized in six rows and six columns. These rows represent the perspectives of each type of stakeholder involved in the project, and the columns outline the questions surrounding the architecture. Using this approach, Draig Airlines can ensure its IT architecture meets operational needs and supports business goals such as scalability, security, and customer satisfaction.

Overview of Zachman Framework Columns

What (Data)

Focus on identifying and maintaining data for Draig Airlines' operating needs. This includes passenger details, booking data, maintenance records, and loyalty program information.

How (Function)

The processes and systems that run Draig Airlines' operations are the processes and systems. This includes how customers book tickets, flights are scheduled, and luggage is tracked from check-in to leaving the destination airport.

Where (Network)

Identifies systems' physical and logical locations that involve Draig Airlines' operations to ensure connectivity and accessibility to the systems. This includes data stored in the cloud or in the data center. Employees and customers access these systems from different locations.

Who (People)

This section specifies the people and roles involved in Draig Airlines' operations. This includes the customers/passengers, ground staff, flight crew, and IT team.

When (Time)

Defines and manages events, schedules, and temporal aspects that involve Draig Airlines' operations. This includes flight schedules, booking deadlines, maintenance schedules, and compliance deadlines.

Why (Motivation)

This outline outlines Draig Airlines' goals, objectives, and motivations. These include reducing costs, improving customer experience, and operational efficiency. The company also aims to meet industry standards, be competitive, and expand services.

Draig Airlines' ISA Participant Perspectives

Strategic Visionary (Scope)

This perspective aligns IT systems with Draig Airlines' long-term vision and business objectives. It ensures that systems are scalable to support future growth, improve customer satisfaction by reducing wait times, and enhance overall operational efficiency by introducing seamless integrations for reservations and ticketing processes.

Business Architect (Business Model)

Responsible for designing and optimizing business processes supported by IT, this perspective ensures that operational goals are met effectively. Examples include streamlining reservations, ticketing, and loyalty programs by integrating systems to create a smoother customer journey and faster, more reliable service.

System Architect (System Model)

This role involves developing logical models and workflows to define how systems interact and operate cohesively. For instance, designing the Entity-Relationship Diagram (ERD) to manage flight, passenger, and reservation data efficiently or proposing APIs for real-time booking updates and third-party integrations reflects this perspective.

Technical Engineer (Technology Model)

This perspective focuses on defining the detailed technical specifications for implementing IT infrastructure. Examples include selecting cloud-based servers for hosting data, developing secure APIs for inter-system communication, and implementing robust security protocols to protect customer and operational data.

Operations Specialist (Components)

This perspective oversees the physical and deployed components of IT systems, ensuring that the infrastructure is reliable and efficient. Examples include managing IoT devices like airport kiosks, ensuring high-performance data storage systems, and maintaining hardware for ticketing and boarding operations.

End User (Operations)

This role represents the needs and experience of those interacting with the systems daily, focusing on usability and satisfaction. Examples include designing an intuitive user interface for the reservation system, optimizing mobile app features for ticket purchasing, and enabling real-time flight status updates to enhance the passenger experience.

Perspective	What (Data)	How (Function)	Where (Network)	Who (People)	When (Time)	Why (Motivation)
Strategic Visionary	Vision and Organizational Goals from **Information Technology Strategy**, focusing on data such as customer profiles, ticketing, and flight schedules.	Automation plans outlined in Technologies to Adopt include cloud platforms and API-first architecture.	Locations of Services are described in the IT Architecture Growth Path.	The constituencies Served section identifies customers, partners, and regulatory bodies.	Phase 1–3 Timelines in the Growth Path of IT Architecture.	Strategic focus on scalability and operational efficiency from Vision.
Business Architect	ERD Key Entities such as Customers, Reservations, and Flights from Data Architecture Strategy.	Use Case Diagram functionalities, booking, and modifying reservations from **Information Technology Architecture for Draig Airlines' Online Reservation Design**.	Cloud-based Platforms and distributed systems integration from **Information Technology Strategy**.	Airline staff and customer roles from Use Case Diagrams in **Information Technology Architecture for Draig Airlines' Online Reservation Design**.	Dynamic Processes like real-time booking updates described in **Information Technology Architecture for Draig Airlines' Online Reservation Design**.	Organizational goals focus on enhancing customer engagement and service scalability.

System Architect	Entity-Relationship Diagram (ERD) detailed in **Data Architecture Strategy**.	API Management and Microservices Design detailed in **Technical Architecture Strategy**.	Logical Database and API Locations as per the network diagram in **Technical Architecture Strategy**.	Roles like Developers and Administrators identified in **Technical Architecture Strategy**.	Real-time operational data exchange from Data Management and Analytics.	Technical goals emphasizing system integration and AI-driven insights.
Technical Engineer	Database Schemas API specifications from **Data Architecture Strategy**.	Implementation details for Payment Gateways and other system APIs in **Information Technology Architecture for Draig Airlines' Online Reservation Design**.	On-Premise and Cloud Storage configurations described in **Technical Architecture Strategy**.	IT roles such as Cloud Infrastructure Specialists and API Engineers from **Information Technology Strategy**.	Deployment Timelines for system rollouts detailed in **Information Technology Strategy**.	Ensuring reliability and scalability through Hybrid Database Systems.
Operations Specialist	Real-time tracking and maintenance data points in **Technical Architecture Strategy**.	Integrated customer and ticketing systems, as in **Information Technology Architecture for Draig Airlines' Online Reservation Design**.	Network Diagrams for routers, switches, and terminals from **Technical Architecture Strategy**.	Operational staff engaging with deployed systems described in **Technical Architecture Strategy**.	Update Schedules and monitoring timelines detailed in **Technical Architecture Strategy**.	Minimizing downtime and ensuring operational integrity.

End User	User interface wireframes or prototypes showcasing accessible data, such as flight options and reservation details.	Functional design documents specifying user interactions like booking and managing reservations.	Access points such as mobile apps, web portals, and kiosks described in UI/UX system specifications.	Documentation highlighting passengers and their interaction with the system, outlined in user personas or stakeholder descriptions.	Timeline for interface updates or user notification schedules (real-time flight status updates).	Goals for customer satisfaction through enhanced interface usability.

Deliverables and their Zachman Placement

Information Technology Strategy

Rows: Strategic Visionary, Business Architect

Columns: Why, What, How

Artifacts: Vision, goals, guiding principles, and high-level workflows for the IT architecture.

Technical Architecture Strategy

Rows: Technical Engineer, Operations Specialist

Columns: Where, How, What

Artifacts: Infrastructure designs (servers, IoT devices), API specifications, and deployment strategies.

Data Architecture Strategy

Rows: System Architect, Technical Engineer

Columns: What, Who, How

Artifacts: ERD, data integration workflows, and system interoperability designs.

Information Technology Architecture

Rows: Business Architect, End User

Columns: What, How, Who

Artifacts:

Use Case Diagram: Placed in How/Business Architect, representing system workflows.

Actor Descriptions: Placed in Who/Business Architect, capturing roles and responsibilities.

Use Case Descriptions: Placed in How/End User, explaining detailed user interactions.

Interface Design: Placed in How/End User, focusing on user-facing functionality.

Impact Statement for Draig Airlines

Impact on Activities

Enhanced Operational Efficiency

Integrating distributed systems with cloud platforms like AWS will enable real-time data sharing and synchronization across departments. This will, for example, reduce baggage handling errors and cut processing times by an estimated 20%, directly improving operational flow.

Predictive maintenance supported by IoT sensors will reduce aircraft downtime by up to 15%, minimizing schedule disruptions and improving asset utilization.

Improved Customer Satisfaction

Offering features like real-time updates, personalized offers, and self-service options is expected to improve customer satisfaction scores by at least 10% within the first year. These enhancements will also contribute to a projected 8% increase in customer retention rates.

Seamless booking and check-in processes will likely reduce customer complaints about system errors or delays by 30%.

Better Decision-Making

Advanced analytics platforms will unify operational, customer, and third-party data, enabling leadership to make faster, data-driven decisions. This is expected to reduce response times to market changes by 25%.

Automated compliance reporting to bodies like the FAA and TSA will avoid regulatory fines ranging from $50,000 to $1 million per infraction, safeguarding Draig Airlines financially and reputationally.

Benefits

Quantifiable

Cost Reduction

- Happier employees and streamlined workflows will reduce employee turnover by 15%, saving approximately $5,000–$10,000 per replaced employee in recruitment and training costs.
- Consolidating data systems and migrating to the cloud will cut IT infrastructure costs by 20%, translating to an annual savings of $500,000.

Increased Revenue

- Partnerships with ticketing platforms like Amadeus and Sabre will increase market reach, driving an estimated 12% increase in ticket sales annually.
- AI-enabled personalized marketing campaigns and dynamic pricing will boost ancillary revenue streams, such as seat upgrades and in-flight services, by up to $1.2 million annually.

Non-Quantifiable

Enhanced Brand Reputation

- Enhanced customer experiences through personalized services and dynamic pricing to boost ticket sales and loyalty program participation.
- Expanded partnerships with third-party ticketing platforms like Amadeus and Sabre increase Draig Airlines' market reach.
- Cutting-edge technology will position Draig Airlines as a customer-centric and innovative industry leader, fostering long-term loyalty.

Increased Employee Satisfaction

- Employees experience improved workflows and reduce repetitive tasks, enabling them to focus on value-added activities and boosting morale and productivity.
- Reliable and efficient systems create a better working environment, reducing frustration and enhancing collaboration among staff.
- Reduced workload and access to efficient tools will improve morale, leading to a more collaborative work environment.

Regulatory Compliance and Risk Mitigation

- Automated data sharing and reporting with regulatory bodies like the FAA and TSA will ensure compliance, reduce manual errors, and enhance security measures.
- Blockchain integration in cybersecurity systems will protect sensitive data and minimize risks of breaches or fraud.

Costs

Financial Costs

Financial Investments

- **Initial Investments:** Procurement of cloud platforms, IoT devices, AI-driven analytics tools, and cybersecurity systems.
    - Estimated cost: $10 million upfront.
- **Ongoing Costs:** Maintenance, cloud subscriptions, and vendor contracts.
    - Annual expense: $2.5 million.

Human Resource Costs

- **Systems Analysts:** Responsible for requirements gathering and ensuring alignment with business objectives.
    - Estimated annual salary: $90,000–$120,000 per analyst.
- **Software Developers:** Handle custom application development and API integration.
    - Team cost: $150,000 annually per developer.
- **Testers and QA Specialists:** Ensure system reliability and minimize bugs before deployment.
    - Annual salary: $80,000 per tester.
- **Project Managers:** Oversee timelines, budgets, and deliverables.
    - Estimated cost: $120,000 annually per manager.

Resource Allocation for Migration

- Data engineers will handle the migration of historical data from legacy systems.
    - Estimated cost: $50,000–$100,000 for the entire migration process.
- Cross-department collaboration will require temporary reallocation of operational staff for training and transition support.

Change Management Costs

- Investments in communication and training programs for employees across departments to adapt to new technologies.
- Time and effort are required to phase out legacy systems while ensuring minimal disruption to current operations.
- Communication and training programs to ensure all employees can effectively use the new systems.
    - Estimated cost: $500,000 for workshops and ongoing sessions.

Resource Costs

Employee Training

- Time and resources must be allocated to train staff on the new systems, including workshops and certifications.

System Migration

- Moving from legacy systems to modern IT architecture will require considerable effort and expertise to ensure data integrity and minimal disruptions.

Change Management Costs

Coordinating efforts across various departments to adapt to new workflows and processes will demand leadership focus and dedicated change management teams.
Addressing potential resistance to change among employees will involve tailored communication and support programs.

Preparation

Leadership Alignment

Establish clear goals and timelines to align leadership with the transformation strategy. Frequent updates and stakeholder meetings will ensure continued buy-in and support.

Comprehensive Training Programs

Conduct role-specific training for staff on new systems, such as cloud platforms, AI tools, and APIs. Workshops, certifications, and hands-on sessions will ensure proficiency.

Phased Implementation Plan

Phase 1: Foundational Setup

- **Actions**
  - Migrate critical systems, such as reservations and ticketing, to a cloud-based architecture. Establish API frameworks to facilitate real-time data exchange between legacy and modern systems.
- **Transition**
  - Use ETL tools to preserve key data (flight logs, maintenance records) for secure migration. Legacy systems handling outdated workflows, such as manual check-in processes, will be gradually phased out.

Phase 2: Operational Enhancements

- **Actions**
  - Deploy AI tools for predictive maintenance and dynamic pricing. Replace siloed systems with microservices-based solutions for scalability and flexibility.
- **Transition**
  - Legacy scheduling systems and static pricing models will be retired for real-time, automated systems that better match current demands.

Phase 3: Competitive Differentiation

- **Actions**
  - Introduce advanced customer engagement tools like loyalty program analytics and personalized in-flight experiences. Optimize mobile and web platforms to meet evolving customer expectations.
- **Transition**

    - Abandon redundant manual processes, such as paper-based ticketing and manual customer feedback collection, that have been replaced by automation.

Legacy Elements: Salvaged vs. Abandoned

- **Salvaged**
    - Historical data for reservations, maintenance logs, and customer profiles.
    - Partially functional systems that can integrate with new APIs, such as certain ticketing components.
- **Abandoned**
    - Obsolete hardware like mainframes incompatible with cloud architecture.
    - Siloed software modules that fail to support real-time data sharing.

Stakeholder Collaboration

Establish partnerships with third-party providers, including ticketing platforms, regulatory agencies, and suppliers, to ensure seamless integration and real-time data sharing.
Engage with key internal stakeholders to communicate benefits and foster organizational support.

Monitoring and Evaluation

Implement performance metrics, such as customer satisfaction scores, operational efficiency metrics, and revenue growth, to track progress and measure success.
Establish feedback loops to address challenges and refine the real-time implementation process.

Data Migration and Legacy Transition

Salvage critical data such as historical flight logs and maintenance records for use in the new system.
Thoughtfully abandon outdated hardware and software that cannot integrate with modern platforms, minimizing unnecessary complexity.

Performance Metrics

Operational Metrics

- **Downtime Reduction**
    - Measure the percentage reduction in system outages and aircraft unavailability.
- **Process Speed**
    - Evaluate the time saved in workflows like baggage handling and check-ins.

Customer Metrics

- **Satisfaction Scores**
  - Track improvements in post-flight surveys and reviews.
- **Loyalty Growth**
  - Monitor increases in frequent flyer enrollment and points redemption rates.

Financial Metrics

- **Cost Savings**
  - Compare pre- and post-implementation labor and infrastructure expenses.
- **Revenue Growth**
  - Analyze increased ticket sales and ancillary service revenue driven by customer engagement tools.

Innovation Metrics

- **Automation Adoption**
  - Assess the number of processes automated by AI or IoT.
- **Data Utilization**
  - Track the volume and quality of insights generated from analytics platforms.

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