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University of Texas at Dallas

Cargo Connect: Improving Airport Freight Flow

Group 1

Authors

FNU Anuja

Smit Soneshbhai Patel

Bradley Evan Stover

Chijioke Elisha-Wigwe

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INTRODUCTION

Airports serve as critical hubs for global trade, yet inefficiencies in freight operations such as restricted access controls, fragmented data ecosystems, and infrastructure bottlenecks result in delays, missed deadlines, and increased costs. The Cargo Connect project addresses these challenges by proposing a solution that leverages real-time data integration, predictive scheduling, and adaptive routing algorithms. This feasibility study evaluates the viability of the project across technical, economic, operational, legal dimensions, and feasibility matrix to determine whether it aligns with stakeholder needs and delivers measurable value.

Purpose

This feasibility study evaluates a comprehensive system redesign that will:

- Assess the technical and operational viability of freight management platform.
- Validate the economic benefits and return on investment.
- Ensure compliance with aviation security standards and data protection regulations.
- Provide decision-makers with actionable insights for project implementation.

Scope

The project encompasses three interconnected domains.

- Intelligent Access and Resource Management
    - RFID/barcode-based vehicle authentication.
    - Dynamic allocation of loading/unloading bays.
    - Smart parking management with real-time availability tracking.
    - Automated routing to optimal airport exits based on destination.
- Predictive Operations Platform
    - Real-time aircraft arrival monitoring and freight release time prediction.
    - Priority-based cargo loading orchestration.
    - Emergency handling and congestion management.
    - Dynamic route optimization.
- Unified Data Ecosystem
    - Integration of disparate data sources (airport systems, customs, carriers) for the admin. Admin will provide under scope data for all stakeholders.
    - Admin will have real-time visibility and decision support dashboards of all the data.

Operational Efficiency

- Reduce the vehicle waiting time by 20%.
- Improve the Bay utilization by 15%.
- Reduce the internal transit time for vehicles by 25%.
- Increase the on-time delivery of cargo by 30%.

ECONOMIC FEASIBILITY ANALYSIS

We believe this project is economically feasible. After doing a cost-benefit analysis, we have determined that the upsides outweigh the cons; we also posit that the return on investment will be substantial. All of this is outlined below.

Cost-benefit analysis

The work required to do things such as integrating with existing systems/databases/providers, authenticating DALI-registered vehicles, and providing dashboards displaying real-time metrics will be formidable. However, the cost is that airport traffic will remain logjammed to a significant degree, with delays across the spectrum at a major expense to logistics carriers. In other words, if things stay the way they are, profits will continue to be lost as a direct result of freight inefficiencies at airports. We believe that the cost of development is worth it because the opportunity to stop revenue from continuing to flow out this way is an important one to seize. Our solution will require many hours of labor in the form of tasks such as project planning and coding, but this downside is outweighed by the immense likelihood of the current problem staying the same without intervention.

Return on investment

The prospect of fewer delays and increased efficiency overall at airports could boost profits significantly in the long term. A few months' worth of investment in software engineering labor could produce returns for years to come if the software is properly maintained over time by the recipient(s), allowing for longstanding benefits such as greater coordination of resources and real-time visibility of data. Upsides such as these would be indispensable to the bottom line of a business in the long run.

TECHNICAL FEASIBILITY ANALYSIS

Intelligent Access and Resource Management

- **RFID/Barcode Vehicle Authentication System**: This is technically feasible with secure, real-time scanning. But we are aware of some of the challenges involved in achieving reliability in such environments of high traffic.
- **Dynamic Allocation of Loading/Unloading Bays**: This requires real-time data processing and advanced predictive algorithms to ensure efficient allocation of bays, while considering delays and cargo handling times.
- **Smart Parking Management**: This uses Internet-Of-Things (IoT) sensors for real-time monitoring and tracking of space availability. However, challenges involved scalability and data flow management.
- **Automated Routing to Optimal Exits**: With machine learning and GPS, we can automate routing. Achieving real-time accuracy in changing traffic conditions is vital.

Predictive Operations Platform

- **Aircraft Arrival Monitoring and Freight Release Prediction**: This is feasible by the integration of flight tracking data and using machine learning techniques to predict release times using both historical and real-time data.
- **Priority-Based Cargo Loading**: This needs smart scheduling and dynamic interaction with handling of cargos to ensure that loading based on priority and with high efficiency. However, ensuring this is done in real-time can be complex.
- **Emergency Handling and Congestion Management**: With machine learning and effective predictive algorithms, we can attain this goal. But we must ensure that the system is able to act quickly to reduce disruptions.
- **Dynamic Route Optimization**: This is feasible with GPS, weather, and real-time traffic data. But there are challenges with ensuring fast and efficient updates under unsteady conditions.

Unified Data Ecosystem

- **Integration of Data Sources**: This is feasible with API and middleware integrations but standardizing and managing disparate data streams from various systems like airports, customs, carriers, is challenging.
- **Real-Time Admin Dashboard**: This is also feasible with Business Intelligence (BI) tools. However, it needs advanced decision support, actionable insights and predictive alerts to ensure that the admin can effectively manage operations.

Overall Feasibility

The technologies involved for RFID, IoT, GPS, ML, etc., are available and proven, but combining them into one coordinated, real-time, seamless, and scalable system for airport logistics is a challenging problem. It involved specialized optimizations in data flow and system integration. While this is technically feasible, a strong infrastructure and skilled and organized team will be essential to bring it all together.

OPERATIONAL FEASIBILITY ANALYSIS

Operational feasibility evaluates whether the proposed system will solve business problems effectively and integrate smoothly into daily workflows.

Workflow Integration

- **RFID Access Control:** Replaces manual security checks for DALI-registered vehicles, reducing entry/exit processing time.
- **Unified Dashboard:** Consolidates data from cargo companies, customs, and truck operators into a single interface (DALI) that provides role-based access for making better decisions.
- **Dynamic Scheduling:** Application will dynamically schedule the loading/unloading time slots for the trucks based on the Cargo arrival time, road traffic with the help of the DALI application.

User Training

- **Minimal Learning Curve:** The mobile app's intuitive design requires minimum **training sessions.**
- **Advanced Training:** Admin panel receives workshops on dashboard analytics and emergency protocols.

Stakeholder Collaboration

- **Airport Authorities:** Automated bay assignments reduce congestion at unloading zones, aligning with their goal to maximize terminal throughput.
- **Logistics Carriers:** Real-time aircraft arrival notifications let carriers adjust schedules preemptively, minimizing idle time.
- **Customs:** Secure API integration ensures compliance while accelerating clearance for authorized shipments.

SCHEDULE FEASIBILITY ANALYSIS

Schedule feasibility evaluates if a project can be finished in the allotted amount of time. It involves evaluating the project's schedule, goals, and possible obstacles to make sure it can be completed on schedule and with all its goals met.

- Estimated project duration: The duration of project is 3 months.
- Can all the milestones and completion date schedules be met?
    - For the freight transportation problem, milestones include:
        - Requirement gathering, Planning and design – Month 1
        - Development and integration – Month 2
        - Testing, Deployment, and training – Month 3
    - By limiting the requirements to few, with proper project management and team planning, the milestones can be met in 3 months.
- For this project, 3-month deadline is mandatory as this project is confined to only one semester. Hence, the requirements are limited.
- Learning curve duration would be few days in the final month. Learning curve for users to adopt to new system can be minimized by:
    - Providing training session.
    - Designing a user-friendly interface.

Tentative project plan

- Month 1
    - Design and Planning
    - Collect and analyze requirements.
    - Complete the design architecture, features, and scope.
    - Create prototypes.
- Month 2
    - Integration and Development
    - Create the essential functions, such as scheduling, real-time tracking, and notifications.
    - Connect to external systems (such as airport systems, traffic APIs, and GPS).
    - Perform preliminary testing on each module separately.

- Month 3:
    - Deployment, Training, and Testing
    - Conduct thorough testing, including security, performance, and functional testing.
    - Organize end-user training sessions.
    - Complete the system based on user input and fully implement it.

Will the project be useful by the time it is completed?

The proposed solution will improve efficiency, reduce delays, and optimize resource utilization. Hence it will be very helpful in addressing freight transportation challenges.

LEGAL FEASIBILITY ANALYSIS

In terms of copyright infringements, failing to respect patents could result in lawsuits or forced removal of critical features. This applies to trademarks as well. Proper patent research and trademark clearance must be planned out ahead of time to avoid any future trouble.

As far as privacy concerns go, privacy laws must be a major focus due to the involvement of customer data in the mix. Tracking the movement of drivers and their behavior in real-time also poses potential issues with surveillance. Transparency of data practices will be a critical component of the project.

Adhering to labor laws is essential. This includes both federal and local statutes. Work hours, wages, worker benefits, and other similar matters must be respected so that they are in compliance with regulations across the board.

There are times when software or data shared under a licensing agreement may not be used for other purposes, or certain regions may be off-limits. A violation of these terms could result in legal action, financial penalties, and/or termination of agreements.

In terms of operational licenses, there must be verification that drivers and operators meet the regulatory requirements in each area where the service is operable. A lack of compliance could result in fines and even a delay in project rollout.

Health and safety concerns apply to drivers in particular and must be prioritized in all aspects of design. Any violation of health and safety rules could have catastrophic consequences, exposing the project to unnecessary liability.

Environmental impact must be assessed by looking especially at emissions, fuel consumption, and how vehicles affect local air quality. A project of this scale will require compliance with local environmental laws and regulations around noise, emissions, and resource use.

Copyright Infringements (IP, Patents, Trademarks, etc.)

– A failure to respect patents could result in expensive lawsuits or the forced removal of key features. The same applies to trademarks. Ensuring proper patent research and trademark clearance should be part of the planning phase to avoid any disputes down the line.

Privacy Concerns (Drivers of DALI-vehicles and Customers' Information)

- Since this project involves vehicles (and potentially customer data), privacy laws must be a major focus. Additionally, tracking drivers' movements and behavior in real-time raises potential concerns around surveillance, so transparency of data practices will be critical.

Labor Laws (Local and Federal Regulations)

- Adhering to local and federal labor laws is essential. Work hours, wages, worker benefits, and more must be in compliance with applicable regulations.

Violation of Pre-existing Contracts and Agreements

- Sometimes, software or data shared under a licensing agreement may not be used for other purposes, or certain territories may be off-limits. Violating these terms could result in legal action, termination of agreements, or financial penalties.

Concerns Around Operational Licenses for Drivers and Other Operators

- The project needs to verify that drivers and operators meet the regulatory requirements in each jurisdiction where the service operates. Non-compliance could result in fines, delays in project rollout, or even the inability to offer the service in certain areas.

Health and Safety Regulatory Concerns for All Parties Involved

- As this project involves moving vehicles, safety becomes a major concern. The health and safety of both drivers and passengers should be prioritized in all aspects of design and operation. Any violation of health and safety rules could have catastrophic consequences and expose the project to significant liability.

Environmental Concerns (As We Are Dealing with Moving Vehicles)

- Assessing environmental impact could involve looking at emissions, fuel consumption, and how vehicles contribute to local air quality. Any project of this scale may require compliance with local environmental laws or regulations surrounding noise, emissions, or resource use.

FEASIBILITY ANALYSIS MATRIX

Aspect	Rating	Comment
Economic	4/4	It is economically feasible as we are not relying on any hardware components
Technical	3/4	Achievable with stakeholder partnerships and scalability of the project.
Operational	4/4	It makes the workflow more efficient with minimal disruption.
Schedule	3.5/4	Our team is hoping to complete all work as per schedule.
Legal	4/4	We are rightful in doing this project and have put our own ideas into it.