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| Lambert Air |
| Flight Management System |
| Initial System Requirement |

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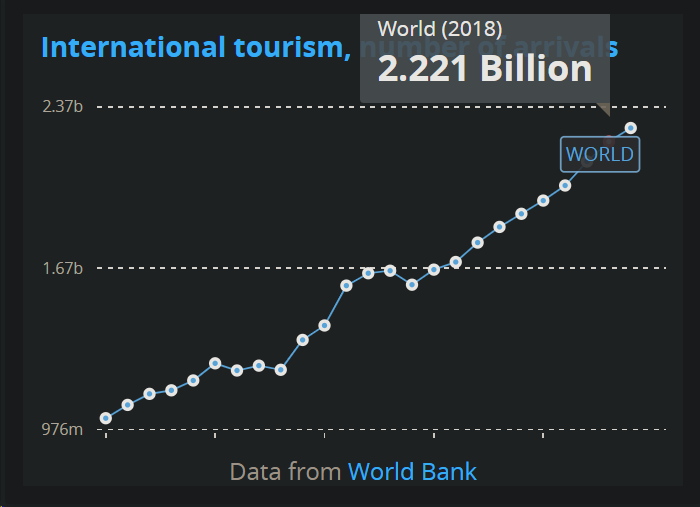
# Problem Definition

The airline industry has gone through significant upheaval in recent years; challenges in staffing and consumer demand have placed considerable strain on even well-established airlines and airports. Daily operation of an airport involves the management of traffic and staff from multiple airlines operating numerous flights, some detailed procedures that are required to maintain efficiency include:

* Runway access for landing without long holding patterns
* Prompt access to an open gate upon landing, without having to hold on the tarmac
* Open gate when flight is ready to be boarded/disembark (short wait times ideally)
* Flight crew arrangement and attendance for scheduled flight, staff emergency scheduling
* Maximizing the flight schedule for more flights in a day, increase in revenue daily
* Control tower staff scheduling and flight directing for multiple runways to avoid collision
* Oversee a flight and all related information about that flight to check if it is on schedule
* Resource management for landside operations, airside operations, billing and invoicing, and information management departments will be based off flight information for all airports.

Poor airline service due to delays reflects poorly on both us and the firms we work with. The air travel industry continues to grow steadily as more and more demand hits the markets, airport staffing and scheduling gets increasingly difficult as airports try to expand to accept more customers and keep all related departments in the green. Below is a figure from World Bank that shows very clearly how year after year the air travel industry must react to increasing demand with exception of events that ban air travel en masse. If there is no solution proposed beyond simply more manpower and more processing stations for various tasks the air travel industry will very quickly run out of resources and manpower to accomplish the tasks needed to sustain the demand professionally enough that it is deemed acceptable.

Figure 1: World Bank statistics on increase in international tourism (1995 to 2019)

  
Figure 1: <https://data.worldbank.org/indicator/ST.INT.ARVL>

Customers that are waiting around costs money for all involved airports and the air travel industry at large, a streamlined solution is required. Take for example a flight ‘x’ that is to be boarded in an hour as it has been scheduled, but for whatever reason a flight crew member ends up missing their check in time. We now need another crew member to fill in for flight ‘x’, but first you have to figure out who exactly the flight crew is by identifying and labeling the flight appropriately, then cross reference the crew information and scheduling to find a replacement, you also may want to go through delayed or canceled flights that may have crew still available to fill your need. You could do all of that with people power, but you may find that task quite daunting especially if the airports grow in size, but as discussed previously it simply has it’s limitation in terms of speed and efficiency, so it is not sustainable long term.

# Proposed Solution

We propose an automated solution to this problem with the development of a Flight Management System (FMS) **can be configured for any port in any country**. This solution will reduce manpower requirements for all departments involved in flight logistics, streamlining the decision-making process for management by providing concise and accurate information about flights, crew and boarding/disembarking controls to a variety of airports internationally. This will standardize the workflow of all impacted airlines and participating ports around the world. This process is fast enough to communicate all the way around the world in a matter of seconds about a specific crew member, a flight, a port, an aircraft type, etc. It is a time saving, cost saving, space saving, and highly efficient system if done properly. Air traffic control becomes more fluid, and they are notified about flights of concern far faster and more consistently than by traditional means, thereby avoiding more potential expenses for accidents of varying kinds. This system will store empirical, quantifiable, and identifiable data on the following systems:

* Countries of origin with associated unique code
* Participating ports using FMS
* Airlines operating using FMS
* All aircraft that have flown with FMS even once, associated code and characteristics
* All runways at associated ports using FMS
* All terminals at associated ports using FMS
* All gates at associated ports using FMS
* Simple Flight Faculty (Flight Officials for this project) scheduling
* All flights flown from an FMS port with identifiers, origin and destination
* Flight scheduling with crew and departure date

This system will be on windows devices but strive for platform independence and as such will be able to communicate with any other windows system with this software solution. This will utilize a MySQL database to serve and maintain information and form necessary relationships between our entities of note (the systems we’re keeping track of).

\*Either python or java.

# System Scope

* A relational database system will store data for all subsystems.
* Arrival/Departure Subsystem: Collation of data on all scheduled arrivals and departures, as well as the status of each flight; all public-facing arrival/departure boards and online displays will rely on this system. By drawing a public-facing report directly from the relevant internal data, we ensure that customers and crew know about changes in flight status as soon as possible. This subsystem will be able to retrieve and organize flight information for the crew. The information will include assigned responsibilities for the flight, certain necessary traveler information such as allergies or specific medical histories, and other general information about the flight.
* Port Information Subsystem – This subsystem will manage all data related to airports, their runways, and their terminals and gates.
* Aircraft & Airline Subsystem - Here, the user will be provided with information regarding the airline, and aircraft, as well as weather conditions, flight patterns and timing of departure and descent.

## Object Flow Diagram (OFD)

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## Information Topology Chart (ITC)

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# System Objectives

The Flight Management System (FMS) will fulfill the following objectives:

* Give internal and public-facing access to arrivals and departures
* Provide user-friendly access to flight information for both travelers and crew
* Robust, stable system design
* Build for modularity and maintainability
* Identify conflicts in flight schedules
* Automatically generate reports on delayed or cancelled flights
* Facilitate addition, alteration, and deletion of routes and scheduled flights
* Track operating airlines
* Generate rosters of aircraft in operation
* Generate reports of flight crew availability
* Generate statistical reports on system

# Expected Benefits

* The system will keep accurate, up-to-date, easily accessible records on all scheduled flights in and out of the airport.
* Facilitate more efficient scheduling of flights in and out, distributing load across all gates to avoid conflict
* Efficiently utilize runways, reducing the need for planes to hold before landing
* Eliminate conflicts in flight crew schedules, keeping errors out of employee schedules
* Streamline business processes by making data entry and updates simple across all roles
* Flexibility for each airline having it’s own implementation of the Air Lambert System suited to their needs

# Storage Requirements

We anticipate that the flight management system will include the following entities within its database:

1. **Countries**: For defining information countries. Essential attributed include:
   * Country Code (CnCode)
   * System Name (CnName)
   * System Abbreviations (CnAbbr)

Primary Key: {CnCode}

1. **Participating Ports**: for defining information on participating ports. Essential attributed include:
   * Airport Code (PortCode)
   * Airport Name (PortName)
   * Airport Short Name (PortShort)
   * Related Country (PortCnCode **reference to E01**)

Primary Key: {PortCode}

1. **Airlines**: for identification of all airlines that use that port. Essential attributes include:
   * Airline Identification Code (AlCode)
   * Airline Name (AlName)
   * Airline Host Country (AlCnCode **reference to E01**)
   * Airline Base Port (AlPortCode **references E02**)
   * Airline Headquarters Address Line 1 (AlAddrLine1)
   * Airline Headquarters City (AlCity)
   * Airline Telephone Number(s) (AlTelephone)
   * Airline Contact Person(s) (AlContact)

Primary Key: {AlCode}

1. **Aircrafts**: for definition of all aircrafts. Essential attributes include:
   * Aircraft Code (AcCode)
   * Aircraft Name (AcName)
   * Aircraft Description (AcModelDscr)
   * Aircraft Seating (AcCapacity)
   * Aircraft Features (AcFeatures)
   * Aircraft Type Code (AcTypeCD **references O11**)
   * Aircraft Host Airline (AcAlCode **references E03**)

Primary Key: {AcCode}

1. **Runways**: for defining each runway at each port. Essential attributes include:
   * Runway Code (RwCode)
   * Runway Name (RwName)
   * Runway Length (RwLength)
   * Runway Width (RwWidth)
   * Runway Port (RwPortCode **references E02**)

Primary Key: {RwCode}

1. **Terminals**: for defining each terminal at each port. Essential attributes include:
   * Terminal Code (TCode)
   * Terminal Name (TName)
   * Terminal Letter (TLetter)
   * Terminal Port (TPortCode **references E02**)

Primary Key: {TCode}

1. **Gates**: for defining each gate at each port. Essential atttributes include:
   * Gate Code (GCode)
   * Gate Namee (GName)
   * Gate Letter (GLetter)
   * Gate Port (GPortCode **references E02**)

Primary Key: {GCode}

1. **Flight Officials**: for specifying flight attendants and pilots each airline has. Essential attributes indlude:
   * Official Code (OCode)
   * Official First Name (OFName)
   * Official Middle Initial (OMIntl)
   * Official Last Name (OLName)
   * Official’s Related Airline (OAICode **references E03**)

Primary Key: {OCode}

1. **Flights**: for specifying all flights. Essential attributes include:
   * Flight Number (FNumber)
   * Flight Source Port (FSPortCode **references E02**)
   * Flight Destination POrt (FDPortCode **references E02**)
   * Flight Intermediary Port (FIPortCode **references E02**)
   * Flight’s Related Airline (FAICode **references E03**)
   * Flight’s Related Aircraft (FAcCode **references E04**)

Primary Key: {FNumber}

1. **Arrival/Departure Schedule**: for tracking all arrivals. Essential attributes include:
   * Flight Number (FNumber **references E09**)
   * Flight Date (FDate)
   * Flight First Pilot (FFPCode **references E08**)
   * Flight Second Pilot (FSPCode **references E08**)
   * Flight Main Attendant (FAtt1Code **references E08**)
   * Flight Other Attendant 2 (FAtt2Code **references E08**)
   * Flight Other Attendant 3 (FAtt3Code **references E08**)
   * Flight Other Attendant 4 (FAtt4Code **references E08**)
   * Flight Other Attendant 5 (FAtt5Code **references E08**)
   * Flight Other Attendant 6 (FAtt6Code **references E08**)
   * Flight In/Out Flag (FIOFlag)
   * Flight On-time Flag (FOnTime)

Primary Key: {FNumber, FDate}

1. **Aircraft Types**: for different types of aircrafts. Essential attributes include:
   * Aircraft Type Code (AcTypeCD)
   * Aircraft Type (AcTypeDescr)

Primary Key: {AcTypeCD)

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# Anticipated Outputs

The FMS will be able to output a range of useful reports to airport and airline staff, including the following:

1. Standard arrival and departure board for display in terminals
2. Arrival log
3. Departure log
4. Announcements of delayed or cancelled flights
5. Flight crew log, including past and future scheduled flights
6. Terminal and gate information
7. Statistical reports on traffic by various categories

Make more anticipated outputs based on the entities.

# Feasibility Analysis

Alternative solutions examined in this report are as follows:

1. Manual management of incoming and outgoing flights, as well as crew logistics, on physical documents
2. Acquiring an existing software system and upgrading it to accommodate our needs
3. Develop an integrated system to meet an airport's specific logistical challenges

## Feasibility of Alternative A

The **technical feasibility** of this alternative may be summarized as follows:

* Minimal demand for computer hardware, only basic office supplies or printers to create the documents and copy machines to distribute data
* No computer software needed beyond a standard office suite

The **economic feasibility** of this alternative may be summarized as follows:

* Minimal cost from implementing the plan itself
* Cost of office supplies incurred by creating hard copies in bulk should have minimal impact on the airport
* Cost of supporting additional staff will be incurred

The **operational feasibility** of this alternative may be summarized as follows:

* Considerable amounts of time will be spent simply getting data onto paper and getting it to employees, rather than having data at hand to make quick decisions
* Minimal training is involved in deploying this plan, as no complex tasks or new software is involved
* Business processes will be as flexible as writing additional information on a sheet of paper, but who decides what can be written down?

The **risks** involved with this alternative are significant, as no modern business operates only on hard-copy documents. Decision-making will remain slow, if not slower than before, as secretarial tasks become the most time-consuming part of the job. It is less a risk of inefficiency so much as a guarantee.

## Feasibility of Alternative B

The **technical feasibility** of this alternative may be summarized as follows:

* Existing computer and network infrastructure can presumably handle any mainstream software solution
* Off-the-shelf solutions may vary in their ability to be retooled to the task at hand. If the underlying system turns out to be a dud, the entire project could be slowed down.
* Support may be spotty or nonexistent, as there is no guarantee that the original developers will stay in business.

The **economic feasibility** of this alternative will most likely be manageable at the start, or at least well-defined as an initial purchase price and a long-term service contract. However, what is purchased may not end up being what is best for the job.

The **operational feasibility** of this alternative may be summarized as follows:

* Minimal to low development time, since existing logistics software should be readily adapted to fit the use case.
* Time from installation to full implementation will vary depending on the quality of the software. Does it offer an efficient, readily-learned workflow?

The **risks** involved with this alternative involve the quality of the software system selected. A high-quality option could serve the purpose well, while a low-quality option would become a significant liability.

## Feasibility of Alternative C

The **technical feasibility** of this alternative may be summarized as follows:

* Development environment and deployment must be acquired and integrated into the existing infrastructure.
* Since software development experience already exists, talent does not need to be acquired.

The **economic feasibility** of this alternative may be summarized as follows:

* Cost of development tools and other technology is low, bordering on free
* Infrastructure upon which the software would operate already exists

The **operational feasibility** of this alternative may be summarized as follows:

* Implementation time will be long, due to being a student effort
* Reasonable user training will be required for onboarding

The **risks** involved with this alternative vary depending on the approach chosen. Close oversight of deliverables helps to manage risk, as problems are spotted earlier in the process. With a well-selected and well-managed development team, overall risks can be greatly reduced.

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| Feasibility Factors | Alt-A | Alt-B | Alt-C |
| Technical Feasibility [80] | **58** | **72** | **75** |
| Hardware Availability [20] | 15 | 15 | 15 |
| Software Availability [20] | 10 | 18 | 20 |
| Expertise Availability [20] | 15 | 19 | 20 |
| Technology Availability [20] | 18 | 20 | 20 |
|  | | | |
| Economic Feasibility [140] | **97** | **115** | **124** |
| Cost of Engineering [20] | 15 | 10 | 18 |
| Cost of Equipment [20] | 15 | 15 | 15 |
| Cost of Operations [20] | 10 | 18 | 17 |
| Cost of Facilities [20] | 12 | 15 | 16 |
| Time of Development [20] | 15 | 18 | 20 |
| Longevity [20] | 15 | 19 | 18 |
| Risk Factor [20] | 15 | 20 | 20 |
|  | | | |
| Operational Feasibility [60] | **53** | **58** | **57** |
| Users Response [25] | 22 | 25 | 24 |
| Organizational Changes [15] | 15 | 15 | 15 |
| Implementation [20] | 16 | 18 | 18 |
|  | | | |
| Software Quality [220] | **149** | **202** | **213** |
| Needed Maintenance [20] | 12 | 16 | 18 |
| Effective User-Interface [20] | 13 | 19 | 20 |
| Compatibility [20] | 15 | 20 | 20 |
| Security [20] | 20 | 20 | 20 |
| Reliability [20] | 10 | 18 | 20 |
| Documentation [20] | 15 | 20 | 16 |
| Update Friendly [20] | 17 | 20 | 19 |
| Flexibility/Functionality [20] | 15 | 18 | 20 |
| Adaptability [20] | 12 | 15 | 20 |
| Productivity [20] | 10 | 16 | 20 |
| Growth Potential [20] | 10 | 20 | 20 |
|  | | | |
| Overall Evaluation Score [500] | **357** | **447** | **469** |
| Notes:   * Specific feasibility factors were looked at and evaluated each alternative through a thorough discussion. * Specific quality factors were evaluated based on discussions pertaining to the performance of each alternative. * Based on the thorough analysis, Alternative C has been selected as the most feasible option for this project. | | | |

Figure 2: Feasibility factors table

# Initial Project Schedule

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| --- | --- | --- |
| Activity # | Activity Description | Weeks |
| 1 | Initial System Requirement | 1 |
| 2 | Requirements Specification | 2 |
| 3 | Design Specification | 3 |
| 4 | Database Creation | 3 |
| 5 | Prototype Development | 10 |
| 6 | Software Documentation | 3 |
| 7 | Software Install & Delivery | 2 |
|  | Total duration | 24 |

# References

Figure 1 : *International tourism, number of arrivals | Data*. (2020). [Data Polling]. The World Bank. <https://data.worldbank.org/indicator/ST.INT.ARVL>

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