Chapter 1
Introduction to Airline Management

Introduction

Aviation provides the only transportation network across the globe and it is crucial for global business development and tourism enrichment. Air transportation is one of the most important services to offer both significant social and economic benefits. By serving tourism and trade, it contributes to economic growth. It also provides jobs and increases tax revenues. Air transportation is essential for the fast movement of people and cargo shipments around the world. Finally, air transportation improves the quality of people's lives by broadening their leisure and cultural experiences. It gives a broad choice of holiday destinations around the world and is an affordable means to visit distant friends and relatives (ATAG 2005).

The use of commercial aviation has grown significantly over the last few decades, estimated to be more than seventy-fold since the first jet airliner flew in 1949 (ATAG 2005). This rapid growth is attributed to a number of factors. First, rising disposable income and quality of life in many parts of the world have encouraged more people in these areas to travel and explore opportunities overseas. Second, deregulation of aviation laws, and bilateral and open-sky agreements between governments have opened new markets for airlines, which make travel easier and cheaper. Third, demand is increasing because of growing confidence in aviation as a safe mode of travel. Fourth, increased efficiency and increasing competition have reduced world airfares and the cost of travel. Finally, globalization has increased the average distance traveled, as people do business in countries which now have improved political and social environments. The impact of these factors is expected to continue, however, at different levels in different parts of the world. The number of air travelers and the volume of air cargo is expected to continue to grow, increasing the pressure on all the contributors to the air transportation service to take advantage of opportunities and efficiently manage their service.

A major player in the air transportation industry is the airline. Current records indicate that there are more than 900 commercial airlines around the world, with a total fleet of nearly 22,000 aircraft (ICAO 2006). Commercial airlines serve nearly 1,670 airports through a route network of several million kilometers. These airlines transport close to 2 billion passengers annually and 40 percent of interregional exports of goods (by value). Also, an estimated 2.1 million people are employed by airline or handling agents: for example, as flight crew, check-in staff, and maintenance crew (ICAO 2006). Airline services are categorized as

being intercontinental, continental, regional, or domestic, and may be operated as scheduled services or charters. In terms of size, airlines vary from those with a single airplane carrying mail or cargo, through full-service international airlines operating many hundreds of airplanes. In many parts of the world, airlines are government-owned or supported. In recent decades, however, the trend has been to move toward independent, commercial public companies by giving more freedom to non-government ownership of airlines.

The increasing number of commercial airline companies has put more pressure on their management to continually seek profits, reduce cost, and increase revenues. Increasing demand for air transportation service has compelled airline management to take advantage of opportunities in different markets. At the same time, increasing competition among airlines necessitates that airline management seek efficiency in all their decisions to promote their profit. It is no surprise that many airlines throughout aviation history have been unable to remain in business, and in most cases, it is agreed that the demise of these airlines has been attributable to deficient management.

Airline management practice has evolved significantly over the past three decades. The development of this practice has contributed to recent advances in computation and communication technologies and, more importantly, the need to reduce costs and increase revenues. Nowadays airlines seek to perform efficiently in a competitive environment that only provides marginal profits. The airline business is characterized as being one of the most complex, involving multiple conflicting decisions that all need to be optimized at the same time. Several tactics have been developed and used to better plan and operate airlines. These tactics bank on scientific approaches available in operations research and mathematics literature to optimize airlines' decision-making processes, and are usually modeled within computerized systems that can automate decision making. Therefore, these scientifically-based tactics promise an easier decision-making practice for the airlines. The need for these tactics becomes more crucial as the size of the airline increases, and making decisions based on individuals' judgment or experience becomes more difficult. The next section highlights the main challenges of airline management that elaborate the complexity of the airline decision-making process.

Challenges of Airline Management

Impact of Other Players in the Industry

Airline management does not work independently of other players in the air transportation industry. Indeed, the decisions of airline management are very much affected by these other players. Figure 1.1 depicts the different entities that interact with airline management and affect decisions concerning government, airports, customers, alliances, suppliers, unions, and competitors.

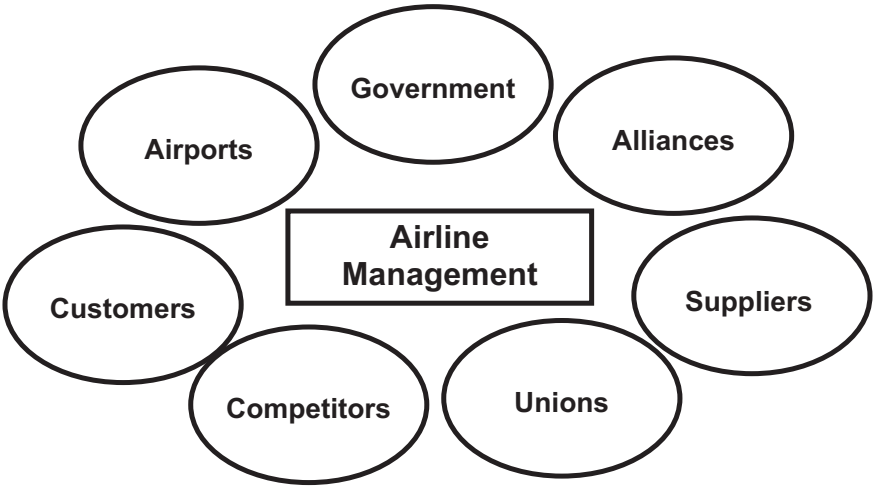


Figure 1.1 The different players in the air transportation industry

First, airline management must comply with the regulations of the airline's home country. It must also take into consideration and comply with the regulations of the governments of the countries where the airlines fly to and from, and whose airspace they cross. Governments typically watch competition between airlines and control airlines' strategic decisions, such as merging, acquisition between carriers, market entry or exit and pricing, environmental regulations, security regulations, maintenance, and safety requirements. Second, airline management should carefully consider the terms of their agreements with the different airports they serve. Several factors affect these agreements, including available infrastructure (gates, runways, baggage handling, and so on), expected traffic, airport charges and incentives, competition from nearby airports, available landing slots, congestion, and operational curfews. Third, an airline should consider the needs and preferences of its potential customers, the travelers. For instance, the airline should consider schedule convenience, competitive fares, onboard services, punctuality, and efficient customer service. Failing to fulfill the needs and preferences of customers might lead to losing them to other competing carriers or other modes of transportation. Fourth, in many cases, an airline participates in one or more alliances to expand its network coverage or share resources with other airlines. Several forms of alliance are available that reflect the level of cooperation between participating airlines. It is important for an airline to decide which alliance to participate in and how to share its resources efficiently with each member in the alliance to promote profitability. Typically, the airline has to maintain a certain level of operating standards to serve within a worldwide alliance.

Fifth, suppliers are crucial to the continuation of the airline's operation. Airlines depend on suppliers to provide important items such as aircraft, fuel, spare parts, meals, employee uniforms, and so on. Also, in many cases, airlines outsource to

vendors some of their jobs and services, such as aircraft maintenance, aircraft cleaning, ground handling, and sales. Therefore, an airline has to keep healthy relationships with its suppliers to continue operating successfully. Another entity in the air transportation industry that an airline has to deal with is unions. Different groups of workers form unions to achieve stronger negotiation power with airline management in terms of salary, benefits, or working rules. Keeping a good relation with labor in order to guarantee smooth operation of the business is one of the main objectives of airline management. Conflicts with unions might typically lead to negative actions by the unions, such as work slowdown or strikes, which usually impair the airline's operation significantly. Finally, in most markets, there is tough competition between several airlines. Typically, airlines continuously monitor the decisions of their competitors that relate to providing capacity, fare levels, fare restrictions, and departure times. In many situations, the decisions of the competing airlines proceed in a leader-follower pattern, where one airline takes an action and the other competing airlines try to find the best way to respond to this action.

Interacting Layers of Decisions

Like many other businesses, airlines management faces three levels of interacting decisions. These levels, as shown in Figure 1.2, include strategic, planning, and operations decisions. Strategic decisions typically require a long lead time before implementation and require a considerable monetary investment. They are also expected to have a significant impact on the form of the airline in the long term. Examples of strategic decisions include growth and expansion, fleet sizing (aircraft orders), hub locations, merging with other airlines, alliance participation, and location of maintenance facilities. Planning decisions are within a few months horizon, and can be defined as the process of efficiently using airline's available resources to maximize its revenue. The resources available to an airline include the facilities and the personnel that operate the business, including, for example, aircraft in different fleets, pilots with different qualifications, flight attendants, maintenance facilities, mechanics, gates, customer service agents, and ramp agents. The planning decisions include forecasting the demand between every origin-destination (OD), flight schedule development, assignment of flights to the different aircraft fleet (if the airline has more than one fleet type), aircraft routing across the different airports' with its maintenance consideration, planning the line of flight for pilots and cabin crew, crew accommodations, flight-gate assignment, and catering. Other planning decisions include the number of staff required to operate flights at different airports including customer service, ramp agents, baggage handlers, and so on. They also include decisions regarding fare levels in each OD market, fare restrictions, and seat inventory control for each flight. It should be mentioned here that these planning decisions are very dependent on each other, which makes the planning process complex.

The operations decisions for the airlines are those decisions that need to be verified or updated on an hourly or maximally on a daily basis. They include, for

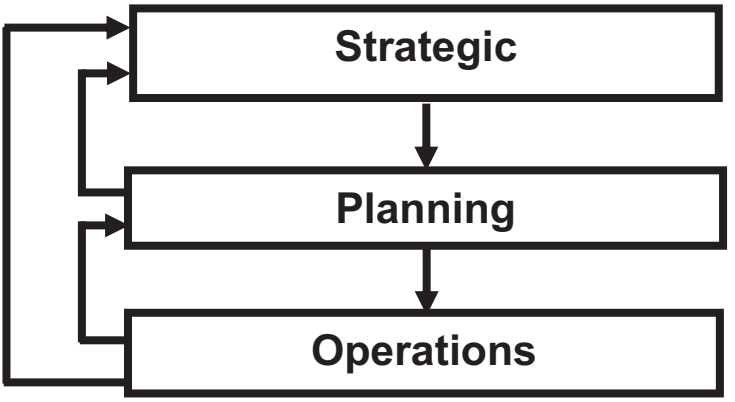


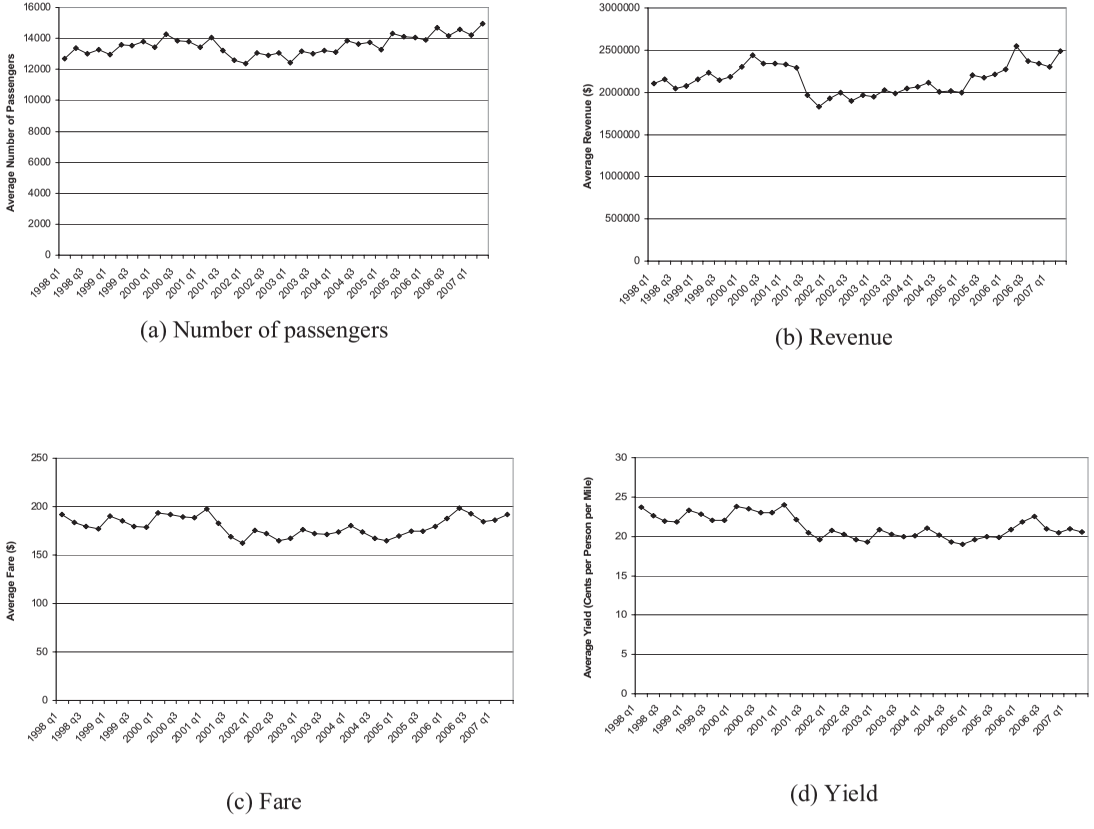
Figure 1.2 Decision levels of airline management

example, the response to unanticipated incidents such as adverse weather conditions, flights delays and cancellations, aircraft breakdown, and absence of crew or staff due to illness. Operations decisions also include watching revenues, bookings, and anticipated demand levels in the different markets, matching prices with competitors, and managing seat inventory on each flight on a daily basis.

Strategic decisions are expected to impact on planning decisions, which, in turn, affect the operations decisions. In addition, there is a reverse feedback from the operations phase to the planning phase, which also, in turn, may provide feedback to the strategic decisions phase. For example, the observation of a frequent delay of a certain flight waiting for its inbound aircraft might alert schedule planning to alter the schedule of this flight to give enough connection time for its inbound aircraft. Also, strong demand forecasting in markets might call for a change in the strategic plan regarding expansion and increase of fleet size. As explained in the next section, this book covers in detail the tactics currently practiced by airline management for the planning and operations phase. Strategic decisions are considered to be beyond the scope of this book.

Surrounding Events

The air transportation industry is characterized by the effects of rapid and significant impacts from surrounding events and economic and social changes. The negative impact on air transportation of factors such as wars, civil unrest, terrorist actions, increasing fuel prices, and epidemics has been clearly observed in several areas across the world. These events necessitate that airline management respond quickly and efficiently to study the impact of these events and take actions to alleviate their impact. To survive in business, in many situations, airlines may be forced to cut schedules, reduce fares, lay off employees, and cut salaries and benefits. For example, Figure 1.3 shows impacts on passenger demand, revenue, average fare, and average yield (revenue per seat mile) for airlines in the domestic



(a) Number of passengers

(b) Revenue

(c) Fare

(d) Yield

Figure 1.3 Changes in the main market characteristics due to the 9/11 terrorist attack in the domestic US market

US markets following the September 11, 2001 (9/11) terrorist attack. It is clear that these four measures were affected significantly because of this event. At that time, most domestic airlines considered significant actions such as cutting capacity, lowering fares, and discharging employees to respond to these market changes.

Many Groups to Contribute

Another challenge of airline operations is the interaction process among several groups of workers who work together to operate the flights. The product that an airline generates is a passenger seat or a space for cargo. This passenger seat or cargo space is typically a part of a flight that connects between two airports. The number of flights that an airline operates depends on the size of the airline. For large air carriers, the number of flights reaches a few hundred flights a day. Operating each flight requires significant cooperation among several groups of workers who all share the same objective of making the flight ready for departure on time. There are about 12 different groups who work on each flight before its departure. These groups include pilots (cockpit crew), flight attendants (cabin crew), maintenance crew, ramp agents, baggage-handling crew, cargo agents, fueling agents, customer service agents, gate agents, catering agents, aircraft cleaning agents, and operations agents or dispatchers. While the personnel in these groups differ in their qualifications, nature of work, workloads, and salary, they are all equally important for the departure of the flight. It is important for airline management to adequately set the work plan for each group, facilitate their work, and alleviate any possible conflict between them.

A pilot is a certified person who flies the aircraft of a certain aircraft fleet. Typically, each type of aircraft requires a certain number of pilots with certain specified qualifications. Flight attendants are airline staff employed primarily for the safety of passengers onboard. Their secondary function is the care and comfort of the passengers. The maintenance crew (maintenance) is responsible for servicing and repairing the aircraft to make sure that it is operational. Typically, maintenance performs several pre-specified mandatory service checks on the aircraft before departure, as specified by the manufacturers. Maintenance also performs several scheduled service checks on each aircraft in operation. Ramp agents help guide the aircraft to taxi in, park, and taxi out at the gate. Baggage handlers and cargo agents transport, load, and unload baggage and other cargo to and from the aircraft. Fueling agents provide fuel to the aircraft before departure or at intermediate stops in the flight. Customer service agents assist passengers with check-in, seat assignments, seat upgrades, and itinerary changes. Gate agents ensure that only authorized persons and passengers have access to the aircraft. Catering agents provide meals and beverages to be consumed on the flight. Aircraft cleaning agents clean the aircraft and the lavatories. The operations' agent or dispatcher coordinates the flight plan, weight, fuel requirements, and any weather-related or operations delays that are issued to the flight.

Airline Planning and Operations

As mentioned earlier, this book focuses on explaining the planning and operations phases of the airline. This section elaborates further on these two phases and introduces the different processes that are considered and explained in detail throughout this book. Figure 1.4 gives a sketch of the main processes considered in the planning and operations phases of the airlines. Planning starts by recording the anticipated demand and supply (available airline resources). Next, a set of interrelated planning processes is considered, including schedule planning, time banking, fleet assignment, aircraft routing, crew scheduling, airport facility planning, airport staff scheduling, pricing and seat inventory control, and sales and marketing initiatives. The planning processes are typically completed by a month to a few months before the implementation of the schedule, and they are repeated on a frequent basis as long as the airline is in business. The operations phase of the airline is concerned with implementing the planned airline schedule, while taking into consideration recovery for any unanticipated incidents such as adverse weather conditions, aircraft breakdown, crew absence, and so on. The operations phase is where decisions are made to recover the airline schedule from flight delay and cancellations, to compensate for missing or delayed aircraft and crew, and to reaccommodate stranded passengers. The operations phase also monitors seat bookings in the different markets and updates seat inventory control and pricing decisions. It should be mentioned that the current practice of airline planning and operations might differ to some extent, based on airline size and network structure. In the next subsection, the main objectives of each of the planning and operations processes are highlighted.

Network Structure

Airlines are typically classified as scheduled airlines or charter airlines. Scheduled airlines have a predefined flight schedule that is published through designated channels. In this schedule, the airline specifies the markets it flies to and the departure time and capacity of each flight in the schedule. Charter airlines, on the other hand, do not have a predefined schedule and typically operate on a demand basis. This book focuses on the business process of scheduled airlines, although many of these processes are also applicable to charter airlines.

Typically each scheduled airline has a predefined network structure. Selecting a network structure is considered one of the major strategic decisions of the airline. Most common network structures include 1) hub-and-spoke, 2) point-to-point, or 3) a combination of both. The hub-and-spoke network structure is one in which the airline considers one or more stations in the network to be its hub. Accordingly, any flight that is operated by this airline either starts or terminates at one of those hubs. The hub station is characterized by having numerous departures and arrivals every day for the airline. The spoke station has only a few departures and arrivals each

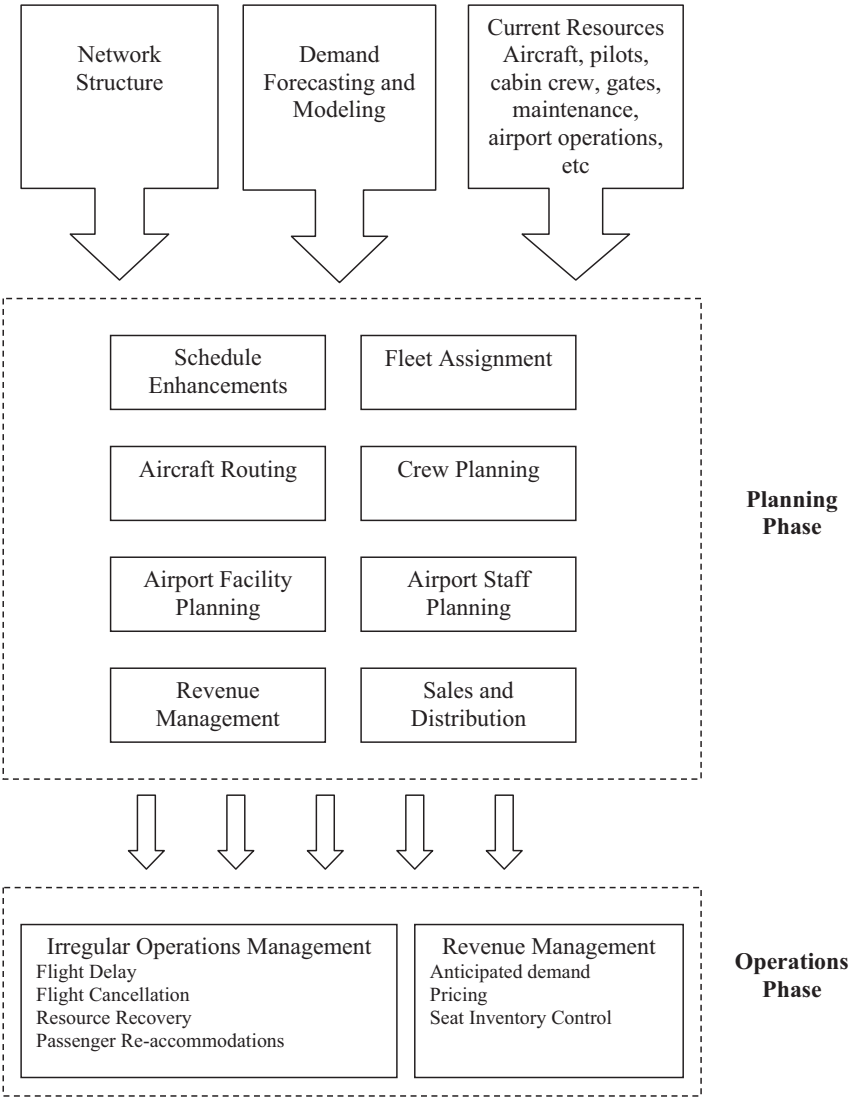


Figure 1.4 Processes considered in the planning and operations phases of the airlines

day. Figure 1.5 shows an example of a hub-and-spoke network for a hypothetical airline in the domestic US market that has a single hub at Dallas Forth-Worth airport, TX (DFW), and spokes at Atlanta, GA (ATL), Chicago, IL (ORD), Los Angeles, CA (LAX), San Francisco, CA (SFO), Denver, CO (DEN), Miami, FL (MIA), Newark, NJ (EWR), Detroit, MI (DTW), and New York, NY (JFK). This hub-and-spoke network structure gives considerable network coverage, enabling

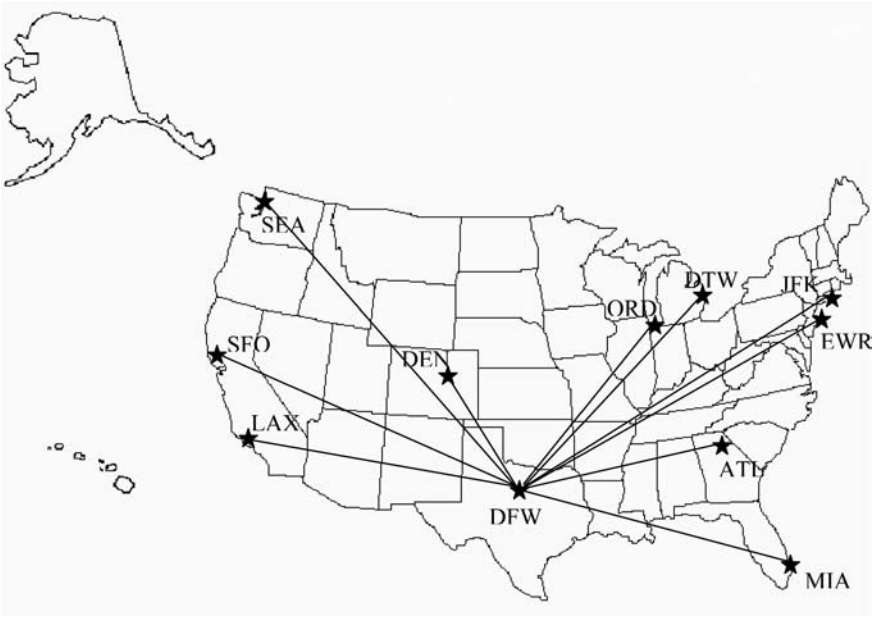


Figure 1.5 Example of a hub-and-spoke network structure

passengers to travel between any two cities served by the airline by physically connecting through the hub(s). Therefore, any flight in this network serves both local travelers between the origin and the destination of the flight and connecting passengers to and from other destinations.

For an airline adopting a hub-and-spoke network structure, to allow for smooth and convenient passengers connection at the hub, the arrivals and departures at the hub are adjusted in what is known as time banks. A time bank consists of a set of flight arrivals followed by a set of departures. Therefore, the time bank allows for several connection possibilities during a short period of time. For example, Figure 1.6 shows three hypothetical time banks at the DFW hub. In the first time bank, four flight arrivals (from SFO, SEA, LAX, and DEN) are connecting to four departures (to MIA, JFK, ATL, and EWR). Therefore, this time bank creates 16 different connection possibilities, as shown in Figure 1.6. Hub-and-spoke airlines pay considerable attention to selecting the flights included in each time bank to maximize passengers' connection possibilities and reduce unnecessary waiting time at the connecting hub. A hub-and-spoke network structure with condensed time banks, where many flights are scheduled to or from the hub over a short period of time, usually results in airport congestion. Airport congestion might lead to uncertainty in the taxi-in and taxi-out time of aircraft, which could affect the airlines' on-time performance. Several airports encourage the airlines to distribute their departures and arrivals over longer periods of time to alleviate this congestion; this is known as schedule de-peaking.

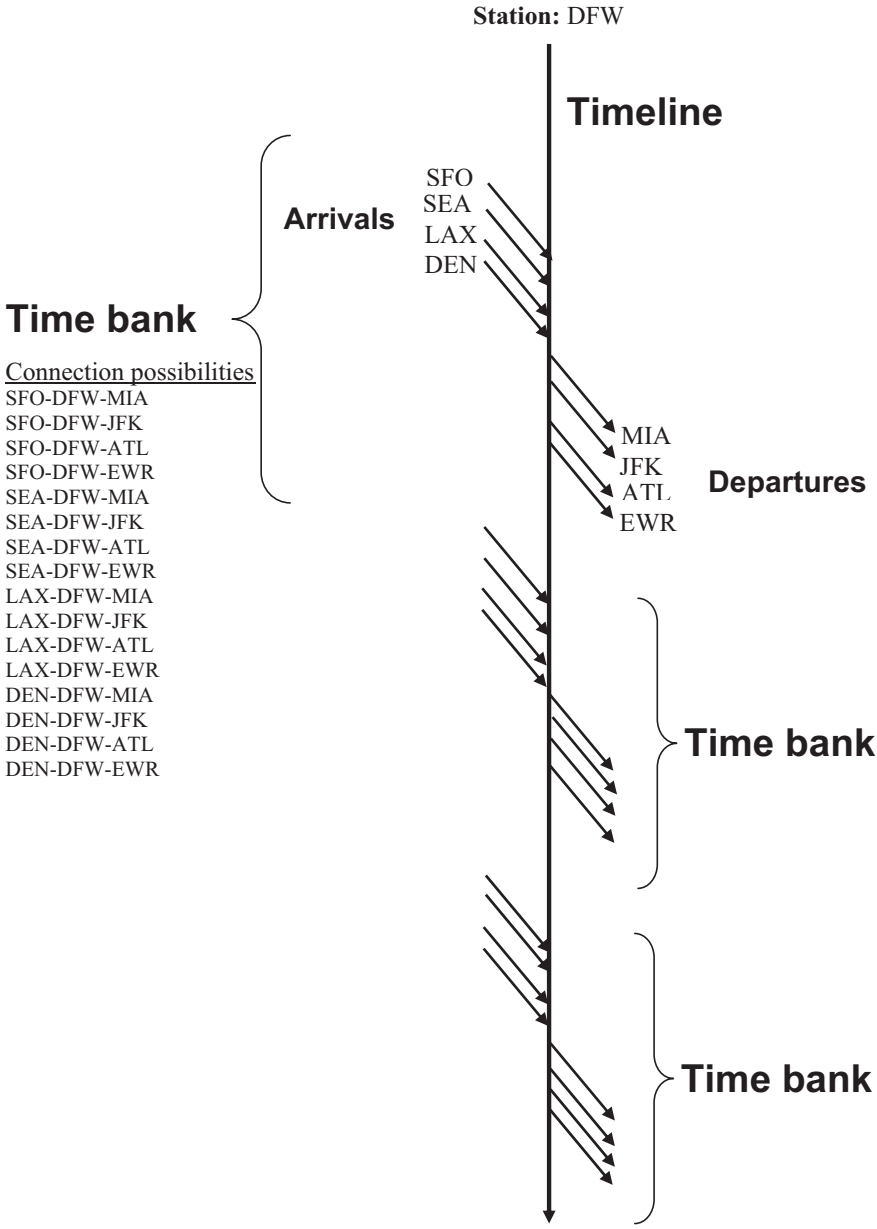


Figure 1.6 Example of time bank for hub-and-spoke airline

The hub-and-spoke network structure involves considerable interdependencies among the different resources of the airline, such as aircraft, pilots, and flight attendants. When an aircraft lands at the hub, it is typically scheduled to operate

another flight departing shortly from that hub. The same also applies to pilots and flight attendants. Accordingly, if a flight arrival is delayed at the hub, there is a chance that one or more departures will also be delayed while waiting for their inbound resources. Therefore, airlines that adopt a hub-and-spoke network structure must pay much attention to their flight on-time performance to minimize any downline impact of flight delay (also known as the snowball effect).

In the point-to-point network structure, as the name implies, airlines operate direct flights between cities. Therefore, the focus of these airlines is to serve local traffic between these two cities, and less attention is given to the connecting traffic beyond their immediate destinations. Because the point-to-point airlines do not depend on any connecting traffic to fill their flights, they have to select markets that have enough local demand, typically between large- and medium-size city pairs. The point-to-point airlines can also adjust arrivals and departures at one or more of their stations to allow for a few possibilities of profitably connecting itineraries for the passengers. Figure 1.7 shows a hypothetical example for a point-to-point network structure in the domestic US market.

Demand Forecasting and Modeling

Demand forecasting is the process of estimating the expected number of travelers on each flight in the schedule, given the flight schedules of all competitors in the

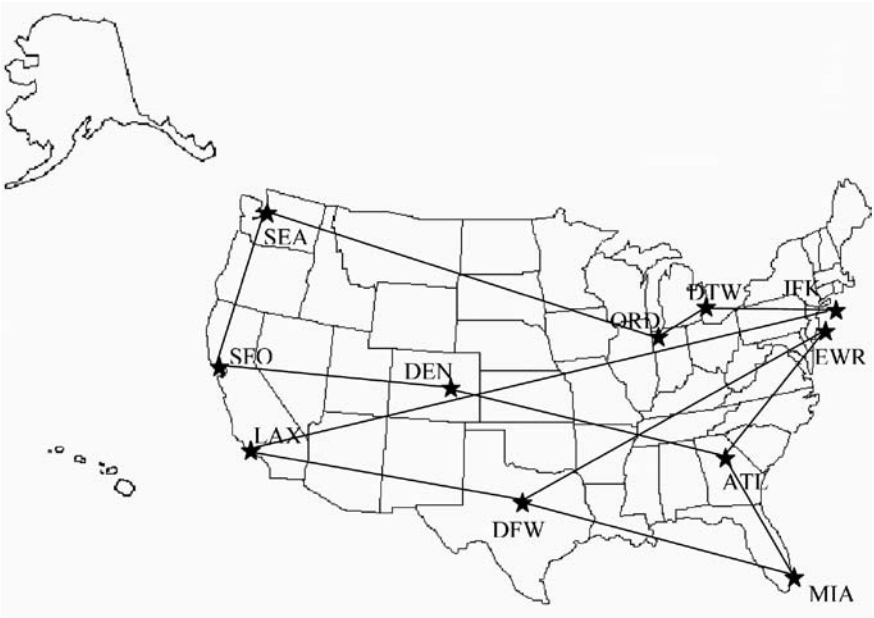


Figure 1.7 Example of a point-to-point network structure

different travel market. For example, Figure 1.5 shows the route map of a small airline operating in the domestic US market. This airline operates all its flights through a hub at DFW. As mentioned earlier, the different flights are scheduled such that passengers can travel between any two cities by connecting through the hub. For example, the passengers on the flight from Dallas (DFW) to Miami (MIA) are a mix of: 1) local travelers from Dallas to Miami, and 2) connecting travelers from other cities (San Francisco, Los Angeles, Seattle, and so on) to Miami. The demand forecasting and modeling process has to predict the passenger counts on each flight in the schedule and also estimate the possible changes in demand due to changes in schedule, pricing, competition, and so on. The demand forecasting process also estimates the airline share in each city-pair (OD market).

Fleet Assignment

The fleet assignment process is necessary for airlines that have more than one type of aircraft. It is the process of assigning the different flights in the schedule to the different fleet types. The process matches the characteristics of the aircraft and the flight to minimize the total cost of the flight to the airline. For example, the aircraft travel range must be consistent with the distance between the flight origin and destination. Also, in terms of the economics of fuel consumption, each aircraft type has an optimal range of travel distance in which it produces the best fuel consumption performance. Furthermore, the seat capacity of the aircraft should be consistent with the expected passenger count for the flight. Also, airport characteristics at the origin and the destination of the flight, including runway, gates, allowed noise levels, and curfews should be considered in the fleet assignment. Another logical constraint is maintaining continuity of fleet types at the different airport stations. The number of inbound flights assigned to a certain fleet type at any station should equal the number of outbound flights that are assigned to this fleet type. Other constraints related to the location of maintenance facilities and crew bases should be considered. Understandably there is a strong relationship between schedule design and fleet assignment. For example, an airline might decide to schedule and operate two small flights from point A to point B using two small aircraft or to schedule and operate one large flight using a large aircraft.

Aircraft Routing

Aircraft routing, as the name implies, means determining a route for each aircraft. Figure 1.8 presents an example of an aircraft route. As shown in the figure, the route of an aircraft consists of a sequence of flights and maintenance activities that extend over a few days (5–7 days). The flights are selected to ensure there is enough time between them to complete an aircraft turn or a maintenance activity. An aircraft turn is the time difference between the arrival time of a flight and the departure time of the next flight. An aircraft turn time should be long enough for

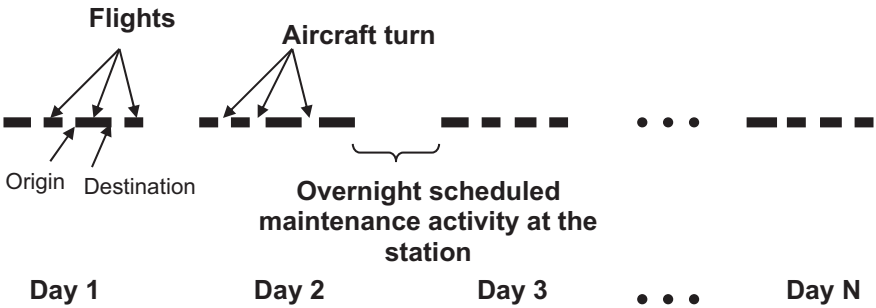


Figure 1.8 Example of an aircraft route

deplaning passengers of the inbound flight from the aircraft, unloading cargo and baggage, cleaning the aircraft, boarding passengers of the outbound flight, loading cargo and baggage, fueling, catering, exchanging crew, and so on. At the same time, the aircraft turn should not take long; long aircraft turns cause the aircraft to remain idle or unused over long periods of time. Longer idle time on the ground is expected to significantly dilute the revenue of the airline, as the throughput of its fleet declines.

Each aircraft must undergo certain maintenance activities, as specified by its manufacturer. Typically, the manufacturer specifies that a maintenance activity should be performed either after a few departures, certain flying hours, or certain operational hours. The maintenance activity of the aircraft extends over a few hours and is usually performed overnight at one of the airline's maintenance stations. Airlines usually position their maintenance facilities at one or more of their hub stations. Each aircraft must be scheduled for the required maintenance activities at the right time and at the right maintenance station.

Crew Planning

It is important for the crew (pilots and flight attendants) to know their traveling schedule ahead of time, so that they can plan their other life activities accordingly. The crew's work plan is typically extended over a period of one month. During the month, the crew member is classified either as a line crew or a reserve crew. A line crew gets a sequence of predefined trippairs over the month. A trippair represents a sequence of flights (segments), the first of which originates from the home city (domicile) of the crew and the last flight of which ends at the domicile. Figure 1.9 shows an example of a trippair for an airline crew. The trippair typically extends over two to seven days and consists of several duty periods followed by a rest (layover) period. A crew connection time occurs between every two successive flights in the same duty period, to enable the crew to connect from the gate of the inbound flight to the gate of the outbound flight. The duration of the minimum connection time, the maximum duty period, and the minimum layover period is pre-specified by the aviation authorities and the crew contract. Reserve crew

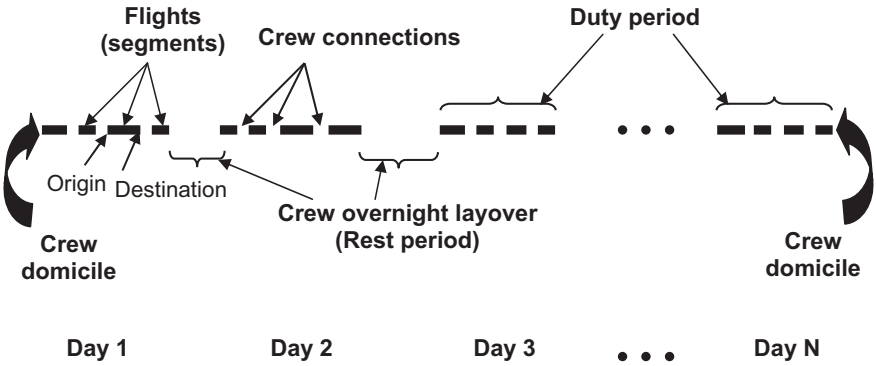


Figure 1.9 Example of a crew trippair

members are not given a line of flying. However, they are used as backup in case of system irregularity. It should be clear that the crew cost is one of the major cost components of the airlines. Efficient scheduling of the airline crew is expected to make considerable savings in airline costs.

Airport Facility and Staff Planning

During the planning phase, the scheduler must consider the different facilities at the different airports, including gates and baggage-handling facilities. The facilities at the airports should be planned efficiently to accommodate the planned flight schedule economically. The processes of facility planning are more crucial at the airline hub, where the airline operates many flights, and the usability of each resource is critical. The scheduling of airport facilities should take into consideration schedule disruptions that typically result from adverse weather conditions. Airport staff includes customer service agents, gate agents, baggage handlers, and ground agents. Typically, this staff works on shifts of about eight to ten hours every day. It is important for the airline to position the adequate number of staff at the appropriate times to operate the planned schedule economically and efficiently. The airport staff should also be adequate enough to manage any unplanned schedule disruptions at the airport due to adverse weather conditions or any other unforeseen factors.

Revenue Management

Airlines apply advanced revenue management (RM) techniques to maximize the revenue of their flights in different markets. RM is defined as selling the right seat to the right customer at the right price and at the right time. The idea behind RM is that travelers have different characteristics and primarily have different requirements for their travel. Basically, travelers can be classified as business travelers and leisure travelers. Business travelers are traveling for a work-related

trip or a business meeting. This group of travelers is typically less sensitive to the price of the ticket, because, in most cases, they are reimbursed for the cost of their travel by their employers. Business travelers have rigid travel plans that are typically constrained by predefined dates and times that usually span weekdays. They also tend to spend shorter periods of time at their destinations. They do not book their tickets far in advance and prefer flexible tickets that can be changed or canceled to match any possible changes in their travel plans. Leisure travelers, as the name implies, travel for recreational purposes or to visit family or friends. These travelers are sensitive to ticket prices. They also have flexible travel plans and tend to spend longer periods of time, including weekends, at their destinations.

Given that business travelers are more profitable to the airlines, the objective of RM is to ensure that enough seats are always available for these travelers, while the remaining seats on each flight are filled with low-revenue leisure passengers. The RM process involves three main modules, including pricing, demand forecasting, and seat inventory control. The main objective of pricing is to determine the right price for each market, taking into consideration competition from other carriers in the market. Demand forecasting means predicting the number of travelers by type in each market. Finally, the objective of seat inventory control is to assign seats on each flight to the different demand streams to maximize total revenue. The RM process is implemented for each future flight. The decisions of the RM process are updated on a daily basis until the day of the flight departure.

Sales and Distribution

Airlines expend considerable effort on sales and distribution initiatives that improve their market share and enhance profitability. These initiatives include, for example, relations with travel agents, global distribution systems, online ticket distribution channels, travelers' mileage plans, sales agreements with major businesses and promotions, and alliances and code sharing. Each of these initiatives needs proper evaluation in order to understand its impact on the airline profitability.

Irregular Operations Management

It is almost rare that an airline schedule is implemented as planned. Airline schedules are usually subject to disruptions due to adverse weather conditions, aircraft breakdowns, crew delays, and security breaches. When the airline schedule is disrupted, it is important for the airline to alleviate the impact of this disruption and recover the schedule in order to return to normal operations. When recovering the schedule, several objectives are considered by the airline. For example, the airline must minimize the deviation from the planned schedule by minimizing flight delays, cancellations, and crew swapping. In addition, it must not only adhere to the maintenance requirements of different aircraft at the right time, but also follow the regulations that govern the work rules of the crew on different

flights. Furthermore, the airline must comply with air traffic control regulations and programs that manage traffic in the airspace and at airports. Last but not least, it must minimize the total cost of recovery by avoiding expensive decisions such as flight cancellations, calling additional crew, and passenger rebooking on other airlines.

Structure of the Book

This book is structured in four main sections:

- Section I presents airline demand modeling and forecasting. In this section, we present the recent advances in modeling the airline network and the airlines' competition. Emphasis is given to itinerary choice models and factors affecting flight load factors and the airlines' market share.
- Section II is devoted to resource planning including aircraft, crew, and airport resources. This section presents recent advances in fleet assignment, aircraft maintenance routing, and crew scheduling. This section also discusses the recent advances in gate assignments and management of baggage-handling facilities. Techniques of flight planning and fuel management are also presented.
- Section III describes the process of airline RM, including demand forecasting and seat inventory control. It also offers an introduction to the ticket distribution practice, code sharing, and airline contract management with corporations to promote the number of business travelers.
- Section IV presents an introduction to the practice and tactics of irregular operations management. It provides an introduction to ground delay programs and the relation between the different actions in schedule recovery.

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