AIRLINE OPERATIONS AND MANAGEMENT

A Management Textbook

GERALD N. COOK and
BRUCE G. BILLIG

ROUTLEDGE

Airline Operations and Management

Airline Operations and Management: A Management Textbook is a survey of the airline industry, mostly from a managerial perspective. It integrates and applies the fundamentals of several management disciplines, particularly economics, operations, marketing and finance, in developing the overview of the industry. The focus is on tactical, rather than strategic, management that is specialized or unique to the airline industry.

The primary audiences for this textbook are both senior and graduate students of airline management, but it should also be useful to entry and junior level airline managers and professionals seeking to expand their knowledge of the industry beyond their own functional area.

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To our wives for encouragement, perseverance, research, and initial editing.

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Introduction

Goal of Airline Management and Operations

This textbook is a survey of the airline industry from a managerial perspective. The primary audience is senior and graduate students of airline management, but it should also be useful for entry and junior level airline managers needing a broad knowledge of the industry extending beyond their own functional area. A background in the various management disciplines typically covered in an undergraduate degree program in business or management is helpful, but not essential. The text applies and integrates the fundamentals of several management disciplines, particularly, economics, operations, marketing, and finance in developing the overview of the industry. The focus is on tactical, rather than strategic, management that is specialized or unique to the airline industry. Human Resource management, for example, is not addressed, not because it isn't crucial to an airline's success, but because the skills required are not unique to the industry. The manager with a broad understanding of the industry and its competitive environment is better equipped to work in interdisciplinary assignments and, ultimately, to succeed and progress in an airline career. This is the goal of this text.

June 2016

Introduction

The dynamic and rapidly expanding airline industry is essential to the function of the world economy and for continued economic growth. It's also an industry often in turmoil, sometimes as a result of myopic management focus on market share but more often due to economic crises beyond the control of airline executives. The first decade of the twenty-first century was especially cruel to the industry as it endured two severe economic recessions, the so-called Great Recession beginning in 2008 being the most devastating since the Great Depression of the 1930s. As a direct result of falling demand, several airlines failed including ATA, Maxjet, Aloha, Sterling, and Oasis. Others were forced to pare routes and frequencies and reduce costs in restructuring that continues today. This book examines the history, structure, and functions of the airline industry from a management perspective with the goal of providing students and junior managers with a broad overview of airline operations and management. Although the tools of several management disciplines are employed, previous study of business administration is not required.

The text begins with a summary of airline history from the emergence of the earliest passenger airlines immediately following the end of World War I to the present. Chapter 1 emphasizes the role of government economic regulation, ownership, and subsidies in the development of the early industry. Rapid technological progress, especially in aircraft speed, reliability, and comfort, increased demand and lowered costs to the point that government policy makers, beginning in the United States, freed airlines from regulation of routes and fares leading to an increasingly free market in much of the developed world.

Chapter 2 turns to the forces that drive airline demand and supply and the rapid growth in airline passenger and cargo transportation which is now most evident in Asia. Airline product offerings are the subject of the next two chapters beginning with an airline's choice of route structure to connect the destinations it has chosen to serve. An airline has a range of product amenities it can provide with its core transportation product from the Spartan service characteristic of low-cost-airlines to a choice of amenities from first class to economy coach provided by most of the world's largest airlines. The first half of the book ends by exploring the process of developing and managing a flight schedule.

Airline economics and finance are addressed in Chapter 6 with a focus on the largest categories of airline expense and management's options for cost control in the face of increasing competition. Fleet renewal, expansion, and financing concludes the chapter. The complex and frequently misunderstood process of airline pricing is the subject of Chapter 7. Sophisticated airline revenue management systems employed by most airlines attempt to maximize revenue by charging different prices to different passenger segments based on willingness and ability to pay for air travel.

Distribution of airline product information and tickets initially borrowed long established practices from the railroad industry. However, faced with rapid passenger growth and product complexity, the first widespread use of computerized systems for distribution developed in the airline industry to automate early, labor-intensive manual methods to book and track airline passengers. More recently the Internet has enabled passengers to easily compare airline products and fares leading to more price competition.

The text concludes by considering the early regulation and subsequent liberalization of international air commerce, the concurrent privatization of many state-owned airlines, and the emergence of the big three global airline alliances.

Chapter 1

Historical Perspective

Several scheduled passenger airlines emerged in Europe shortly after the end of World War I in 1918. Economic regulation of routes and prices followed shortly thereafter and prevailed for much of the 20th century. Late in the century, the deregulation of the U.S. airline industry began a trend followed by the European Union and then by much of the rest of the world. This history provides a foundation for understanding today's complex, competitive, and global airline industry. This chapter traces the industry from the era of economic regulation to the increasingly free market competition allowed in most of the world's largest markets. After outlining the growth of the early airlines in Europe, the focus shifts to the United States, beginning in 1918 with airmail operated by the U.S. Post Office. Using this early airmail endeavor as our starting point, the chapter traces the fledgling industry through the years of economic regulation under the Civil Aeronautics Board until economic deregulation in 1978, emphasizing the economic, regulatory, and technical evolution that shaped the industry. This historical perspective then continues with post-deregulation developments, including the emergence of low-cost carriers, bankruptcies, mergers, and buyouts. Airline deregulation next occurred in Europe, and then spread to several other world regions. To gain a broader perspective on the deregulation process and outcome, the U.S. experience is compared with that of Europe and China, leading to the conclusion that competitive results are remarkably similar. A short characterization of the industry concludes the chapter.

1.1 Transportation and Commerce

Air transportation is just one element of the world's transportation infrastructure, which is essential for economic growth and prosperity. Sailing ships have traded between countries for at least two millennia, making those cities and states that controlled trade wealthy. The past riches of Venice, still evident today in magnificent buildings, were based on trade. Today, ever larger and more efficient container ships reduce the cost of ocean shipping, facilitating the huge trade between China, Europe, and the Americas.

Rivers were the first and most efficient means for inland transportation of goods and people. The construction of canals to improve and supplement natural waterways dates back to at least the 6th century BC, when a canal linked the Nile River with the Red Sea. Extensive waterway building in China began in the 3rd century BC. The famous Venetian canals were extensions of the natural waterways among the islands on which Venice is built, and date from the founding of the city in the 5th century. Elsewhere in Europe, the Netherlands began canal construction to foster economic development in the 12th century, with construction then spreading across much of Europe. The British canal system played an important role in the Industrial Revolution, beginning in the 18th century. In contrast, economic development in Africa has been stunted by the lack of navigable rivers to facilitate commerce. Waterway construction in the United States is more recent, with the building of the Erie Canal connecting the Hudson River in New York with Lake Erie and the other Great Lakes not completed until 1825. The alternatives to waterway transportation at that time, usually by horse and wagon train, were comparatively much more expensive, slower, and limited. Railroads, first introduced in Great Britain in the early 19th century, gradually supplanted canals, offering higher speed over a much larger geographical area.

Transportation systems have often been financed and built by private firms, but market forces are generally insufficient to provide for the vast transportation infrastructure necessary to foster widespread economic growth. Therefore, governments frequently plan, build or subsidize, and regulate transportation systems.

In the United States, for example, the federal government encouraged and subsidized the development of both water and rail transportation. Railroads were often joint ventures of federal and state governments and private firms. The great western expansion of railroads following the Civil War, most notably the completion of the transcontinental railroad in 1869, allowed farm products from the Midwest to reach the heavily populated East Coast cities beginning in the early 1870s. Midwest farmers, in turn, were able to readily purchase goods from East Coast manufacturers, which vastly improved their standard of living. The Great Plains was transformed from a wasteland to a breadbasket. Transportation enables trade, which improves the overall standard of living.

The federal government remains essential in supporting transportation systems, including highways and roads, waterways, railways, pipelines, airways, and airports. The Army Corps of Engineers still operates the series of locks on the Mississippi and Ohio rivers over which Midwest grains are transported for export worldwide. Likewise, governments have also played a critical role in the development of commercial aviation. The Middle Eastern countries, especially the United Arab Emirates and Qatar, have recently invested heavily in airports and state-owned airlines to promote economic growth and diversity from dependence on petroleum exports.

1.2 First Airlines

Enabled by the rapid wartime advances in aircraft technology and a post-war surplus of aircraft, airlines were founded in the immediate aftermath of World War I in

1918. While there were a few earlier, short-lived ventures, many current European airlines trace their origins to the immediate post-war era. KLM claims the distinction of being the oldest carrier still in operation, having been founded in 1919. Scheduled flights between London and Amsterdam began in 1920 and continue to this day (AirFrance/KLM, n.d.). Similarly, the airlines that would later become Air France trace their origins to this period. Australia's Qantas also dates from 1920. In the Americas, Colombia's Avianca is the world's second oldest airline after KLM. Although Germany lacked the colonial empires of the British, French, and Dutch, it was also home to several early airlines. Today's Lufthansa is a post-World War II creation with some roots dating to 1926. Asia is now the fastest-growing airline market, but its airlines generally trace their origins to the post-World War II era.

KLM's title as the oldest airline in continuous operation notwithstanding, it is British Airways that claims the earliest daily international scheduled service for its forerunner airline, Aircraft Transport and Travel Limited, which started London to Paris service in August 1919. The first flight carried a single passenger. Handley Page Transport soon followed when it inaugurated London and Paris service by converting its former bombers for passenger service. While early European airlines began as private companies, most could not survive independently and quickly became reliant on state subsidies. In fact, all British airlines, finding themselves unable to compete, ceased operations for a few months in 1921 until the British government implemented first temporary and then permanent subsidies. Thus began an era of state control and often direct ownership of European airlines. As national flag carriers emerged in each country, the European airline industry became fragmented and jealously protected, a legacy that has only recently been reversed through privatization and consolidation.

1.3 Early Regulation

The rapid international expansion of airline routes led to the first international conference, the Paris Convention of 1919, to address regulation of air commerce and conflicting claims of national sovereignty of airspace. The conferees concluded that each nation has absolute sovereignty over the airspace overlying its territories and waters and, therefore, the right to deny entry and regulate flights through its airspace. On the other hand, the conference sought to encourage air transport by developing rules applying equally to all airlines and affording as much freedom of passage as possible. Although the convention was ultimately ratified by only 11 states, not including the United States, it provided the principles on which later regulation was founded.

Ten years later, the Warsaw Convention established the first international airline liabilities and passenger rights. Airlines of the ratifying countries were required to issue passenger tickets and baggage claim checks for checked luggage. The Convention recognized the right to compensation for loss of cargo or luggage and for injury or death, but it limited the airlines' liability. The Warsaw Convention has since been modified, but remains the basis for airline liability worldwide.

1.4 History of British Airways

The evolution of British Airways is illustrative of the growth of European aviation. In 1924, the government formed Imperial Airways with the consolidation of four airlines, including Handley Page Transport. Imperial Airways was anointed the "chosen instrument" of the British government, with the mission of developing routes across the vast British Empire (British Airways, n.d.). By 1935, Imperial Airways routes extended from London to Cape Town, South Africa, and across Europe, the Middle East, India, and Asia, terminating in Brisbane, Australia (see Figure 1.1a).

The airline operated a diverse fleet of aircraft, including four-engine flying boats. One land-plane example is the ungainly and aerodynamically inefficient Handley Page H.P. 42, pictured in Figure 1.1b. The H.P. 42 entered service in 1930, flying Imperial Airways eastern routes. Although cruising at only 100 mph, it had a range of 500 miles. Typical seating was for 24 passengers, split between fore and aft cabins in a surprisingly ornate interior.

The name British Airways (BA) first surfaced in 1936 with the consolidation of three airlines. BA and Imperial Airways operated independently for a few years until the start of World War II, when British Overseas Airways Corporation (BOAC) was formed to operate wartime services under control of the Air Ministry. BOAC took over the operations of British Airways and Imperial Airways for the duration of the war.

With the war's conclusion, the new Labour government decided that air services would be provided by three state corporations: BOAC would continue to operate routes to the Far East and North America; British European Airways (BEA) would serve domestic and European destinations; and British South American Airways (BSAA) would begin new services to South American and Caribbean destinations. Following the unexplained disappearance of two aircraft over the Atlantic in 1948 and 1949, BSAA was absorbed by BOAC. The BA brand was resurrected in 1974 when BOAC and BEA merged. The modern era began in 1979, when the Conservative government under Margaret Thatcher declared that BA would no longer receive state support or interference in decision-making. BA was fully privatized in 1987, concurrently with European airline deregulation (British Airways, n.d.).

1.5 U.S. Airmail

Early U.S. airlines did not follow the pattern of the first European carriers. The United States entered World War I late, did not produce any large aircraft, and generally did not enjoy the technological advances common in Europe. An extensive railway system served all major U.S. cities, offering more speed, range, and reliability than the aircraft of the early 1920s. And, unlike several European countries, the United States did not have colonies scattered across continents that could be reached only by ship or tortuous overland routes. Still, the U.S.

(a)

(b)

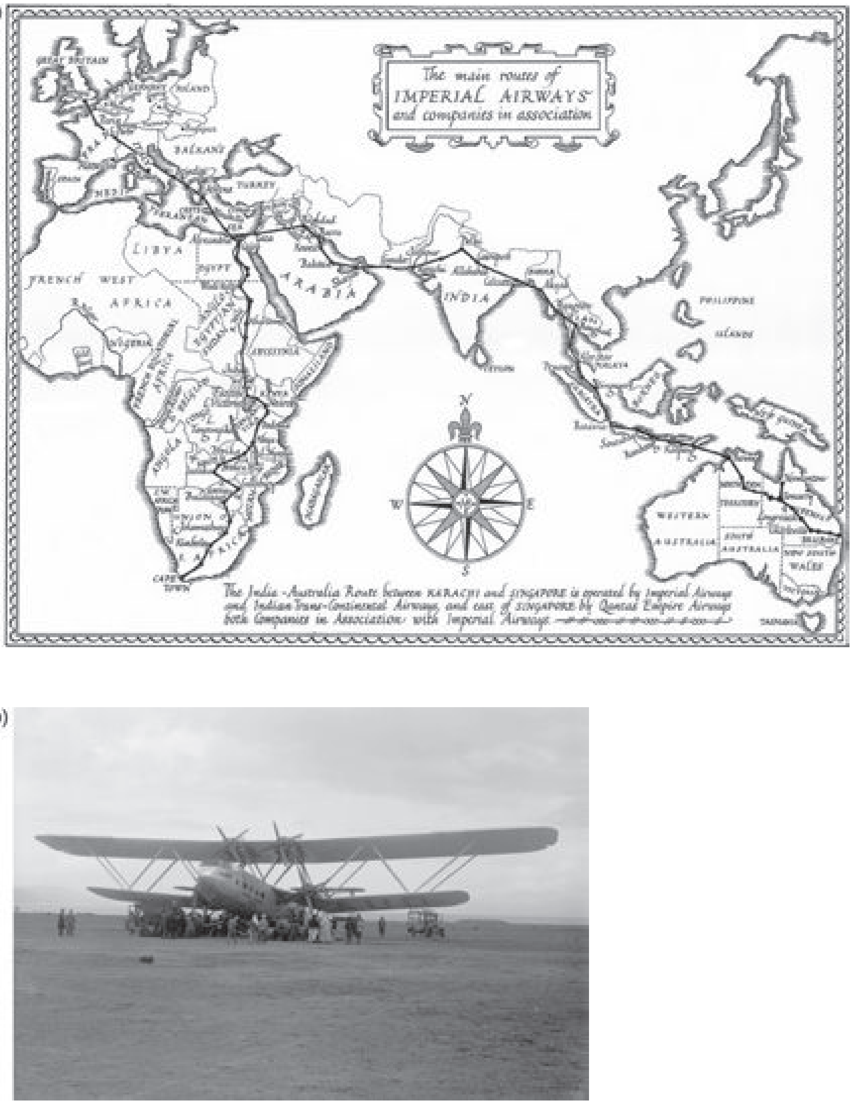

Figure 1.1 Early Airlines. (a) Imperial Airways Route System and (b) Handley Page H.P. 42.
Source: Wikimedia Commons.

government recognized the importance of aviation. The war conclusively demonstrated the power of aircraft as weapons of war and the potential for passenger transportation. Military aircraft production was mostly dismantled after the war, but the United States understood the need to retain an aircraft production capability in the event of a future war, a prospect which unfortunately materialized within 25 years. Passenger transportation, however, was not yet viable in the United States because the available aircraft were too small, slow, unsafe, and uncomfortable. The train offered a superior alternative for long-distance travel. So, rather than attempting to build a system focused on passenger travel, a heavily subsidized airmail service was chosen as a vehicle to begin air transportation system development.

The Post Office had been interested in airmail as early as 1912, but Congress did not appropriate funds until 1918, when $100,000 was made available for an experimental airmail service to be conducted jointly by the Army and the Post Office on a route between Washington and New York with an intermediate stop in Philadelphia. The initial aircraft fleet consisted of six new Curtiss JN-4D Jenny biplanes originally designed as pilot trainers but slightly modified for airmail service. On May 15, 1918, four flights were scheduled to inaugurate the new service, two legs northbound and two legs southbound. The first southbound flight left Belmont Park, Long Island, on time, at about 11:30 am. That aircraft made it to Philadelphia, where the mail was transferred and continued on to Washington without incident. The first northbound aircraft, however, was late departing from the Washington, D.C., polo fields and never made it to Philadelphia. It crash-landed about 25 miles away in Maryland. Unfortunately, the departure ceremony in Washington was attended by many dignitaries, including President Wilson and Postmaster General Burleson. The second leg of the northbound trip left Philadelphia for New York as planned, but without the Washington mail. Although the first day wasn't perfect, the short experiment was successful. After three months of flights flown by Army pilots, the Post Office bought their own Standard JR-1B biplanes designed specifically for mail service, hired civilian pilots, and assumed full control of the operation. Daily (except Sunday) New York to Washington service continued for several years (Eney, n.d.).

Having successfully introduced short-haul airmail, the Post Office set its sights on a far more ambitious goal, transcontinental airmail service. It opened the first segment between Chicago and Cleveland on May 15, 1919, and continued to add segments to the west until a transcontinental route was inaugurated on September 8, 1920. Aircraft performance was lacking, and, as a result, the most difficult segment was crossing the Rocky Mountains. Night flying was not feasible when the service first began, so the mail was handed off to trains at the end of each day. Nonetheless, by using airplanes, the Post Office was able to shave 22 hours off coast-to-coast mail deliveries. In Figure 1.2a, mail is loaded on an Embry-Riddle Waco mailplane. This company later merged into American Airways, predecessor of American Airlines. Embry-Riddle Aeronautical University is also a direct descendant.

Over the next few years, the Post Office developed procedures and facilities for reliable night flying, including sequential beacon lights to guide pilots along the transcontinental airways, weather reporting, and new airports. The Post Office experimented with several types of aircraft, but converted ex-Army DeHavilland

(a)

(b)

Figure 1.2 (a) Waco JTO Taperwing and (b) Boeing B-40. Waco photo courtesy of Embry-Riddle Aeronautical University Archives. B-40 from Wikimedia Commons.

DH-4s were widely used. In 1921, Boeing produced the B-40 aircraft specifically for the transcontinental segment spanning the Rocky Mountains. The B-40, with its interior cabin for two passengers, marked an early attempt to combine mail with passenger service (Figure 1.2b).

In the mid-1920s, Congress decided that the growing airmail service should be transferred from the Post Office to private companies. The Contract Air Mail Act of 1925, better known as the Kelly Act after its chief sponsor Congressman Clyde Kelly, provided for the awarding of airmail routes to private airlines. Of these, many were also aircraft manufacturers, for example, Boeing Air Transport, a division of the Boeing Company. This move to privately owned airlines contrasts with the strategy of government-owned airlines typical of most of the world at that time.

The Post Office awarded contract airmail routes (CAMs) to the lowest bidders. Twelve CAM routes spanning the United States were awarded to various private companies and were in operation by the end of 1926. A total of 34 CAMs were established by 1930 (Figure 1.3).

Despite the shift to private companies, commercial air transport was not economically viable without some form of subsidy. In awarding airmail contracts,

Figure 1.3 Contract Airmail Routes (CAMs), circa 1930.

Source: Wikimedia Commons.

the Post Office tried many compensation formulas to encourage self-sufficiency, but often with unintended consequences. One weight-based formula reportedly led to airlines mailing heavy packages (such as bricks) to themselves. The airline was paid $3.00 per pound by the government, but the postage was only $1.60, an example of the well-known economic law of unintended consequences and possibly the first example of "junk mail." This scheme was quickly changed to one based on the volume of the aircraft mail compartment, which encouraged the purchase of larger aircraft that were also capable of carrying passengers (Eney, n.d.). Yet, limited aircraft performance and Spartan accommodation doomed most early attempts at passenger service offered in conjunction with airmail delivery (Cook, 1996). In 1927 Ford introduced its Tri-Motor transport, and although slow and loud, it was designed for passenger service (Figure 1.4).

The Tri-Motor carried eight passengers, but at 90 miles per hour, it couldn't match the convenience and comfort of long-distance train travel.

By 1928, 44 small, financially weak airlines were transporting mail under contract but often operating recklessly using obsolete, but cheap, aircraft. These airlines were either unable or unwilling to invest in facilities and equipment, so the vision of a viable air transportation industry remained unfulfilled. Still, several major U.S. carriers trace their roots to these early private mail carriers.

In 1929, Walter Folger Brown was appointed Postmaster General under President Herbert Hoover. Hoover and Brown disliked reckless competition and sought stability, efficiency, and growth: specifically, strong companies with regulated competition. In 1930, Brown ushered the McNary-Watres Act through Congress, which allowed the Postmaster General to award airmail routes to the lowest "responsible" bidder, a change that allowed Brown to exclude many smaller carriers. Brown then summoned the heads of the largest airlines to his office to radically revise the airmail structure. With the intent of making

Figure 1.4 The Ford Tri-Motor.

Photo Source: Wikimedia Commons.

airlines profitable and ending subsidies, Brown engineered the consolidation of several carriers, eliminated competitive route bidding, and designated new airmail routes. These closed-door, semi-secret meetings became known as the "Spoils Conference." The "Big Four" airlines, American, Eastern, United, and Transcontinental and Western Air, trace their origins to this conference and emerged with the spoils—the new routes. Gone were smaller carriers, such as Robertson in St. Louis, for whom Charles Lindbergh had flown, and Ludington in Philadelphia. Unfortunately, financial instability, failure, mergers, and acquisitions have been a continuing feature of the airline industry.

1.6 Economic Regulation

In 1929, the U.S. stock market crashed, leading to a world depression. President Hoover's administration proved powerless to reverse the downward economic spiral. Franklin Delano Roosevelt won the Presidency in 1932, and one of FDR's initiatives included a witch hunt of Hoover administration policies and personnel. Beginning in 1934, Alabama Senator Hugo Black, later a Supreme Court Justice, conducted hearings investigating the Spoils Conference and airmail contracts amid unsubstantiated accusations of collusion by former Postmaster Brown and the Department of Commerce. Bidding scandals turned into political theater, attracting wide popular interest.

In a move that proved disastrous, Roosevelt insisted that the new Postmaster General, James A. Farley, cancel all existing airmail contracts, provoking outrage across the airline industry. Disregarding the lack of proper aircraft and pilot training, the President ordered the Army to fly the mail. Over the next six months, there were 66 crashes or forced landings and 12 deaths ("The rise of airlines," n.d.). That experience forced the Post Office to return the mail operation to the airlines, and Farley began by awarding temporary contracts (Correll, 2008).

The Air Mail Act of 1934 returned the airmail routes to private firms, but not without further disruption. Previous Spoils Conference attendees were barred from bidding. Thus, the federal government now sought to destroy the very airlines it had earlier created. Quietly, however, the airlines were advised to reorganize, giving rise to the latest version of the Big Four (Wensveen, 2007). American Airways became American Airlines, Eastern Air Transport became Eastern Airlines and Transcontinental and Western Air added "Inc." to its name (Correll, 2008, p. 65). Aircraft manufacturers were required to divest from airlines. Consequently, United Aircraft and Transport Corporation split into United Aircraft Company, Boeing Airplane Company, and United Air Lines ("Boeing history," n.d.). General Motors sold its stock in Eastern and Western. In addition to the Big Four, Delta and Braniff also won contracts. The Act split the responsibility for airline regulation among the Post Office, the Bureau of Commerce, and the Interstate Commerce Commission, a plan that soon proved cumbersome and unproductive. Within a few years, regulatory reform was again before Congress.

1.7 Civil Aeronautics Board Economic Regulation 1938 to 1978

In a series of acts beginning with the Civil Aeronautics Act of 1938 and culminating in 1940, airline regulation was transferred to two separate entities. The Civil Aeronautics Board (CAB) was given responsibility for economic regulation with a mandate to "promote the development and safety and to provide for the regulation of civil aeronautics" (Civil Aeronautics Act of 1938). The Civil Aviation Administration, forerunner of today's Federal Aviation Administration, assumed responsibility for non-economic regulation, specifically for air traffic control, certification of aircraft and airmen, safety enforcement, and airway development.

Congress charged the CAB with several goals. It was to promote adequate, economical, and efficient service "without unjust discrimination, undue preferences and advantages, and unfair or destructive competitive practices," but yet to preserve "competition to the extent necessary to assure the sound development of an air-transportation system" (Civil Aeronautics Act of 1938, section 2; Meyer & Oster, 1981). These conflicting objectives proved difficult to reconcile in practice. For most of its history, the CAB severely limited both route and price competition.

The CAB's mandate reflected the experiences of the Great Depression, from which the nation had not fully recovered. The unregulated free market was judged destructive. The CAB regulation of the fledgling airline industry was informed by and patterned after railroad regulation. Evidence of the railroad legacy remains today, as airline employee labor relations are still governed by the Railway Labor Act.

CAB regulation addressed three broad categories of airline operation: (a) initial approval to operate, (b) routes flown, and (c) fares charged.

The CAB approved airlines seeking to operate in interstate commerce. Airlines already operating in 1938 received grandfather rights to fly their existing markets. For new applicants, however, the CAB judged not only whether the prospective carrier was "fit, willing, and able," but also that the new service was necessary for "public convenience and necessity." A prospective airline had to demonstrate that it had the financial, managerial, and technical capability to safely operate an airline and that its proposed service was needed to fill a void in the market that would benefit the public. This proved to be a high standard. In the years after World War II, the CAB approved many smaller airlines, but no new large airlines, called trunk carriers, were approved during CAB's 40-year reign (Borenstein & Rose, 2007).

Airlines were approved to operate specific interstate routes, with separate CAB approval needed to add a new route or to drop an existing route. New route requests originated for a variety of reasons, such as a request from a city for new or expanded service or from the CAB's determination that more service was needed. Once a new route case was opened, all airlines could apply for the new service and, in a quasi-legal proceeding lasting a year or more, all arguments were heard. The CAB would eventually render its decision, but by the time the winning airline was announced, the market might have changed, and the winner often found that the new route did not fit well into its existing structure. On all but the largest routes, only a single carrier was permitted. Trunk carriers wishing to expand on routes already served by another airline had to show that the competition would not harm the incumbent carrier. As late as 1958, there was no competition on 23 of the 100 largest domestic routes.

Most routes were operated in point-to-point or in linear service, often along the former airmail routes, which themselves paralleled railroad lines. Enough flights operated from the largest airports to allow some passenger connections, but the CAB generally prevented airlines from optimizing their routes to improve service or reduce costs.

Finally, the CAB set the prices charged by all airlines in scheduled service. Prior to World War II, fares were set to prevailing first-class rail fares, but were later computed on a mileage basis and set to allow reasonable return (12%) on investment (Bailey, 2002). Airlines were effectively required to cross-subsidize routes with profitable, often longer segments, offsetting losses on shorter flights. When fares were changed, increases were applied to all flights; route-specific changes were not adopted. Charter flight fares were not subject to the same regulation, which later became an avenue for price competition, but the CAB discouraged price competition and rarely approved discounting from the fare formula rate. Consequently, airlines attempted to compete and differentiate their products with in-flight service. Even here, however, the CAB attempted to limit non-price competition by restricting first-class and sleeper-seat configurations.

Even under the protective shield of economic regulation, some carriers struggled financially. The CAB responded by awarding lucrative new routes to the weakest airlines. If this was insufficient to curb losses, the CAB orchestrated mergers. For example, Delta absorbed Northeastern with CAB encouragement in 1972.

1.8 Advances in Aircraft Technology

While the CAB was mandated to promote the airline industry, rapid advances in aircraft technology spurred the growth of passenger air travel. The Boeing 247, introduced in 1933, was the first airliner to provide the comfort and speed necessary to compete with the train. Boeing sold the first 60 247s to its affiliated United Airlines, thereby blocking other airlines from acquiring the newest technology. The 247, initially designed to seat 14 passengers, was larger, heavier, and more powerful than earlier airliners. But Boeing, pressured by United's pilots and others, reduced the size to 10 passengers and substituted older and less powerful Wasp engines for the intended Hornet engines. United pilots were concerned that the 247's heavier weight would be a problem on old runways and the Hornet radial engine was too powerful. Additionally, a larger aircraft might require larger hangars, so, as a result, Boeing acquiesced and went with the older engines and 10-passenger configuration. This would prove to be a strategic error. Jack Frye, the legendary president of Transcontinental and Western Air, later TWA, persuaded Donald Douglas to design and build a competing airliner. The resulting DC-1 was a superior aircraft. Douglas quickly improved on the DC-1 with the DC-2. Then, American Airlines convinced Douglas to design a sleeper version of the DC-2. The result was the fabulously successful DC-3, often proclaimed as the first airliner capable of making a profit from passenger service. The DC-3 in Figure 1.5 is pictured in American Airlines' livery. American introduced the DC-3 in transcontinental sleeper service in 1935.

The DC-3 incorporated the advanced technology introduced on the Boeing 247—stress-carrying skin, two engines (with the capability for high-altitude single-engine flight), controllable pitch propellers, retractable gear, deicing for wings and propellers, and a cruising speed of 180 mph. Much larger than the B-247, the DC-3 was capable of carrying 30 passengers versus the 247's 10. Within a year of its introduction in service, United began replacing the B-247 with the DC-3. The DC-3 soon dominated the airline fleets in the years immediately preceding World War II. By 1939, 95% of all U.S. airline flights were operated by the DC-3 (Thomas, 2007).

The DC-3 was larger, faster, and more reliable than the aircraft it replaced. These technological and economic improvements can be quantified with a *productivity index*. The productivity index is a measure of available seat miles per year, the product of three factors: (a) seat capacity, (b) speed, and (c) utilization measured in flight hours per year. A fourth component, load factor or the percentage of seats occupied, is sometimes included for economic comparisons. But load factor is a measure of market demand, competition, and management decisions rather than aircraft design productivity, so it is not included in the index.

Figure 1.5 Douglas DC-3.

Source: Wikimedia Commons.

To compute the productivity index, multiply seat capacity, speed, and yearly utilization. For the DC-3, the index is 30 seats × 180 mph × 1,500 hours/year, or 8.1 million available seat miles per year (ASM/year) per aircraft.

World War II, which the United States entered in late 1941 following the attack on Pearl Harbor, interrupted the growth and development of the civilian air transportation system. Airline capacity was mostly dedicated to providing military and government transport in support of the war. Intensive wartime production allowed many firms to return to profitability during the war following many years of losses in the Great Depression. Airlines were no different, also benefiting throughout the war years.

Advances in aircraft technology required for the production of larger bomber aircraft were quickly utilized in the post-war period to field a new generation of airliners. The Douglas DC-6 was originally intended as a military transport (the C-118 Liftmaster) but was quickly reworked after the war for the long-range commercial market. The DC-6 first entered commercial service with United Airlines in 1947. By 1949, it was in service with United, American, and Delta, among others. The DC-6 cruised at 300 miles per hour and carried about 60 passengers, depending on the model and airline configuration. An American Airlines DC-6 is pictured in Figure 1.6a.

By the mid-1950s, piston engine technology reached its zenith with turbo-compound radial engines capable of 3,500 hp. The Douglas DC-7C, tagged the 7 Seas, and the Lockheed Super Constellation represent the pinnacle of piston aircraft technology. Both were capable of transcontinental and trans-Atlantic non-stop service. The Super Constellation with its distinctive three-tail configuration is pictured in Figure 1.6b.

As an example of the post-war increase in aircraft productivity, the productivity index for the Super Constellation is 85 passengers × 335 mph × 2,000 hours/year = 57 million ASM/year per aircraft. During the 20-year period from the introduction of the DC-3 to the largest piston-powered airliners, aircraft productivity increased seven-fold.

1.9 Post-War Airline Growth

With the conclusion of the war, the airlines and the CAB returned their attention to expanding the domestic route system. With the increased range and capability of post-war airliners, the CAB awarded new routes between major cities to the established trunk airlines. But competition was still restrained, with even the highest-demand markets limited to two carriers.

Under public and political pressure, the CAB approved a new type of airline, the local service carrier (LSA). LSAs were awarded routes connecting smaller cities previously without air service to larger cities served by trunk carriers, thereby allowing air travel between many more cities across the United States. However, such travel was often inconvenient because the schedules of the LSAs and the trunk airlines were poorly coordinated. Two, and often three, changes

(a)

(b)

Figure 1.6 Large Piston-Powered Aircraft. (a) Douglas DC-6 and (b) Lockheed Super Constellation.

Photo sources: Wikimedia Commons (by Bill Larkins – Douglas DC-6 AA N90739, CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=29356711 and by RuthAS – Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=45981419).

of airlines were required on an itinerary connecting two, geographically dispersed, smaller cities. This inconvenience would emerge as an important factor in the post-deregulation development of hub-and-spoke route systems. Large numbers of war-surplus DC-3s became the backbone of the LSA fleets. LSAs were mostly unprofitable, leading to various CAB subsidies (Cook, 1996).

Prior to World War II, Pan American World Airways (Pan Am) was the sole U.S. airline allowed to operate international routes. In return for this government monopoly, Pan Am was not permitted any domestic routes. After industry deregulation, this lack of domestic feed traffic would prove an insurmountable problem for Pan Am. In 1946, Trans World Airlines broke the monopoly and began trans-Atlantic service, making it the second U.S. designated flag carrier. But, in contrast to Pan Am, TWA retained its domestic route structure.

A fourth type of airline, the supplemental carrier, was approved to operate charter services. The CAB's intent was for the supplemental carriers to offer charters during peak season demand that would "supplement" existing scheduled service. Rather, with high-density seating and low costs, charter services gradually began to compete with trunk carriers, introducing some price competition into domestic airline routes.

A second element of price and service competition emerged in 1948 when Capital Airlines initiated high-density coach seating on its DC-4 aircraft operating between Chicago and New York. The CAB approved coach fares of approximately two-thirds of the previously existing first-class fares—and traffic soared. This event was a significant first step to greater competition and, eventually, to deregulation. Capital Airlines later merged into United Airlines.

1.10 The Jet Age

Many of the technological advances developed for military aircraft were later applied to the commercial sector. German jet-powered fighter aircraft emerged at the end of World War II, but the British were first to incorporate this new technology in the de Havilland Comet, which entered service in 1952 with BOAC. Tragically, the aircraft experienced airframe metal fatigue, a phenomenon then not fully understood or appreciated, resulting in three in-flight breakups. Although de Havilland deserves considerable credit for starting the jet age, sales of the redesigned Comet never fully recovered.

Boeing employed a swept-back wing design for its jet-powered B-47 and B-52 bombers to reduce drag and increase speed. This design was incorporated into commercial jets, making them faster and thus more attractive to passengers. Perhaps the best example of military–civilian technology transfer is the KC-135 jet tanker Boeing designed for the U.S. Air Force. The KC-135, introduced in 1956, was a huge success as a military plane, but even more successful when revamped and introduced in 1958 as the first U.S.-built passenger jet, the Boeing 707.

Jet engines proved far more reliable than piston-driven engines. Lower engine vibration delivered a smoother ride, placed less stress on the airframe, and reduced maintenance expense. Jet engines burned kerosene, which, at that time, cost half as much as the high-octane gasoline used in large piston transports. While questions remained about the technical and economic feasibility of commercial jet aircraft, Pan American World Airways was the launch customer for the B-707, ordering 20 aircraft. With Pan Am's successful introduction of the B-707 in 1958, concerns about the feasibility of jet aircraft were resolved; other large airlines lined up to buy the new jet aircraft. The Jet Age began.

The Boeing 707 is pictured in Figure 1.7a in BOAC livery. As noted earlier, BOAC, after a series of mergers and acquisitions, became BA, and is today one of the world's premier carriers.

Figure 1.7 (a) Boeing 707 Operated by British Overseas Airways Corporation and (b) a Pan American World Airways Boeing 747.

Source: Wikimedia Commons.

Aircraft productivity took another big leap with the 707 and other manufacturers' jet transports that soon followed. The 707 was larger, much faster, and more reliable than the piston aircraft it replaced. The productivity index for the Boeing 707 quantifies another significant improvement in technology: 160 seats × 600 mph × 3,000 hours/year = 288 million ASM/year.

The Boeing 747, which first flew in 1969, rivals the B-707 for success and popularity as a commercial jet transport. Buoyed by its success with the 707, Pan Am was the first airline to order and operate the world's first jumbo jet as the Boeing 747 began trans-Atlantic service in 1970. A Pan Am World Airways 747 is pictured in Figure 1.7b. At two and a half times the size of the B-707 and the rival Douglas DC-8, the 747 offered yet another leap in productivity. The productivity index for the Boeing 747 was 360 seats × 550 mph × 4,000 hours/year = 792 million ASM/year.

From the introduction of the Douglas DC-3 in 1933 to the Boeing 747 in 1970, a period of less than 40 years, aircraft productivity measured in available seat miles per year increased by about 100 times. This is a truly astonishing technological feat, a pace of improvement we now associate with consumer electronics.

Airbus Industrie, a government-sponsored consortium including aircraft manufacturers from France, Germany, the Netherlands, and Spain, produced the first wide-body, twin-engine commercial aircraft. The Airbus A300 entered service in 1974 but initially enjoyed few sales (Figure 1.8a). Airbus scored a breakthrough in the United States when Eastern Airlines ordered the A-300-B4. Other U.S. airline orders soon followed, firmly establishing Airbus in the world aircraft market. With increasing engine thrust and reliability, the wide-body, twin-jet design is now predominant, the four-engine Airbus A-380 and Boeing B-747-800 being the exceptions.

Airbus scored another first with the introduction into service of the A-380 by Singapore Airlines in 2007 (Figure 1.8b). The A-380 is the world's largest passenger airliner, typically configured to 525 passengers in three cabins, but with an all-economy capacity of 853.

Since the Boeing 747, the increase in technologically driven productivity has slowed. Neither speed nor capacity increased until the launch of the Airbus 380, but improvements in fuel efficiency and reliability have continued. The supersonic British-French Concorde notwithstanding, economical cruise speed is limited by shock wave–induced drag.

Rather than increases in size and speed, technological developments since the design of the 747 have focused on operating economics. Fuel economy, primarily from more advanced engine technology, has more than doubled over the last 30 years. Aircraft reliability has also increased dramatically, and cockpit automation has improved flight operations efficiency and safety.

The productivity index has been used to provide an appreciation of the rapid improvements in aircraft technology, but this index, as with any economic metric, is an imperfect measure. For the A-380, should the typical passenger seating configuration be used, or is the all-economy seating more representative, even though no airline has yet used that configuration? Because we began with the computations with the DC-3 in single-class configuration, we'll use it again here: 850 seats × 600 mph × 4,750 hours per year = 2.5 billion ASM/year, or some 300 times that of the DC-3. As with the more recent advent of computers and the dramatic increases in processor speeds and memory capacity, improvements in aircraft technology have reduced airline costs, savings which have been passed on to passengers. But the productivity index does not consider improvement in quality, a common deficiency of economic indicators. The passenger riding in current-generation commercial jet aircraft enjoys much greater safety and more comfort with a pressurized and air-conditioned cabin and other interior amenities unimaginable to the DC-3 passenger.

(a)
(b)

Figure 1.8 (a) Airbus A300 operated by launch customer Air France and (b) Singapore Airlines flagship A380. A300 photo courtesy of Airbus. A-380 photo from Wikimedia.

1.11 U.S. Deregulation

With the success of the Boeing 747 in the earlier 1970s, other aircraft manufacturers rushed to build competing jumbo jets, notably the Douglas DC-10 and the Lockheed L-1011. U.S. trunk carriers dutifully ordered jumbo jets for domestic service so as not to be left behind by their competitors. This resulted in an unintended consequence: too many available seats for the market demand at CAB-established prices.

The CAB did not believe in or allow much price competition, so airlines resorted to flight frequency and in-flight service to lure passengers to empty seats. As an example, Continental installed a piano bar in its DC-10 aircraft. Further, the CAB consistently refused to allow airlines operating older, slower, and less comfortable aircraft to charge lower fares, which made the newest aircraft a competitive necessity (Borenstein & Rose, 2007).

Fares remained high, and passenger load factors dropped from 70% in 1950 to 50% by the mid-1970s. Airlines were losing money, to which the CAB responded with a route moratorium. But financial pressures increased, so in 1974 the CAB allowed a 20% fare increase, which further depressed demand. It also sanctioned capacity limitation agreements among major carriers in an effort to staunch continuing losses (Borenstein, 1992; Button, 1991).

As the futility of the CAB's actions became apparent, many academics, regulators, and politicians and an occasional airline executive began calling for drastic changes in CAB regulation. Several factors provided impetus: (a) capacity increased on many routes as jumbo jets entered service, (b) the Middle Eastern oil embargo in 1973 led to skyrocketing fuel costs and contributed generally to price inflation, and (c) an economic downturn put a severe strain on airlines, because business travel demand fell at the same time as capacity and fuel prices were rising.

In 1974, the Ford administration began to press for government regulatory reforms in response to a growing public sentiment that government regulations were overly burdensome on U.S. industry and contributed to inflation. Shortly thereafter, Senator Edward Kennedy chaired Senate subcommittee hearings concluding that airline prices would fall if government constraints on competition were lifted. Comparisons drawn with the unregulated intrastate carriers Southwest Airlines, Pacific Southwest Airlines (PSA), and Air California (AirCal) exposed inefficiencies of the regulated airlines that were costly to consumers. A CAB staff report reached the same conclusion in 1975. The report said the industry was "naturally competitive, not monopolistic" (Civil Aeronautics Board, 1975, Executive Summary) and that the CAB itself could no longer justify entry controls or public utility–type pricing. On its own, the Board began to loosen its grip on the industry (Bailey, Graham, & Kaplan, 1985).

The debate over airline industry economic deregulation was based, in large part, on economic studies and recommendations. Economic theory holds that under conditions of perfect competition, consumer welfare is maximized without government restriction or interference. In attempting to earn a profit under intense competition, suppliers develop and market products that consumers want, while competition ensures that products are produced at the lowest possible cost and sold at prices that just cover the production expense.

But, contrary to the theory of perfect markets, airline markets are natural oligopolies in which only a few airlines compete in each market. While economists recognized this important distinction, they generally argued that airlines were sufficiently competitive to provide the benefits of a competitive market without government regulation. Several arguments were offered in favor of deregulation:

- Deregulated airlines would be more efficient. Proponents argued that regulation resulted in inefficient and costly operations. With fares set by the CAB based on airline costs of operations plus a profit margin, airlines faced few incentives to pursue lower costs. Unable to differentiate their products based on prices, airlines promoted costly and inefficient passenger amenities. Labor successfully pursued a strategy of ever-increasing common industry-wide wages and work rules. Because all airlines incurred similar labor costs, these were incorporated into the base fare computations.
- Subjecting airlines to competition would result in lower fares. Economists pointed to intrastate carriers (PSA, AirCal, and Southwest) that were not subject to CAB price control. These airlines charged only about half the price of CAB-regulated airlines on routes of similar length. Deregulation would allow new, more efficient airlines to enter markets with low fares and innovative service, thereby disciplining the established carriers. Incumbent carriers would either become cost competitive or fail.
- Critics of the CAB also felt that it no longer regulated in the interest of passengers but, rather, in the interest of its clients, the airlines. The CAB staff were often recruited from the airlines for their expertise or hoped to join airline management following their time with the CAB. Indeed, many of the prominent post-deregulation airline executives began their careers at the CAB.
- Expansion by existing carriers and new entrants would provide more service in response to passenger demand.

Deregulation was opposed by most airline executives and labor. Their arguments against deregulation were also persuasive:

- The strongest carriers would engage in predatory pricing, lowering prices on routes until weaker carriers were forced out.
- Having dispatched competing airlines, strong airlines would then monopolize the most profitable routes, raising fares to monopoly levels. Thus, rather than lower fares for passengers, prices would actually increase in the long run.
- Routes with low demand that were cross-subsidized under CAB regulation would be abandoned. Some cities would lose air service altogether.
- Faced with intense price competition, airlines would cut maintenance and other essential safety expenditures.
- Finally, some airlines would fail, with employees losing their careers and livelihoods (Cook, 1996).

1.12 The Airline Deregulation Act of 1978

In 1977, recognizing the growing movement toward deregulation, the CAB consented to American Airlines' request for SuperSaver discounts of some 45% below existing coach fares. When American's traffic swelled as much as 60% in response, the solution to overcapacity seemed at hand in an apparent vindication of the proponents of deregulation. Other carriers quickly filed and received approval for similar discounts (Meyer & Oster, 1981).

Congress first freed cargo airlines from economic regulation in 1977, leading directly to the success of Federal Express (now FedEx). The same principle of free-market competition was next applied to the passenger carriers with the Airline Deregulation Act of 1978. Restrictions on domestic routes and schedules were eliminated, along with government controls over domestic rates.

The Act mandated that domestic route and rate restrictions must be phased out over four years. The CAB actually moved much more quickly. It began granting new route authority so readily that, within a year of the law's passage, carriers were able to launch almost any domestic service they wanted.

The CAB ceased to exist on January 1, 1985, with remaining Board functions shifted to other government agencies, primarily the Department of Transportation.

1.13 Post-Deregulation Evolution

The post-deregulation evolution of the airline industry proved both proponents and skeptics partially correct. The general and, to a large extent, uncritically examined expectation was that the newly deregulated industry would evolve to resemble the unregulated intrastate airlines that had been put forward as a model. These carriers operated simple point-to-point route systems. Fares were low and uncomplicated, often with a single higher fare for peak travel demand times. The result for the greater domestic system, however, was much more varied and complex.

CAB Chairman Alfred Kahn, often credited as the architect of airline deregulation, quickly moved the CAB into the sunset. All the dormant airline routes were put up for auction to certified airlines. Braniff International Airways, betting that deregulation would not last, applied for over 100 routes and expanded very rapidly. The formerly intrastate airline Southwest began to expand out of Texas, and, similarly, Air Florida out of Florida. As predicted by the proponents of deregulation, a host of new carriers formed and entered markets. Twenty-four new jet airlines started service between 1978 and 1985, with People Express perhaps best known.

Contrary to expectation, however, the former trunk airlines moved to develop hub-and-spoke route systems, often through acquisition of or merger with former LSAs. As one of many examples, here is a partial history of vertical integration that eventually led to the current Delta Air Lines:

- In 1968, Hughes Air West was formed by merging Bonanza Air Lines, Pacific Airlines, and West Coast Airlines.
- North Central Airlines merged with Southern Airways to form Republic Airlines in 1979; then, Republic acquired Hughes Air West the following year.
- Next, Republic merged with Northwest Airlines in 1986.
- Finally, in 2010, Northwest merged with Delta Air Lines following the bankruptcies of both carriers.

Today's American and United Airlines are the result of a similar long history of mergers and acquisitions. Even Southwest Airlines has acquired other airlines, mostly recently AirTran Airways. Many of the small, independent commuter airlines that provided service from the smallest commercial airports under contract to both trunk carriers and LSAs were acquired by the major airlines to support the growing hub-and-spoke systems. American Airlines' Eagle Airlines, now rebranded as Envoy, itself a union of several commuters, is but one example.

Unfortunately, tough times quickly roiled the industry. By the mid-1980s, intense competition, an oil embargo, and the air traffic controllers' strike resulted in the failure of all but two post-deregulation carriers: America West and Midwest Express. Nor was this first deregulation carnage restricted to new and small airlines. Several of the large, formerly regulated, carriers also failed. Notable are Braniff, Eastern, and the fabled Pan American International Airways (Borenstein, 1992; Cook, 1996).

1.14 U.S. Deregulation Results

Perhaps not surprisingly, some results of deregulation were anticipated, while others were unforeseen. As predicted, deregulation did lead to lower fares, primarily for leisure travelers. Business fares remained high, but frequency increased, although generally with a stop required at one of the newly emerging hub airports. Economists estimated that in the years shortly after deregulation, consumers saved some $18.4 billion per year (in 1995 dollars) as a result of the Deregulation Act; 55% of the savings resulted from lower fares and 45% from increased service frequency, which helps reduce the number of nights travelers must spend on the road (Morrison & Winston, 1995). By 1986, 90% of passengers traveled on some discounted fare (Bailey, 2002).

Also, as predicted, the entry of lower-cost new airlines quoting much lower fares than incumbents increased competition. These carriers should have prospered, but, with the exception of Southwest Airlines, which has been consistently profitable and grown to the largest U.S. domestic airline, early new entrant carriers mostly struggled and failed. Much later, airlines established in the late 1990s were more successful. JetBlue is the prime example.

Proponents anticipated point-to-point route systems with simple fares, similar to those developed by the intrastate airlines Southwest, PSA, and AirCal. Instead, hub-and-spoke systems developed rapidly. The hub-and-spoke system connects many cities using fewer aircraft than a linear or point-to-point route system, and provides an airline with a better opportunity to keep its passengers all the way to their final destination rather than handing them off to other carriers. Travelers enjoy the advantage of staying with a single airline. Hub-and-spoke systems can generate high load factors, employ larger aircraft, provide more flight frequency, and potentially reduce fares. Route structures are addressed in Chapter 3.

Deregulated fares were expected to be simple, similar to the intrastate airlines on which much of the argument in favor of deregulation had been based. Instead, a complex fare structure was quickly developed by the largest carriers, offering deeply discounted fares to most leisure passengers, with higher fares imposed on business travelers who were unable to book far in advance. Initially, this fare structure was devised to compete with the low fares offered by the new entrant carriers, but then took on increasing sophistication as the revenue potential of price discrimination was fully realized (Kahn, 1988).

Although some of the oldest airlines failed, those incumbent carriers that survived enjoyed advantages over new entrants that had not been fully appreciated. The rapidly developing hub-and-spoke route systems allowed large airlines to control passenger feed to their own hubs. Incumbents also controlled access to the distribution system through ownership of computer reservation systems. These systems were highly biased in favor of the owner, placing new entrants at a significant competitive disadvantage. Similarly, the development of loyalty programs for passengers and travel agents benefited the largest airlines. In total, these advantages rendered the low-cost structure of the new entrant carriers less advantageous than envisioned (Levine, 1987).

Failure of both old-line and new entrant carriers forced many airline employees into unemployment and ruined careers. Employees at surviving carriers faced demands for wage concessions and increased productivity. Labor–management turmoil spread across the industry (Cook, 1996).

The failure of the new entrants would seem to have decreased competition, and, indeed, industry concentration increased with the failures. However, because the surviving carriers rapidly expanded their route systems, these airlines competed on many more routes, in sharp contrast to the regulated era when the CAB allowed little route competition.

1.15 CAB in Retrospect

In the debate that preceded the passage of the Airline Deregulation Act of 1978, many argued that the CAB had outlived its purpose and effectiveness, but it had also accomplished the vision for which it was created: to develop a nationwide, effective air transportation system. During the CAB era, the domestic air transportation network grew to include all large U.S. cities. With the emergence of the LSAs after World War II, many mid-sized cities also received air service. Some itineraries, however, required changing carriers along the route, known as interlining, with connections sometimes poorly timed. Data from Airlines for America show that shortly after World War II in 1948, about 15 million passengers traveled almost 8 billion revenue passenger miles (RPMs) on the U.S. airlines system-wide. By deregulation in 1978, the passenger count had grown to almost 275 million, totaling over 226 billion RPMs—increases of 19- and 29-fold, respectively (Airlines for America, n.d.). Despite the CAB's strict control of air fares, the real price of air travel also decreased substantially over the same period. The average price to travel one mile, known as yield, decreased from approximately 15¢ in 1948 to about 8¢ in 1978 as measured in inflation-adjusted 1978 dollars (Air Transport Association as cited in Sherry, 2010). Over the 30-year period, the real cost of airline travel had fallen by half. As the CAB allowed little price competition, so that airlines were not driven to cost efficiency, the decrease in the price of air travel resulted from the dramatic increase in aircraft technology (productivity index discussed earlier).

The lower real cost of air travel is one factor that drove the increase in passengers and miles traveled by air. Lower fares allowed more people to travel for both business and pleasure, thereby increasing business productivity and consumer pleasure, both of which increased the standard of living, as measured by the amount of goods and services consumed by the average American.

Its overall effectiveness in promoting air transport notwithstanding, it's hard to appreciate the minutiae into which the CAB once delved. Here's a particularly enlightening passage from Alan Greenspan, the former chairman of the U.S. Federal Reserve Bank, commenting on airline regulation:

> Deregulation was the Ford administration's great unsung achievement. It's difficult to imagine how straitjacketed American business was then. Airlines, trucking, railroads, buses, pipelines, telephones, television, stockbrokers, financial markets, savings banks, utilities – all operated under heavy regulations. Operations were monitored down to the tiniest detail. My favorite description of this was by Alfred Kahn, a wisecracking economist from Cornell University whom Jimmy Carter made head of the Civil Aeronautics Board and who became known as the Father of Airline Deregulation. Speaking in 1978 on the need for change, Fred couldn't resist riffing on the thousands of picayune decisions he and the board were called upon to make: "May an air taxi acquire a fifty-seat plane? May a supplemental carrier carry horses from Florida to somewhere in the Northeast. Should we let a scheduled carrier pick up stranded charter customers and carry them on seats that would otherwise be empty, at charter rates? … May a carrier introduce a special fare for skiers but refund the cost of their ticket if there is no snow? May the employees of two financially affiliated airlines wear similar-looking uniforms?" Then he looked at the congressmen and said, "Is it any wonder that I ask myself every day: Is this action necessary? Is this what my mother raised me to do?"
>
> (Greenspan, 2007, pp. 71–72)

Deregulation of the airline industry is important in its own right, but it was also the first in a series of industry deregulations. Trucking was freed from economic regulation by the Motor Carrier Act of 1980, followed by similar legislation for energy, communications, and finance. Faith in the benefits of free markets spread to most of the developed world as nationalized firms were privatized and industries deregulated in many countries, perhaps most famously by Margaret Thatcher in the United Kingdom.

1.16 Deregulation in Europe

Europe followed the United States in airline deregulation. After World War II, airline markets in Europe were regulated by reciprocal agreements between individual countries that designated the airlines allowed to offer service, the routes operated, and fares charged, as well as the flight frequency and capacity. Usually, only one airline from each country was designated, most often the state-owned national carrier. Rather than competition, these *bilateral agreements* were intended to split the traffic and revenues between the signatory countries.

Moves to integrate the many European states into a single market began shortly after World War II and progressed gradually, beginning with the European Coal and Steel Community in 1950. Over time, more goods and services were included, and trade restrictions among the member countries were reduced. The European airline industry was an important piece of the integration project.

Unlike in the United States, where deregulation was achieved with one congressional law in 1978 and implemented swiftly thereafter, European deregulation occurred in three phases or packages, the first of which was realized in 1987. The third package, implemented in 1993, fully opened airline markets to competition among the member states. Any member state airline could operate any route to any airport where it could obtain facilities and charge whatever it chose. Just as importantly, airlines were free to merge with or purchase other carriers within the European Union (Doganis, 2006).

Initial response to European deregulation was somewhat timid; most dense markets continued as high-fare duopolies. Established carriers did expand, creating more competition on some routes, but fares remained high.

But Irish-based Ryanair, following the Southwest low-fare/low-cost business model, offered low fares that stimulated new traffic. Noting Ryanair's success, new low-cost carriers (LCCs) appeared as both independent airlines and subsidiaries of incumbents. Debonair, easyJet and Virgin Express began as independent airlines, whereas BA and KLM set up LCC subsidiaries Go and Buzz, respectively.

The greatest impact of LCCs in Europe occurred only after Ryanair and easyJet emerged as the clear leaders. Each began rapid expansion in the early 21st century. By 2005, LCCs had captured 25% of the European market.

As in the United States, low fares greatly expanded traffic, which doubled and even quadrupled on many routes. Manchester–Dublin traffic, as an example, grew from 230,000 passengers annually to over 600,000 within three years of Ryanair's entry. But, as in the United States, most new entrant LCCs did not survive. Many were merged or acquired—both Ryanair and easyJet grew through acquisition—while others failed and went out of business (Doganis, 2006; Hanlon, 2007).

In contrast to the United States, prior to deregulation, European airlines operated networks concentrated around the national airport, but flights were not scheduled to provide for timely connections. Transfer opportunities were mostly random. European deregulation stimulated network restructuring, developing hub-and-spokes systems similar to the earlier U.S. experience (Burghouwt & de Wit, 2005).

1.17 Deregulation in China

While liberalization of the airline industry has progressed in most world regions, China presents another informative example. During their first 30 years of operation from 1950 until 1980, airlines in the People's Republic of China were owned and operated by the Civil Aviation Administration of China (CAAC), which was itself a unit of the Air Force. Passenger service, restricted to high-level government officials and senior managers of large state-owned firms, was limited, inefficient, and generally of poor quality.

After the death of Mao Zedong in 1976, China gradually adopted mixed-market policies and began to embrace competition as the means of economic development and growth. As in Europe, China pursued a more gradual and cautious approach to airline liberalization.

The first step separated airlines from CAAC ownership. Although airlines remained under government ownership, each airline assumed responsibility for operations, profits, and losses. Six trunk carriers emerged, from which the current Chinese Big Three – Air China, China Eastern, and China Southern – trace their origins.

Similarly in many respects to the 40 years of U.S. regulation under the CAB, the CAAC retained regulatory control over airline approval, fares, frequency, and route entry and exit. The CAAC allowed and even encouraged the entry of new regional airlines to feed traffic to the six trunk carriers. This development is also similar to the growth of LSAs in the United States following World War II, but, unlike in the United States, the regional airlines were owned by provincial governments (Zhang, 1998).

Aggressive liberalization of air transportation markets began in 1997 and continues today, although not always in accordance with CAAC plans and desires. To encourage airline growth and expand the passenger market, the CAAC allowed airlines to provide several layers of discount tickets. A fare war promptly ensued. The CAAC attempted to regain control of fares by limiting the range of discounts, revenue-sharing schemes, and punishing non-compliant airlines with route expulsions. Airlines circumvented all attempts at control.

Interestingly, by 2004, the CAAC essentially acknowledged defeat and gave up on efforts to control fares even as it remained nominally in control. Carriers were still owned by state or regional governments, but limited foreign investment and ownership were permitted after 1994; public shares began trading on major stock exchanges, beginning with China Eastern Airlines in 1997.

Privately owned airlines were permitted following China's entry to the World Trade Organization in 2001. Several new private airlines, mostly following the LCC business model, entered service, but most struggled financially. Of the more than 40 private carriers that entered the domestic market, after some initial success, most either merged with larger carriers or went out of business. The CAAC also gradually permitted free entry and exit from most routes and markets (Zhang & Round, 2008).

As we have already seen, fare wars erupted as soon as the CAAC permitted discount fares. Since de facto deregulation in 1997, China's airlines experienced explosive growth of more than 15% per year until slowed by the global recession of 2008. Growth was spurred by a combination of more affordable fares and route expansion providing more widespread, convenient, frequent, and affordable airline service.

Beginning in 2002, a wave of consolidation occurred among China's airlines. Today's Big Three dominate regions of the country based in the largest cities of Beijing, Shanghai, and Guangzhou, with each having merged with or absorbed three or more formerly independent airlines. The consolidation created carriers with sufficient geographical scope that the linear route structures developed under CAAC regulation could be rationalized in hub-and-spoke networks connecting cities across the entire country.

Finally, as in Europe and the United States, deregulation brought inconsistent financial results. In 2008, the Chinese government provided huge bailout packages to keep the largest carriers aloft, but recovery from the Great Recession was quick, with most carriers enjoying record profits by 2010 (Cantle, 2009, 2011; Zhang & Round, 2008).

In the United States, the European Union, and China, deregulation brought not only lower prices and increased service that benefited passengers, but also turmoil, including new entrants, failure, and consolidation. It's interesting that the results are similar even though the economic systems differ significantly. More generally, liberalization and the adoption of free markets fosters economic growth, more jobs, and higher incomes, but is accompanied by consolidation and corporate failures. Some turmoil and chaos, famously termed "creative destruction" by the economist Joseph Schumpeter, is the price of free competition.

1.18 Airline Industry Today

As the evolution of the airline industry continues, several important characteristics are evident that will be explored in the rest of the text, some of which have been suggested in this review of airline history:

- Demand for air travel is "derived" from passengers' wants and needs to travel to different locations for business or pleasure. In other words, passengers do not fly to enjoy the flight but, rather, to get to a destination for a particular purpose. Especially for business, the need to travel follows the business cycle, so air travel demand is closely tied to the general economy.

- The domestic coach seat has become a commodity. A commodity product is one in which the consumer considers all producers' products to be equal; many basic agricultural products are examples. With low brand loyalty and little product differentiation, leisure passengers often choose among airlines based on price. Business passengers display somewhat more loyalty.
- Although freed from economic regulation, the airline industry in the United States remains highly regulated by the Department of Transportation and the Federal Aviation Administration. Other countries have a similar regulatory structure. Gradually, the world's safety regulations and requirements are being harmonized. The United States and the European Union have agreed on many common standards.
- The airlines do not own or control many factors of production. Airport facilities are usually not owned by airlines, national airspace (NAS) is controlled by the states, and the system has reached capacity around many hub airports. In Europe, major airports also operate at capacity, with flights limited by rights, known as slots, granted to individual airlines. Infrastructure constraints are increasing in most of the industrialized countries.
- The industry is heavily unionized; because the product cannot be stored, pilots or other employee groups can shut down an airline, and all revenue ceases. Harmonious labor relations are a key element in airline success.
- Fuel and many other costs are not controllable. However, since 2001, major carriers have been successful in reducing labor costs, aircraft lease costs, and some other expenses once considered nearly uncontrollable.
- The airline product, a seat from one place to another, is consumed when produced—it is fully perishable. This contrasts with manufactured products, such as air conditioners and automobiles, that can be held in inventory until purchased, or stockpiled to fend off a possible labor strike.
- Once the flight schedule is finalized, most costs of operation are fixed. On the other hand, as long as an airplane is not full, the cost of carrying an additional passenger, the marginal cost, is very low. Low marginal cost leads to intense price competition, especially for leisure passengers.
- There is relatively low market entry cost considering the size of achievable revenue. Equipment and airport space can be leased, and free entry is permitted in the United States, the European Union, and increasingly in many other world markets. But, new carriers do have to prove financial fitness to Department of Transportation and the ability to operate safely in accordance with the regulations of the Federal Aviation Administration in the United States, with similar requirements in other countries.
- The industry has historically suffered from chronic overcapacity for several reasons. New aircraft lead time is long, three years or more. As a result, aircraft are often ordered during the economic boom but arrive during the subsequent down cycle, creating a drain on financial resources at an inopportune time.

High frequency is valued by passengers and used as a competitive weapon. Finally, the capacity to meet peak demand leaves idle capacity at off-peak hours.

As Robert Crandall, the former CEO of American Airlines, once observed, "in many respects, conventional solutions to problems of inadequate revenues, excessive costs, and unsatisfactory profitability are not terribly useful to airline managers." This is a challenging and, in many ways, a unique industry.

1.19 Summary

The earliest airlines emerged in Europe shortly after the end of World War I, often with the objective of providing service to colonial empires. Over time, most countries developed state-owned flag carriers. Airline development in the United States followed a somewhat different path. In the early 20th century, the U.S. public, and especially politicians, harbored a profound distrust of free competition that led to 40 years of economic regulation of U.S. airlines. The CAB controlled which airlines were allowed to operate, the routes they flew, and the fares charged. After the industry was deregulated in 1978, an often traumatic transformation swept the industry, with consequences that are still felt today. Many new airlines started and failed, accompanied by the loss of some of the great old carriers. Other major airlines grew, developing the hub-and-spoke route systems that predominate today. Price structures became increasingly complex even as passengers flocked to new LCCs. Europe, China, and other countries followed the United States in deregulating their airline industries. Though the paths to deregulation were quite different, the results were surprisingly similar.

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Review Questions

1 Give an example of how trade increases people's standard of living.
2 Why do national governments often build or subsidize transportation infrastructure? Provide an example.

3 How and why did the early development of the airline industry in the United States differ from that in Europe?
4 Early European airlines carried passengers. Why weren't passengers carried on the first U.S. commercial flights?
5 What was the greater objective in federal subsidization of the airlines?
6 What was the Spoils Conference, and was it an appropriate use of government power?
7 What two, sometimes conflicting, goals were established by Congress for the Civil Aeronautics Board (CAB)?
8 What regulated industry was the CAB patterned from?
9 Why did Congress not trust the free market to discipline the U.S. airline industry?
10 What did the CAB regulate? Why?
11 Did the CAB allow airlines to compete on price?
12 Airline fares have declined in real terms since the introduction of the Douglas DC-3 throughout the regulated era. What has enabled this decline?
13 What are the three factors used to compute the Productivity Index? What is the relationship between productivity and standard of living?
14 Describe the differences among trunk, local service, flag (international), and supplemental carriers in the post-World War II period.
15 How were supplemental carriers and Capital Airlines responsible for early price (fare) competition?
16 How did the introduction of wide-body aircraft (B-747, DC-10, L-1011) in the early 1970s contribute to industry losses?
17 What factors led to airline losses in the early to mid-1970s? How did these losses contribute to the move toward deregulation?
18 What was the result of American Airlines' SuperSaver fares in terms of the number of passengers carried? What solution to airline overcapacity does this result suggest? How does this reflect on the CAB's control of fares?
19 What were the arguments for and against deregulation? What other industries have been deregulated?
20 A decade after the passage of the Airline Deregulation Act, what were the major results of deregulation? Which arguments for and against deregulation proved true?
21 What is the relationship between the post-deregulation development of hub-and-spoke route systems and airline mergers and acquisitions that occurred in the same period?
22 How might membership in an airline frequent flier program influence a businessman to book an airline flight that is not in the best interests of his employer? How might a travel agency commission override (TACO) influence a travel agent to book a flight not in the best interests of her customer?
23 Explain how a major hub-and-spoke carrier might drive a small new entrant carrier from its new route to the major carrier's hub city (for example, Frontier Airlines begins service from Los Angeles to Minneapolis, Northwest Airlines' home and major hub city).

24 Compare the processes for economic airline deregulation in the United States, the European Union, and China.
25 Are the results of deregulation similar across the world?
26 Judging from the results of airline deregulation as an example, what are the costs and benefits of free markets?

Chapter 2

Supply and Demand for Air Transportation

The air transport industry is a vital component of the global transportation network. Aviation provides the only means of rapid, long-distance travel, which makes it essential for the conduct of global business and tourism. A study produced for the International Air Transport Association asserts that "By facilitating tourism and trade, air transportation generates economic growth, provides jobs, improves living standards, alleviates poverty and increases revenues from taxes" (Air Transport Action Group, 2012, p. 6). This is a bold statement, but these effects are most evident in developing countries. Africa, for example, has long been plagued by inadequate or non-existent surface transportation, which has hindered economic growth, but the recent expansion of airline service provided a springboard for growth after decades of stagnation. By allowing executives, engineers, and other critical employees to travel between widely dispersed business locations, aviation supports business operations and efficiency, improves productivity, encourages investment, and allows companies to attract high-quality employees. Aviation is also essential to tourism, which is an important part of many national economies, again often in developing countries. Finally, aviation offers a vital link to communities that lack adequate road and rail infrastructure. This contribution is most apparent when aircraft deliver life-saving supplies in the immediate wake of natural disasters.

This chapter begins by examining the global size and scope of the aviation industry and then turns to the factors driving the demand and supply of air transportation. Long-range forecasts of air travel demand are essential to commercial aircraft manufacturers, whose products are marketed worldwide and have a long service life. The 20-year forecasts developed by the two largest commercial aircraft manufacturers, Airbus and Boeing, are examined for factors driving global and regional demand. Airlines are concerned with macro-scale forecasts for long-term strategic planning, but also require shorter-term and smaller-scale forecasts, down to the individual city-pair forecasts, for their near-term planning and management. These micro-forecasts are addressed in the latter sections of the chapter.

2.1 Size, Scope, and Economic Importance

In 2013, the world's airlines carried over 3.1 billion passengers and 49 million tons of freight. The aviation industry directly employed some 8.7 million people and contributed $606 billion to the world gross domestic product (GDP). For perspective, the industry is larger than the pharmaceutical ($451 billion), the textile ($223 billion), or the automotive industry ($555 billion) and is about half the size of the global chemical ($1,282 billion) and food and beverage ($984 billion) sectors. In comparison with national GDP, aviation's gross product would rank 21st in the world, or roughly equal to that of Switzerland or Poland (Air Transport Action Group, 2014).

Including indirect jobs, many of which are in tourism, aviation supports some 58 million jobs with a $2.4 trillion global economic impact, or about 3.4% of global GDP. These figures are impressive, but some caution is warranted when including indirect and induced effects. Tourism supports millions of jobs worldwide that wouldn't exist without aviation. On the other hand, tourism boosters would argue that tourism supports airline jobs. Certainly, there's merit in both assertions.

Other facts on the size of the world air transport industry in 2013 are presented in Table 2.1 as compiled by Oxford Economics for the Air Transport Action Group (2014). Of course, the data are estimates, and figures from other studies will vary, but these data are representative of the industry's size and reflect the importance of the aviation industry in the world's economy.

By facilitating tourism and trade, aviation contributes to globalization, which generates economic growth, provides jobs, improves living standards, and alleviates poverty. While the benefits are widespread, international trade and globalization are not without controversy. On the one hand, trade allows people to purchase goods and services that would otherwise be unavailable. Think, for example, of fruits and vegetables that would be unavailable in colder regions of the world were it not for international trade. Trade enlarges markets, allowing increased specialization. The rapid advance in personal electronics would not be as swift if products were not sold worldwide. Further, trade across international markets has lifted millions of people from abject poverty, much more so than all the world's humanitarian programs combined. China is the prime example. On the other hand, international trade is disruptive, bringing ruin to some industries unable to compete with imports. Textile manufacturing has mostly disappeared

Table 2.1 Airline Industry Size and Scope for 2013

Passengers traveling by air	*2.97 billion; largest markets are the United States, the United Kingdom, and China; 52% of international tourists travel by air*
Air cargo	49.8 million tons $6.4 trillion in value or 35% of international trade by value
Jobs	8.7 million direct 18.6 indirect 30.5 induced
Airlines	1,397 airlines 25,332 commercial aircraft in service 3,864 airports with scheduled commercial flights

Source: Air Transport Action Group, 2014.

in the United States, Europe, and other developed countries because it cannot compete with imports from low-wage countries, mostly in Southeast Asia. Just as airline deregulation created turmoil in the United States, including the loss of jobs at several long-established carriers, expanding international trade creates both hardships and opportunities.

As Figure 2.1 shows, in the 40 years between 1974 and 2014, world air traffic expanded more than six-fold and is forecast to double again over the next 15 years (Airbus, 2015). World economic crises have had a substantial, but relatively short-term, adverse effect on traffic. The depressing effect of the combination of the terrorist attacks of 2001 and the severe acute respiratory syndrome (SARS) pandemic that followed in 2002 are clearly visible in the graph as a downturn in revenue passenger kilometers. More recently, the financial crisis of 2008, often termed the Great Recession, produced a similar decline in traffic.

2.2 Factors Driving Global Air Transportation Growth

Many factors drive the growth of world air travel, but these can be conveniently grouped into four categories: (a) globalization, (b) demographics, (c) liberalization, and (d) factors of production. The first two primarily affect demand for travel, whereas the last two affect supply. The following subsections address each in greater detail.

2.2.1 Globalization

Globalization broadly refers to the increasing integration of world economies and societies. While the cultural, political, and environmental dimensions

Figure 2.1 World Air Traffic 1974 to 2034. Traffic is measured in trillions of revenue passenger kilometers (RPK). One RPK represents one passenger flying one kilometer in air transportation. In the U.S., the more common statistic is the revenue passenger mile (RPM). Figure courtesy of Airbus, 2015.

are important, the emphasis here is on economic aspects of globalization. Long-distance trade has existed for thousands of years and shaped much of world history, but globalization accelerated after World War II as countries reduced tariffs, subsidies, and other restrictions on trade in goods and services. Impediments to foreign investment and the movement of capital were gradually relaxed. Shipping costs fell, especially with the introduction of containerized ocean and rail cargo transport.

As restrictions on trade, investment, and foreign ownership of manufacturing are reduced, firms take advantage of country and regional comparative advantage, investing in foreign countries and increasing trade in merchandise and services with the creation of international supply chains (Gillen, 2009). The many critics of globalization notwithstanding, those countries that have integrated into the global economy have enjoyed faster growth and reduced poverty. Many East Asian countries, among the poorest in the world 50 years ago, have evolved into the world's fastest growing economies through an emphasis on trade, which in turn, promotes progress toward democracy and human rights. Many corporations are now truly global, with manufacturing and sales worldwide. Automobile companies are one highly visible example.

The International Monetary Fund (2010) identified four aspects of globalization: (a) trade, (b) capital movements, (c) migration, and (d) knowledge and technology. The global expansion of each requires extensive international travel by executives, managers, engineers, a host of other business specialists, and laborers. In the European Union, for example, laborers commonly travel on Europe's new low-cost airlines to work in other countries but return regularly to their homeland. As the world has outsourced much of its manufacturing to China, India, and other low-wage countries in Asia, managers need to travel to manage their far-flung businesses.

Components for the Apple iPhone are made in the United States, Europe, Japan, and South Korea and assembled in Taiwan and China. Firms throughout the world are suppliers for the Boeing 787 Dreamliner, with the main components built in the United States, Japan, Italy, Korea, Germany, the United Kingdom, Sweden, and France and shipped to Everett, Washington, and Charleston, South Carolina. The production of these and countless other products is dependent on global air transportation.

Although periodic political upheavals and civil wars disrupt and even halt trade, globalization has been enabled by growing political stability across much of the world.

2.2.2 Demographics

Demographic factors—population growth, urbanization, diaspora, and per capita income—are perhaps the most important factors driving the demand for air travel. Population growth, of course, expands the potential market for air travel. The current world population of approximately 7 billion is forecast to grow to

9.5 billion by 2050. With two-thirds of the world's population living on less than $10 per day (Airbus, 2015; Kharas & Gertz, 2010), most people have never flown and cannot afford to do so, but the 6 billion people in developing countries represent a huge potential market. The world's poor are mostly subsistence farmers scattered across vast reaches of land. In recent decades, however, these farmers have been moving to large cities in search of a better standard of living, and this migration is expected to continue. Airbus defines a *mega-city* as supporting 10,000 daily long-haul passengers (Airbus, 2015). It counts 47 mega-cities today, but expects this number to more than double to 91 by 2032. It's the growth of mega-cities in developing countries that provides for vast future markets. Indeed, this rapid urbanization is the major rationale for Airbus' flagship A-380 aircraft.

As Booz and Company (2011) note, "few sectors will benefit as much from globalization and economic development as air travel." Figure 2.2 illustrates the relationship between per capita income and air trips per year. As per capita income passes $20,000 per year, the rate of air travel increases markedly. Note that income in the two largest countries, China (PRC) and India, currently falls well below this level, so air travel is still restricted to the relatively rich, but as tens of millions of people move into the middle class, air travel demand will surge. The middle class today comprises 37% of the population, which Airbus forecasts will nearly double to 55% by 2032, but in the Asia-Pacific region, the middle class will quadruple (Airbus, 2015).[1]

The population in the developed economies of North America and Europe make up 15% of the world's total but account for 49% of total airline traffic (Figure 2.3). The airline industry in these countries is mature, offering relatively slow growth opportunities of 3.3% per year. Mature economies rely on productivity gains, service industries, and consumer markets for much of their gains, whereas emerging economies are characterized by expanding labor forces, increased manufacturing, and entry into global capital and trade markets. These factors led Airbus (Airbus, 2015) to conclude that air travel growth in the

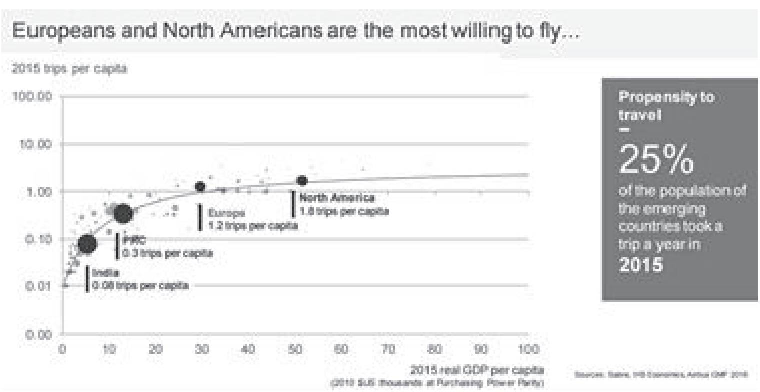

Figure 2.2 Air Travel and Per Capita Income. Figure courtesy of Airbus, 2015.

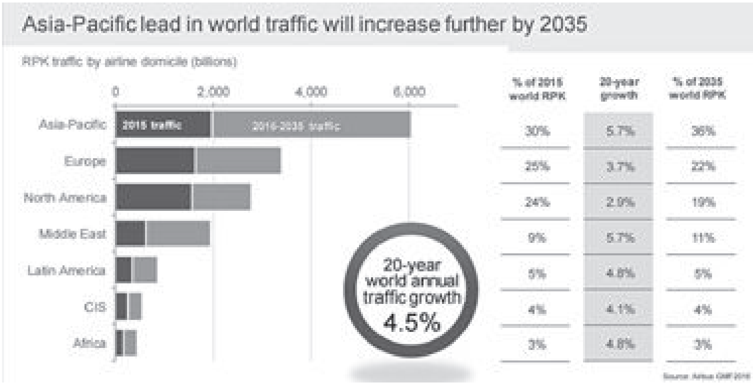

Figure 2.3 Annual Air Traffic Growth. Figure courtesy of Airbus, 2015.

developing economies will increase 6% per year over the next 20 years. Similarly, Boeing (2014) estimated that more than 70% of air travel growth will come from emerging and developing economies. The difference between these two markets' growth, 3.3% and 6% respectively, will result in substantial changes in the distribution of air traffic over the next 20 years. As Figure 2.3 shows, Europe and North America's 49% market share will shrink to 41% by 2035, or about the same traffic share as the faster-growing Asia-Pacific region.

Business travel will continue to increase, but discretionary travel from the expanding middle class with sufficient disposable income to choose air travel for holidays will provide most passenger growth. As ethnic groups disperse across the world, travel to visit or reunite with relatives, known in industry jargon as *visiting friends and relatives*, will also contribute to leisure travel growth.

2.2.3 Liberalization

Globalization and demographics drive increased demand for air travel, but liberalization, or the reduction in rules and restrictions on airline competition, enables more supply of air travel available to consumers. As the regulation of international air services is relaxed, air services expand, fares drop, and new airlines emerge. The largest airlines reorganize their networks and hubs, often in coordination with partner airlines in global airline alliances, providing more flight frequency and improved connections. New airlines, mostly following a low-cost model, emerge, some as subsidiaries of existing network carriers and others as independent private ventures. Improvement in service variety and quality, in turn, stimulates demand (Gillen, 2009). Studies suggest that a rise in the relative openness of a country's air service from the 20th to the 70th percentile results in a rise of 30% in travel demand. Improved air service stimulates further economic growth, creating a virtuous circle that leads to more airline services (Boeing, 2012).

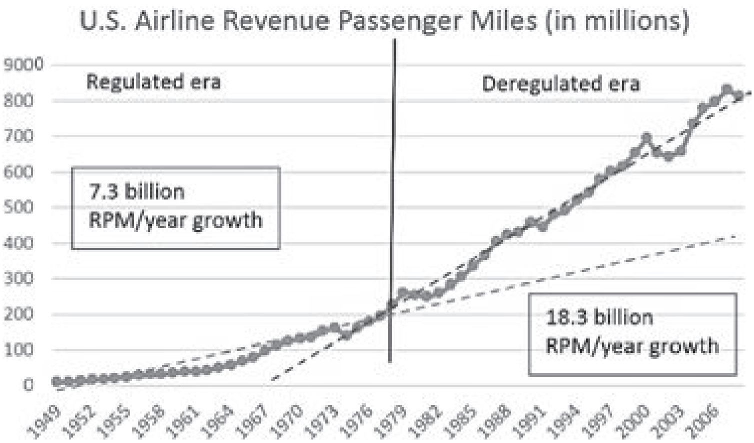

Figure 2.4 Growth in U.S. Scheduled Revenue Passenger Miles.

Data source: Airlines for America.

The U.S. experience is illustrative. Figure 2.4 shows that airline deregulation spurred air travel growth as airlines provided service according to market demands rather than what the CAB estimated was required for public convenience and necessity. Increased competition, especially from new entrant LCCs, reduced prices, inducing more people to travel by air. In the 30 years following deregulation, revenue passenger miles grew by an average of 18.3 billion per year, more than double the 7.3 billion RPM annual growth in the 30 years preceding deregulation.

Led by U.S. Open Skies initiatives begun in 1978, countries worldwide have gradually liberalized restrictions on air travel, allowing freer access to their airways and markets. As competition increased and service expanded, fares have fallen, allowing more people to afford air travel. One example is the Open Skies agreement between the United States and the European Union, first adopted in 2008 and extended in 2010. The agreement allows any U.S. or EU airline to fly between any point in the European Union and any point in the United States. In what some critics view as unfair, U.S. airlines are also allowed to fly between points in the European Union. The counter-argument is that the United States and all of the European Union are comparable markets. Similar agreements have been negotiated among countries elsewhere. The ten-member Association of Southeast Nations agreed in 2009 to gradually liberalize aviation markets. Latin America is on a similar path. The history and growth of international aviation are the subjects of Chapter 9.

2.2.4 Factors of Production

Liberalization reduces the legal restrictions on the addition of airline service to meet passenger demand. Factors of production, on the other hand, determine the cost of providing air transportation. The two largest airline expenses are fuel and labor. Fuel prices are volatile and difficult to predict. Few analysts, for example, predicted the 50% drop in petroleum prices that began in the fall of 2014. Although current forecasts are for fuel prices to moderate over the next several years (Airbus, 2015), another spike in prices would lower airline profits and limit supply. Lack of infrastructure may also restrict airline growth in some world regions. Many European airports are operating at or near capacity. India must invest in airports and other aviation infrastructure if it is to meet its airline growth potential. Finally, increased environmental regulation and taxation will likely increase future airline costs.

While high fuel cost, infrastructure, and environmental regulation could potentially impede airline growth, improved technology will partially mitigate all three. Between 1978 and 2013, airline fuel efficiency more than doubled, and new aircraft models such as the Airbus 320neo and Boeing 737 Max promise an additional boost in efficiency that will reduce both fuel costs and lower emissions. Similarly, airspace utilization can be improved through better air traffic control technology.

2.3 Air Cargo

Growing world trade also increases the demand for air cargo. The historical growth in air cargo as shown in Figure 2.5 is similar to the growth of passenger traffic

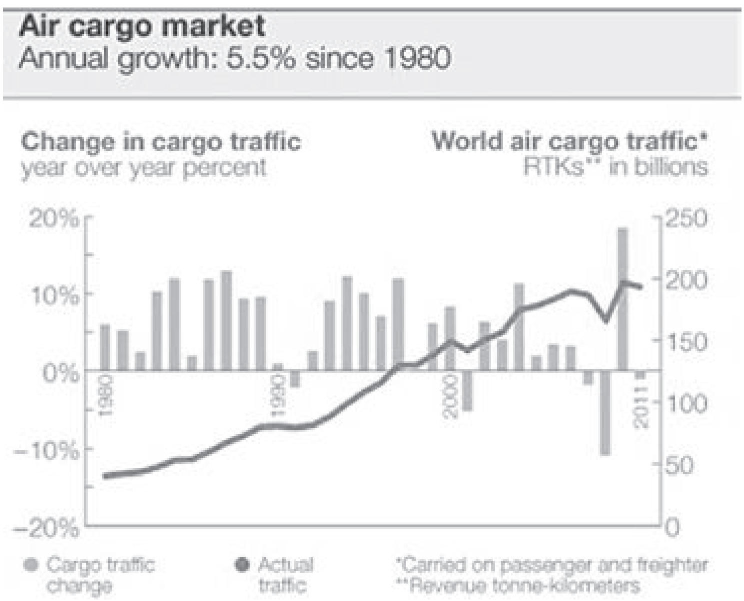

Figure 2.5 Air Cargo Growth. Figure courtesy of Boeing, 2012.

(Figure 2.1); however, air freight is more closely tied to the world business cycle. Note, for example, the more than 10% drop in cargo volume during the Great Recession beginning in 2008. In fact, air freight volume is one indicator of the current state of business. Air freight is much more expensive than competing forms of land and sea transportation, so air cargo is limited to high-value–low-volume, perishable, and emergency freight. Figure 2.5 shows that air cargo has grown at an average of 5.5% since 1980, but periods of negative growth are also evident.

2.4 Forecasting Air Travel Demand

Forecasts of demand are the basis for planning and essential to manufacturers, airlines, airports, and most other aviation-related firms. Long-term forecasts of air transport demand are most important for aircraft manufacturers because of the lead time and expense involved in developing and marketing new aircraft. New aircraft will likely be in service for 30 or more years, so the manufacturers' horizon is long. Airports and airlines also depend on long-range forecasts to accommodate passenger and freight demand. Both Airbus and Boeing develop 20-year forecasts, which are updated and published annually (Airbus, 2015; Boeing, 2015). As Boeing states,

> The forecast has several important practical applications. It helps shape our product strategy and provides guidance for our long-term business planning. We have shared the forecast with the public since 1964 to help airlines, suppliers, and the financial community make informed decisions.
>
> (Boeing, 2014, p. 1)

2.4.1 Macro-Forecasting

The development of long-range forecasts of air travel demand usually begins with estimates of GDP, because the two are highly correlated. GDP is the market value of all final goods and services produced in a country during a given period of time, usually one year. Individual country GDPs can be aggregated to obtain a world region GDP or a global GDP. Figure 2.6 shows the close relationship between air travel and GDP.

Note in Figure 2.6 the different scales for the percentage annual change in passenger traffic and the change in GDP; passenger traffic growth is on the left vertical axis, while GDP change is on the right. The high correlation between the two metrics is clear, but passenger traffic has historically grown faster than GDP. As per capita income increases, people tend to spend proportionately more on air travel. By examining the chart, it's evident that world air travel has grown at roughly twice the rate of GDP growth over the last four decades. Air travel is also more volatile than GDP and highly cyclical. Because of the great interest that GDP growth holds for governments, corporations, and economists worldwide, it is subject to highly elaborate forecasts. GDP forecasts are available for various time periods from many

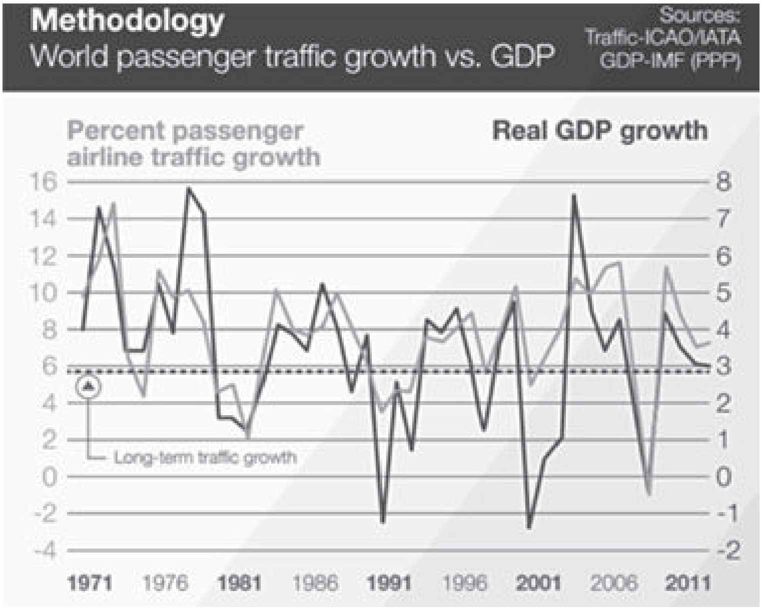

Figure 2.6 Air Travel and GDP. Figure courtesy of Boeing, 2014.

authoritative sources (e.g., International Monetary Fund, 2015). Manufacturers, airlines, and others in the aviation industry use these forecasts of GDP as one independent variable in deriving estimates of future air travel demand.

Other important factors driving air travel demand are population and per capita income growth, as discussed previously. Population and income growth are reflected in GDP, so the correlation of GDP and air travel is not surprising. Boeing concludes that 60% to 80% of air travel growth can be attributed to economic growth. The remaining 20% to 40% of air travel growth that is not directly associated with GDP growth derives from other factors, primarily the fare level and service provided. As noted earlier, airline service typically increases and fares fall as markets are liberalized. Travelers value a choice of arrival and departure times, routings, non-stop flights, choice of carriers, and service class, and respond with increased air travel. Over time, this response to improved service and lower fares causes the share of GDP a country devotes to air travel to increase. Air travel averages about 1% of GDP worldwide. Most countries, regardless of the size of the national economy, move toward this average over time. In mature economies where air travel revenues have reached the 1% level, air travel growth will be lower than in countries where air service is rapidly expanding (Boeing, 2014).

Long-range, macro-level forecasting is essential for manufacturers' new aircraft decisions. Airbus Industries' flagship A-380 is an interesting example. The A-380 is a new class of very large aircraft (VLA). It's capable of seating up

Figure 2.7 Airbus A-380. Photo courtesy of Airbus.

to 850 passengers in an all-coach configuration, although 550 or fewer seats with three cabins is more common. The upper and lower rows of windows seen in Figure 2.7 reveal the double deck design. Even though Airbus and Boeing differ on the forecast for the size of the market for VLA, both understood that the market could only support one manufacturer profitably. Boeing dropped plans for a VLA, but did upgrade its venerable B-747, introducing the somewhat larger B-747-8, which entered service in 2011.

How do manufacturers develop forecasts for market demand for the next 20 or more years? The annual Airbus and Boeing forecasts include outlines of their methodologies. Airbus titles its forecast the *Global Market Forecast*, whereas Boeing tags its forecast the *Current Market Outlook*. The forecasts are based on a range of methodologies. For new product introductions, such as the A-380, the development and sales history of early similar products are helpful. Airbus certainly researched the introduction of the original Boeing 747. Several statistical methods generally use regression of historical market growth against independent variables including GDP, population growth, urban population density, and oil prices, among others. Boeing and Airbus know every airline with the potential to purchase a new aircraft type. Many of these airlines can be surveyed. There are relatively few airlines with a need for an airplane the size of the A-380, so detailed discussion with each airline is feasible. Other methods include surveys of sales force opinion as well as those of industry experts. For a detailed discussion of forecasting methods used in the airline industry, see Vasigh, Fleming, and Tacker (2013) and Doganis (2010).

2.4.2 Route-Level Micro-Forecasting

Whether evaluating potential new routes or estimating growth in the existing network, airlines incorporate the factors that drive global and regional demand, but also many additional factors that influence the demand on individual routes. These include historical traffic, the types of passengers, competition, and prevailing fares. With an estimate of total demand at the route level, the airline must then estimate the share of that demand, or *market share*, it can obtain versus that of competing airlines.

Historical data on the number of passengers and fares in a given market are usually the starting point for demand estimation and route planning. For its own existing markets, of course, the airline will have internal data. External data on passenger traffic and fares are available from several sources. The Marketing Information Data Transfer (MIDT) is a database that captures booking information from the major global distribution systems (GDS). Actual sales data, in contrast to booking data, are available for transactions settled through the Airlines Reporting Corporation (usually referred to as simply ARC) and the Billing and Settlement Plan (BSP). Because direct sales through airline websites and reservations centers are not captured by any of these databases, the data represent only a portion of the total market. Data from each of these sources are processed and sold by several vendors, many of whom do provide estimates of total traffic and sales. For the U.S. carriers, the Department of Transportation, Bureau of Transportation Statistics, makes a 10% sample of all tickets available to the public without charge. Many airline economic studies utilize this database.

An airline considering a new route without existing service will have little or no historical traffic data on which to base its forecasts. It might rely on market research and expert opinion, but demand can be at least crudely estimated using the populations of the two cities and the distance between them. The *gravity model* has a long history, first having been used in the late 19th century to estimate railroad demand and later by highway engineers. Demand is hypothesized to vary directly with the product of the populations and inversely with the square of the distance between the cities; hence the name, because of its similarity to Newton's law of gravity. The model has been refined using other indicators of economic activity instead of populations and calibrated on existing airline routes (Doganis, 2010).

Forecast demand is a starting point for airline planning, but it is subject to considerable uncertainty and error. A common error has been the failure to differentiate between underlying demand and past traffic growth that was stimulated by declining yield (low fares). Falling prices will increase traffic, especially leisure travel. Airlines have frequently overestimated traffic growth and ordered new aircraft to meet the expected demand. When traffic failed to materialize, ticket prices fell, which stimulated new traffic. Subsequent forecasts based on this traffic history could well be overstated but self-fulfilling; that is, extra capacity will force future yields even lower (Love, Goth, Budde, & Schilling, 2006).

2.4.3 Passenger Segmentation

Demand for air travel is derived from the purpose of travel. That is, passengers do not fly for the enjoyment of flight but because they need to be in another location for some reason, be it for business or pleasure. Economists term this *derived demand*. Some markets attract mostly business passengers, whereas others are dominated by leisure travelers. The Chicago–New York market, for example, is predominately a business market, whereas flights to Orlando and other Florida destinations are mostly filled by passengers on vacation. Similarly in Europe, passengers on holiday will predominate on routes to the Mediterranean cities. Depending on the reason for travel, passengers have different wants and needs. The airline must tailor its product and pricing to meet the desires of its passengers.

Airlines have traditionally segmented passengers into two major categories according to the reason for travel—business or leisure—but usually develop several more subcategories (Doganis, 2010). Business passengers, for example, may be classified as lower and higher end. Leisure passengers are universally divided into those who are visiting friends and relatives (VFR) and those on vacation or holiday.

Passengers traveling for business tend to value flight frequency, non-stop flights, choice of cabin classes, in-flight service, and flexible, refundable fares. High-end business travelers are less price sensitive and often book flights near the departure date, while the lower-end business passengers display more price sensitivity. VFR passengers usually have some flexibility in travel plans, book far in advance, and often select the airline offering the lowest price. Flight frequency and amenities are less important. Leisure passengers display most of the same wants as VFR, but are usually traveling on vacation or holiday, so the destination appeal is an important consideration, and their travel days may be restricted by the days they are off work. To meet these varying wants and needs, airlines align their product strategy with flexibility for business passengers and price for leisure and VFR passengers (Teichert, Shehu, & von Wartburg, 2008).

Of course, the same passenger may be traveling for business one week and for leisure the next, so the passenger wants and needs are tied to the purpose of the trip, not the individual. Passenger wants and needs also vary with the length of the travel. Many passengers will sacrifice cabin amenities, such as seat and legroom, for a lower price on a short segment of less than three hours, but will demand a higher-quality service on longer flights.

2.4.4 Variation in Demand

The airline planner tries to match the demand in each market with capacity, flight frequency, and aircraft size. If an airline does not provide enough capacity to meet periods of peak demand, it risks losing passengers to other airlines, a loss known in industry jargon as *spill*. This concern tends to create excess capacity during lower-demand periods. Unlike manufactured goods, airline capacity cannot be stored until demand is higher. On the other hand, too much capacity for the existing demand results in empty seats (known as *spoil*) or, more often, in lower prices. This challenge is daunting, because demand in each market varies substantially by hour of the day, day of the week, and season, and with the business or economic cycle.

Business travelers favor morning departures and late afternoon or earlier evening return flights. In a predominately business market, a flight departing at 7 a.m. may face heavy demand. However, when the aircraft operating this flight reaches its destination, little demand may exist for the next departure at, say, 10 a.m. Similarly, business travelers also travel more frequently on Mondays and Fridays. In contrast, both VFR and leisure passengers are less sensitive to the timing of flights, but often wish to leave on a Saturday and return on Sunday. As a result of these desires, demand mid-week on Tuesdays and Wednesdays is typically low.

Demand also varies by season of the year. Using the North American market as an example, travel to Florida and other sun destinations is strongest in the winter, whereas transcontinental and other east-west demand is strongest during the summer vacation season. Canadians flock to flights to the Caribbean islands during the winter, but this market dries up in the summer. Similarly, Europe experiences heavy summer holiday demand for sun destinations on the Mediterranean, but much less demand during the winter. Finally, holidays generate outsized, short-lived demand. For perspective, U.S. domestic traffic in the weakest month of the year, usually January or February, is only 75% of that in the peak summer months, July or August.[2]

Directional demand introduces another complication. This is easiest to visualize with special events such as big sporting attractions. Prior to the event, demand will be high into the host city and strong leaving the city after the event. The result is that with sufficient capacity for the high demand, flights in the opposite direction will be wanting. Directional demand, however, is evident in some markets for reasons other than special events. One example is holiday travel to Florida or other sun destinations. Passengers travel to the sun at the beginning of holiday periods, returning at the end.

The need for business travel also varies with the business economic environment; when business is good, managers and sales staff travel extensively. When the economy softens or even contracts, business travel is curtailed. Thus, business travel follows, but lags, the larger economic cycle. The business cycle also affects leisure travelers, but to a somewhat lower extent than for the business segment. This effect is readily apparent in Figures 2.1 and 2.6.

Demand is further complicated by natural disasters; political upheavals, especially war; and economic crises, all of which are unpredictable. The impact of natural disasters from hurricanes, tsunamis, and volcanoes is usually regional rather than worldwide. Traffic falls because of a lack of demand, as well as the reduction in supply as airlines reduce flights. The Japanese earthquake and tsunami of 2011 is one of many examples. The effects of war vary from regional to worldwide. Financial crises should, in principle, be predictable, but few economists foresaw the Great Recession of 2008. The declines in world traffic as a result of the first Gulf War in 1990 and from the Great Recession are evident in Figure 2.1.

The uneven nature of demand further complicates the airline's efforts to match capacity with demand. If sufficient capacity is provided to meet demand on, say, Monday morning, then excess capacity is available on Tuesday afternoon. The airline faces the choice of not flying aircraft during low-demand periods while incurring high ownership costs or operating those aircraft with lower passenger loads and at lower prices.

2.5 Demand Curve

Economists capture many of these concepts of demand in the demand curve. Demand is the quantity of goods or services that customers are willing and able to purchase in a period of time at a given price. The demand curve is a graphical representation of the relationship between price and the quantity of goods or services demanded. Figure 2.8 shows a stylized demand curve for air travel. In Panel A, ticket price is shown on the Y-axis, while the number of tickets sold during some period of time is on the X-axis. Not surprisingly, the lower the price, the more tickets passengers are willing and able to purchase. This inverse relationship between price and the quantity of goods sold is known as the *law of demand*, one of the most robust principles of microeconomics.

The demand curve is not linear but convex, sloping steeply downward in the upper left corner and gradually flattening toward the lower right. At relatively high prices, few passengers are willing and able to purchase tickets. Those who do are typically traveling for business, although a few will be wealthy and traveling for leisure. This passenger segment is not especially sensitive to the price of travel. In the case of the business traveler, the potential gain from the trip far exceeds the cost of travel. In fact, the ticket price may be only a small portion of the total trip cost. In economic parlance, this section of the demand curve has low *price elasticity*. But, as the price becomes much lower, many more people will purchase tickets. Most of these passengers will be traveling for leisure. They carefully consider alternatives such as driving or traveling to a different desirable destination, or may simply choose not to travel if the price is high. Leisure passengers are highly sensitive to price, or *price elastic*, and regularly choose the airline offering

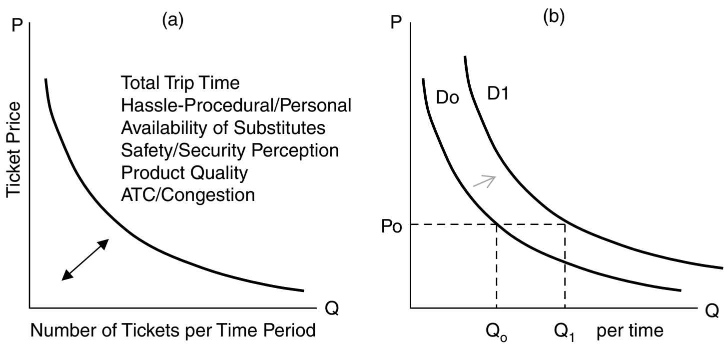

Figure 2.8 Demand for Air Travel.

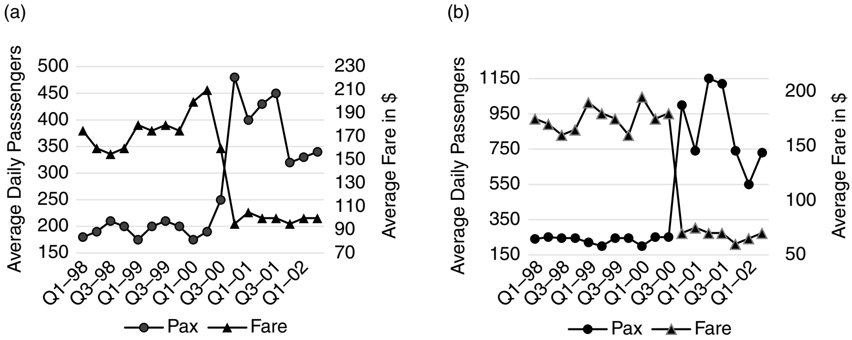

Figure 2.9 The Southwest Effect.

Data source: Henderson, G. (2004). The changing shape of the industry. Presented at the 2nd Annual Asian Aviation Summit.

the lowest fare. The low-cost-carriers (low-fare airlines) target this price-sensitive passenger segment.

LCCs, such as Europe's Ryanair, that market their product solely on low prices can greatly expand a market, as passengers who would not otherwise have flown flock to a perceived travel bargain. This concept is illustrated in Figure 2.9, which shows the dramatic increase in passenger traffic when an LCC enters a market. A 50% decrease in fares caused traffic to increase by 140% when JetBlue entered the New York–Burlington, Vermont market (Figure 2.9a). Similarly, Southwest's entry into the Buffalo–Baltimore market resulted in a tripling of traffic on a 60% decrease in fares (Figure 2.9b). A doubling or more of traffic in response to Southwest's entry into a market was common in the 1990s and was dubbed the *Southwest effect.*

It is important to note that not all of the increase is new traffic; some is diverted from surrounding areas. Many leisure passengers will drive up to three hours to take advantage of lower fares.

The Southwest effect illustrates the point that price is the most important variable in determining the amount of goods or services that will be purchased in any given period of time, especially in the short term, but many other variables are important as well. Several of these have already been discussed; the most important are the size of the population and per capita income. A two-dimensional graph is limited to displaying the relationship between two variables. Because the demand curve cannot show the influence of a change in population or an increase in disposable income, these are incorporated in the analysis as a shift in the demand curve. If per capita income increases, then more tickets will be purchased at any given price, so the demand curve will shift to the right, as shown in Figure 2.8b. The demand curve shifts from D0 to D1. Taking any price, such as P0, the quantity of tickets demanded increases from Q0 and Q1. The actual number of tickets sold depends on the supply of flights that airlines offer in response to the new demand.

As Figure 2.8 suggests, there is a host of factors that can cause a shift or change in demand. For example, in Europe, Japan, increasingly in China, and in the U.S. northeast corridor between Boston and Washington, D.C., the high-speed train is an alternative to air travel. Some passengers who would have previously flown now choose the train. The demand for air travel shifts to the left. The Acela train between Boston and New York has gained more than 50% of the passenger market share. This is probably the first time since the 1950s that the train has had a greater market share in a major U.S. city-pair than the airlines. As a consequence, the once large and lucrative airline shuttles between these cities have suffered.

Many other factors that will cause the air travel demand curve to shift or, in economic terminology, a *change in demand* are summarized in Table 2.2 (Vasigh et al., 2013).

The listing in Table 2.2 is not exhaustive, but suggests the complexity of the airline planner's task. Even with extensive data and sophisticated planning tools, both of which large airlines employ, many circumstances that shift the demand curve are unforeseen. Apprehension and more intense passenger security checks implemented after 2001 lengthened total travel time and increased the stress of an airline trip. This, among many other factors, shifted the airline demand curve substantially to the left; that is, at any given price, passengers were less willing to purchase tickets. The airlines generally responded by further reducing ticket prices in order to fill otherwise empty seats.

Unfortunately, like many academic terms used in popular discourse, the distinction between a change in demand and a movement along the demand curve with changing price is rarely made outside the economics profession. This can be confusing. In the marketing discipline, the term *demand* is used somewhat differently and more in line with popular usage. Marketers may state that demand is "strong" for the next quarter. This implies that the demand curve has shifted right, perhaps because passengers feel more positive about the economy. On the other hand, the marketer may state that "demand was stimulated" by a new pricing initiative. This implies that lower prices resulted in more ticket sales. In this case, the demand curve did not shift; lower prices are a movement down the demand curve. The distinction is important. The first case bodes well for the airline, implying that future bookings are strong, some pricing power is available, and revenues should meet or exceed the budget. On the other hand, the need to lower prices to stimulate demand indicates that bookings are disappointing. Lower prices may help fill otherwise empty seats, but profits will suffer.

Finally, Figure 2.8 implies that a single price exists in the market. This is a simplification; the price may be interpreted as the average fare, but airlines rarely charge a single price. Rather, there may be ten or more different prices just for economy seating on any given flight. Restrictions are attached to the lower prices, such as an advance booking requirement. This is a reflection of revenue management, which is addressed in detail in Chapter 7.

Demand is a theoretical construct; it can't be directly seen or measured, but is reflected in the level of reservations and yields. Still, the concept of demand is useful in analyzing market trends and forecasting.

Table 2.2 Factors Causing a Change in Demand

Macro Factors	*Effect*	*Curve Shifts*
Population	Population growth increases the number of potential passengers.	Right
Per capita income/ wealth	Higher per capita income, especially disposable income, increases the ability of people to pay for air travel.	Right
Business cycle/ economic environment	More passengers travel when the business cycle is positive and the general economic environment is favorable.	Right
Taxes/fees	Higher taxes on travel decrease the ability of people to pay for travel. This effect can also be viewed as an increase in price.	Left
Safety, security	Concerns about safety and security decrease passengers' willingness to travel.	Left
Micro Factors		
Substitutes	More substitutes, such as automobile and train, allow passengers a choice of means of transportation.	Left
Competition	Increased competition, from both substitutes and other airlines, generally increases the quality of service. Competition also lowers prices, but a lower price is reflected in a movement down the demand curve, not a shift.	Right
Ease of travel/ hassle	The greater the ease, the more people are willing to travel. New terminals, for example, increase ease. Unfortunately, in recent years, the hassle of security screening has reduced the ease of travel.	Right (with greater ease)
Quality of Service		
Total trip time	Lower total trip time increases the willingness to travel. Non-stop flights; quick, easy connections; and reduced check-in and security times reduce total trip time.	Right
Frequency of flights	Higher frequency of flights allows passengers to choose the flight time that best meets their needs. More competition usually increases frequency.[3]	Right
Choice of service	Greater choice of service, both in the number of airlines and in the services each airline offers, increases the appeal of air travel.	Right

2.6 Need for Forecasts

Given the complexity and uncertainty inherent in forecasting demand, one might wonder why airlines expend time and money on such a problematic task. The short answer is that most airline planning is based on estimates of future sales that derive directly from demand forecasts. Estimating demand and forecasting future sales are essential to business planning. In most companies, this responsibility falls to the marketing department, which uses a myriad of inputs and information. In some airlines, the function resides in a separate airline planning department. Whatever its source, the sales forecast and other statistics prepared with it form the basis for planning and budgeting by all other operational areas.

A typical yearly planning and budgeting process begins with the preparation of passenger and market share forecasts by route. From these data, the marketing and finance departments jointly estimate yield, a measure of average fares, and revenue. From these and other data, the marketing, operations, and engineering departments prepare a proposed flight schedule and estimate of flight hours (block hours). It is this flight schedule that drives much of airline planning and budgeting. Here are a few examples of how various airline departments utilize the flight schedule:

- Reservations department begins selling flights, sometimes up to one year in advance.
- Flight Operations estimates required crew member staffing, plans recruitment and hiring, schedules training, basing, and crew member work schedules.
- Maintenance and Engineering establishes aircraft maintenance rotation, heavy maintenance schedules, staffing, and spare part requirements.
- Station Operations determines the staffing and airport facilities such as counter space, gates, and ground support equipment needed to support the planned flight schedule.

Each department prepares budgets, which the finance department consolidates and then estimates revenue, cash flow, capital expenditures, and internal and external financing for the upcoming year, usually with a less detailed plan extended out five years or more. This process may go through several iterations with inputs from all departments before being finalized.

2.7 New Route Example

Exploring how an airline decides to add a new route illustrates the application of many of the concepts covered in this chapter. In 2015, the U.S. hybrid carrier Virgin America decided to enter the San Francisco–Hawaii market. Figure 2.10 shows Virgin America's route map of the new routes to Honolulu and Kahului from its San Francisco base, with planned additional service from Los Angeles

Figure 2.10 New Route Evaluation. June 2016 route map courtesy of Virgin America.

in 2016. In making this expansion decision, Virgin estimated how much of the already crowded market it could capture with its new service: specifically, how many passengers it would carry and at what price. This estimate depends on the total demand in the market, the product Virgin America offers in terms of frequency, timing, and quality, and, critically, the reaction of competitors.

Market planners begin any route evaluation by estimating current traffic levels and growth potential. For Virgin's new routes, the San Francisco to Honolulu and Kahului city-pairs are only a portion of the total market Virgin intends to serve, because it can also offer connecting service from several other destinations. For example, passengers originating in Boston and Chicago will be able to connect in SFO to flights for Hawaii. Virgin compiled available historical data on the number of passengers traveling in each of the city-pairs and fares charged. Planners also determined the airlines currently serving these markets, the flight frequency, aircraft capacity, and ground and in-flight product offerings. Historical market growth will also be of interest.

With an estimate of the total demand in the various city-pairs, Virgin then estimated what percentage, or market share, it could obtain. A naïve estimate is based simply on the percentage of total seats it intends to offer in the market. An airline with 25% of the seats and flights in a market might plan on capturing 25% of the market demand. Such naïve estimates can be improved significantly by careful consideration of the product offered by the competition. Variables considered include:

- flight frequency
- time of departures
- number of stops
- en route time

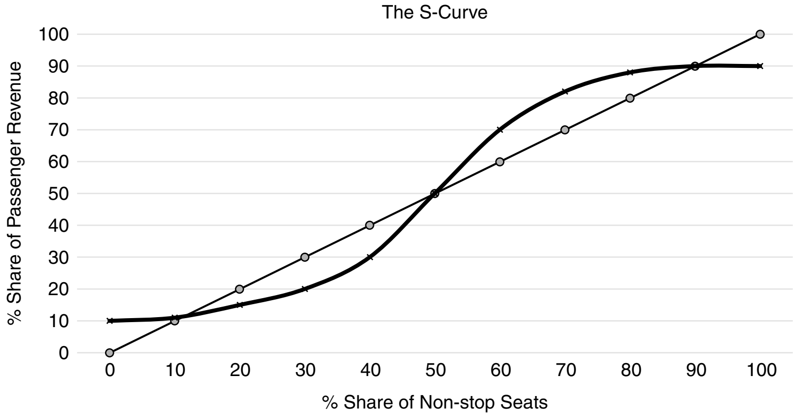

Figure 2.11 S-Curve.

- aircraft type
- airline reputation
- competitive reaction

Of these variables, flight frequency has long been considered critical. High frequency is an important choice criterion, especially with business passengers. The S-curve, shown in Figure 2.11, provides a graphical presentation of market share, measured in revenue or total passengers, and flight frequency or total seats offered.

In a market in which no carrier has a significant price or product advantage, the carrier with the greatest frequency enjoys a disproportionately higher company or market share. For example, this S-curve shows that an airline with 70% of flights enjoys a disproportionate 80% market share. While the precise shape of the curve would vary by market, the concept remains the same: High frequency captures more of the market.

There may be several reasons for the existence of the S-curve phenomenon. An airline that offers more frequency will capture business travelers, who will choose the airline with a flight that best fits their time of travel needs. As business travelers are usually more time sensitive than those traveling for leisure, frequency is an important competitive product feature for the higher-fare business segment. Also, passengers become familiar with the airlines offering high frequency, so search costs are lower and buying habits are established. Frequent flyer programs add incentives to stick with the dominant carrier in a market.

The S-curve's validity is widely accepted in the airline industry. Still, not all analysts are convinced. In one study, Button and Dexler (2005) found some past evidence for the curve, but little recently. The curve implicitly assumes that all competitors charge the same price. With price being the first criterion of airline choice for most passengers, a carrier with low frequency may obtain a relatively high market share by offering a lower price. It follows that an LCC's entry into a legacy-predominated market may affect the S-curve enjoyed by an incumbent airline offering higher frequency.

The existing service and competitive intensity are critical for estimating the market share a new entrant can obtain. Virgin's entry into the Hawaiian market promises to be challenging because the markets are amply served by incumbent carriers. United, Delta, and Hawaiian serve SFO-HNL, and United and Hawaiian also fly to SFO-OGG. But competition is not limited to SFO, as Hawaiian and Alaska Airlines also provide service from the two other Bay Area airports in San Jose and Oakland (CAPA Centre for Aviation, 2015). Then, there are non-stop flights to Hawaii from several of Virgin's other destinations plus competing flight connections at Los Angeles and Seattle.

The airline's product offering is another important factor in estimating market share. Virgin America has established a loyal following in the San Francisco area, earned with a quality product that rivals or exceeds its larger competitors but sold at a lower price point. Is the product sufficiently differentiated to appeal to a substantial share of the market?

Depending on the price sensitivity of the market, lower prices can generate more traffic, a significant consideration for LCCs. Virgin also considered the types of passengers traveling in the various city-pairs. In many markets, ethnic travel demand with passengers visiting dispersed friends and family is important. Hawaii is primarily a vacation destination, and leisure passengers are more price sensitive, so lower fares may stimulate demand. But Virgin also needed to estimate the extent of business demand. Although Virgin tends to price below larger competitors, its fares may not be low enough to stimulate much additional traffic.

Finally, Virgin must be cognizant of the potential reaction of competitors to its entry into the Hawaiian market. Most airline markets are oligopolies, served by a few competitors. In oligopoly markets, each airline is acutely aware of the product offered by competitors and new marketing initiatives. Virgin must consider how each competitor will react to its entry. Will competitors lower prices to meet Virgin's prices or increase flight frequency to add to the appeal of their product, or both?

These new route considerations are obviously difficult. Some can be evaluated with analytical techniques, whereas others will be based more on executive judgment. The airline's experience in entering other new routes will be valuable and proprietary. Still, estimates of demand, especially for new routes, are often found wanting. Airlines vary greatly in their commitment to new routes. Some, such as Spirit and Allegiant, pull out after a few months if revenues fall short of expectations, while others view new routes as a long-term investment that may take years to fully develop.

Airlines occasionally employ limited product introduction to test new marketing concepts. For example, Delta test-marketed a new business product with aircraft reconfigured to all business class in two markets, Atlanta–Kansas City and Atlanta–Washington Dulles, for a 12-week period in the fall of 2003.

Similarly, American and Delta tested new fare structures with lower and less restrictive business fares in a limited number of markets before deciding whether to implement the fare structure system-wide.

At least in theory, the result of this analysis is a demand curve for Virgin America's Hawaii service. The curve will show that an individual airline's passengers are more sensitive to price, that is, more price elastic, than for the total market. Further, the greater the number of competing airlines in a city-pair, the more elastic is the demand curve for any airline, because price-sensitive passengers have greater ability to choose an airline offering a lower price when there are more competing airlines. In some small city markets, in contrast, only one airline may serve a route. In this monopoly market, the airline's demand curve will be less elastic. If people choose to fly, they have no choice of airlines. The importance of these concepts will be evident when we address airline pricing in Chapter 7.

2.8 Summary

Aviation provides the only means of rapid, long-distance travel across the globe, which makes it essential to global business and tourism. Worldwide air travel demand is driven by several factors, including economic globalization and a growing, dispersed, and increasingly affluent population. Airline supply is positively affected by a reduction in government restrictions on airline service and the introduction of ever more efficient new aircraft. The wants and needs of airline passengers depend on the purpose of travel; business travelers value the convenience of schedule and service more than price, whereas leisure passengers are often very price sensitive and choose the airline offering the lowest fare. The uneven and cyclical demand for air travel challenges airline managers, who must design flight schedules and product features to satisfy anticipated customers' needs. Methods for estimating demand include various statistical techniques, historical comparison, and sales force opinion, among others. Other departments within the airline base their planning on initial marketing forecasts; thus, estimating demand is critical to airline performance.

Airlines offer products ranging from the low-fare carriers that typically provide point-to-point service with a minimum of amenities to global, full-service network carriers whose in-flight products range from first class to tourist economy in three or more cabins. The next two chapters address this range of products.

Notes

1 The middle class is defined as households with yearly incomes of between $20,000 and $150,000 measured in purchasing power parity at constant 2014 prices.

2 Author's calculation based on total monthly enplanements from 1997 through 2014. Data obtained from the Bureau of Transportation Statistics.

3 An increase in frequency could be considered an increase in supply in microeconomic theory; however, including it as part of demand is consistent with thinking within the airline industry and simplifies the presentation for the non-economist.

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Review Questions

1. Why is air transport important for economic growth?
2. Provide some measures of aviation industry size and a comparison with other major industries.
3. What factors drive long-term global and regional air travel demand and supply?
4. What is liberalization, and how does it affect air travel? Provide an example.

5 Which world regions are forecast for the fastest air travel growth? Why are these regions expected to grow more rapidly than others?
6 How does historical air cargo growth compare with that of passenger air travel?
7 What macroeconomic indicator is closely correlated with air travel growth? Why?
8 How does air travel demand vary by time of day, day of the week, season, and economic cycle?
9 If an airline planner could perfectly forecast future demand, would a problem in matching capacity with demand remain? Why?
10 What does the demand curve show?
11 What segment of the aviation industry is most concerned with macro-forecasts? Micro-forecasts? Why?
12 What does the S-curve show?
13 Compare the wants and needs of the typical business passenger with those of leisure passengers.
14 Explain the difference between a movement along the demand curve and a shift in demand. Provide an example of each.
15 What segment of the demand curve is targeted by the low-cost carriers such as Ryanair?
16 Given the complexity and uncertainty in forecasting demand, why do airlines bother?
17 If you are tasked with evaluating a potential new route for your airline, how do you begin?
18 What factors should be considered in estimating the market share a new entrant airline on a route with existing service can garner?

Chapter 3

Route Structure

An airline must provide a product that passengers value and are willing to purchase at a price from which the airline can profit. This chapter and the next explore the range of airline products. Among an airline's most critical strategic choices are the destinations served and the route structure connecting these cities. These decisions flow from even more fundamental strategic choices about the targeted customer segments and how the airline intends to obtain a competitive advantage in its product offering. These latter questions are the subject of business strategy and are not considered in depth in this text.

An airline can choose among three generic route system architectures that vary in complexity and cost of operation: point-to-point, linear, and hub-and-spoke (H&S). Route structure choice is examined in this chapter. Chapter 4 explores the type and number of product features to include with the core air transportation product.

3.1 History

Early airline route structures were mostly *linear*, going from one city to the next and on to the next, similarly to a train. As we saw in the review of airline history, an airline passenger in the 1930s could leave London and, after about ten days and many stops at cities along the way, arrive in Cape Town, South Africa. Early air routes in the United States often followed the railroad lines connecting large cities. Indeed, in 1929, the first transcontinental passenger air service between New York and Los Angeles and continuing to San Francisco utilized airplanes by day and trains by night. Both plane and train made many stops so that passengers could travel between any two cities along the route, but usually with several intermediate stops. During the regulated era, the Civil Aeronautics Board (CAB) continued awarding routes mostly in this linear system, especially with the early trunk carriers, in part because the limited range of early commercial aircraft required frequent refueling stops. After World War II, the CAB certified local service airlines to provide connecting service from the smaller cities previously without air service to the large cities served by the established trunk carriers. Geographical coverage expanded, but the required connections were often poorly coordinated and inconvenient, and usually involved one or more changes of airline. Although linear route systems predominated in the regulated era, some airlines gradually developed limited connecting service with flight connections at major cities; notable are Delta and Eastern in Atlanta, United in Chicago, American in Dallas, and Allegheny in Pittsburgh. Prior to airline deregulation in 1978, intrastate carriers were not subject to CAB restrictions. Pacific Southwest Airlines in California and Southwest Airlines in Texas operated point-to-point service. Deregulation proponents assumed that the industry would evolve into a nation-wide, linear, and point-to-point route system. One of the biggest surprises of the post-deregulation era was the widespread development of the H&S system, which is now the predominant route structure for large airlines worldwide (Cook & Goodwin, 2008).

3.2 Generic Route Structures

Route structure choice is the foundation of an airline's product. Point-to-point and H&S architectures lie at the poles of a continuum. The linear system is in between, but closer to the point-to-point pole. In practice, pure forms are rare; most airlines operate some hybrid form. For clarity, however, each is discussed in a pure form, as depicted in Figure 3.1.

A point-to-point system connects destinations with non-stop service. As shown on the left of Figure 3.1, all passengers board at the flight origin and deplane at the destination. With a linear system (center), passengers may board at the origin or at any intermediate stop and deplane at a subsequent stop along the route. The H&S system is depicted on the right of Figure 3.1. Flights operate from spoke cities (A through F in Figure 3.1), a term adapted from a wheel analogy, to the hub airport (H). At the hub, passengers whose destination is not the hub change planes for a connecting flight to their destination at another spoke city. Each system has advantages best suited to certain markets.

3.3 Point-to-Point

The point-to-point system is the simplest means to connect the cities an airline chooses to serve. Each origin and destination city, or *city-pair*, is served by

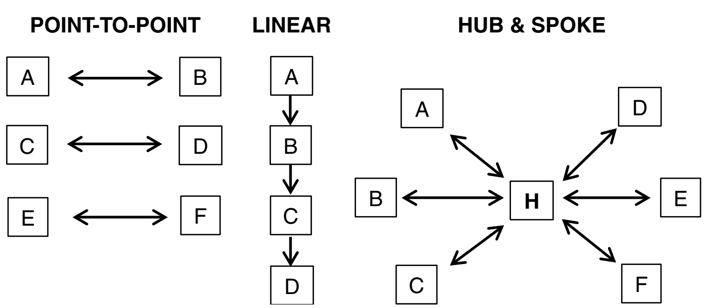

Figure 3.1 Generic Route Systems.

non-stop flights. All passengers who board at the origin deplane at the destination. In a pure point-to-point system, passengers do not connect to any other flight.

3.3.1 Fast, Cheap, and Independent

Non-stop flights in a point-to-point system provide the shortest total travel time from origin to destination. Passengers value non-stop service, a benefit for which business travelers will often pay a premium. Subject to air traffic control restraints, non-stop flights operate on a direct routing between the origin and the destination, allowing the shortest flight distance and the most efficient and cost-effective flight profile. Because connecting flights are not offered, flights operate independently, relieving the airline of the burden of synchronizing the entire flight schedule. Moreover, irregular operations on one flight do not disrupt other flights. This independence also allows flights to be spread across the day and night. A range of frequencies can be scheduled depending on demand and type of market—business versus leisure. High utilization of aircraft, gates, and personnel is attainable. The schedule is easily adjusted for seasonality without impacting other traffic.

3.3.2 Limited to Large Markets

The inability to consolidate traffic bound for many destinations severely limits the number of city-pairs in which non-stop flights can be profitably operated. Most small and mid-sized cities have sufficient demand to support non-stop flights to only a few destinations. Of the more than 400 U.S. domestic airports with commercial service, the top 20% generate 75% of all domestic passengers. The remaining 80% are highly dependent on connecting service from a network carrier (Lott & Taylor, 2004).

Low-density markets might be served by smaller aircraft. One role envisioned for the regional jet was in point-to-point service between mid-sized cities bypassing large hub airports, but the seat-mile costs of regional jets are more than twice those of low-cost carriers (LCCs) operating mainline jets, usually the Boeing 737 and Airbus 320 series. The fares required to cover the operating costs of the regional jet are too high to stimulate traffic for expanded point-to-point service. Consequently, the role of the regional jet has been almost exclusively as a feeder to large network carriers.

Finally, demand varies significantly by season. Without connecting traffic that might offset some seasonal variation, the point-to-point carrier has no ability to balance route-specific demand, but it may adjust flight frequency, aircraft size, or operate a route only during some seasons in attempting to match capacity and demand.

3.3.3 Example: Ryanair

Europe's largest LCC, Ryanair, is an example of a pure point-to-point airline. Figure 3.2 shows Ryanair's route map from Stockholm.[1] Although every flight

Figure 3.2 Ryanair's Stockholm Base Routes.

operates from and returns to Stockholm, there are no connections offered to other flights. So Stockholm is not a hub, but rather, a base city for crews and aircraft. Ryanair has more than 70 base cities across Europe, with each base sporting a similar point-to-point route structure. Aircraft and crews originate from the base each day and return every evening. Ryanair's European low-cost rival, easyJet, very close to Ryanair's size as measured by revenue ("Low-cost line up," 2015), employs a similar basing system and point-to-point route structure. Allegiant Air is a rare U.S. example of a point-to-point system. Allegiant markets all-inclusive vacations to Orlando, Tampa Bay, Las Vegas, and, more recently, Hawaii, but air-only tickets are also available. Allegiant Air connects mid-sized cities with non-stop flights to its vacation destinations, a competitive advantage, as larger competitors' service most often requires a connection at a hub airport. Frequency is low, with many markets served only a few days per week. No connections are provided to any other Allegiant flight.

Although the popular press habitually proclaims that all LCCs operate point-to-point service, most U.S. LCCs, including Southwest Airlines, are increasingly dependent on connecting passengers, which a point-to-point system does not provide. Point-to-point systems are well suited to high-density vacation and leisure markets, because of low production costs, and for business markets, where offering the shortest trip time is important.

3.4 Linear

The linear route system is a simple extension of the point-to-point structure. Rather than terminating at the first stop, the flight continues to one or several additional cities. This travel experience is familiar to anyone who has ridden a long-distance train and most commuter rail lines as well. Airline passengers traveling on a linear system board at the origin or other cities along the route and, likewise, deplane at their respective destinations. Some itineraries require several stops before reaching the destination. The linear system has several advantages. Like the point-to-point, each route operates independently of others. Scheduling and operational control are simplified; disruptions on one route do not affect another. Also like the point-to-point system, a range of frequencies and high asset utilization are feasible. However, because passengers traveling between several city-pairs are consolidated on a single aircraft, the combined demand allows economical service to smaller cities. Therefore, a larger aircraft with lower costs per seat mile can be utilized.

The linear system is not without disadvantages. Multiple stops are required to accommodate passenger itineraries, which conflict with the customer's desire for quick and convenient flights. Distance between stops is often short, which increases the unit cost (cost per available seat mile) because the aircraft doesn't reach an economical cruising altitude and each stop adds airport costs.

A pure linear system is now rare and often not included in academic discussions of route structure. In fact, part of the reason for its inclusion here is historical, as most early airline routes were linear, as a perusal of old airline route maps will show. Range limitations of early commercial aircraft prior to the introduction of the DC-7 and Lockheed Constellation and economic regulation account for this prevalence of the linear route structure. But linear routes are still found within the hybrid route systems operated by many airlines. Southwest Airlines has a significant, though decreasing, number of linear routes within its network. Figure 3.3 shows a hypothetical aircraft routing along a linear route.

Figure 3.3a is a stylized example of Southwest Airlines' route system; a flight operates across the entire Continental United States, originating in Ft. Lauderdale and ending in Seattle-Tacoma. Along the route are stops in Tampa, New Orleans, Dallas, Phoenix, Las Vegas, and Reno.

Figure 3.3b shows Southwest's network from a few years ago and prior to its acquisition of AirTran Airways. Careful examination shows a combination of point-to-point and linear routes. The frequency of service varies by city, and a concentration of flights is evident at some *focus* cities. This hybrid linear system does not preclude passenger connections; in fact, Southwest markets connecting flights at many of these focus cities. Until recently, however, these connections were not the result of careful planning but, rather, because of high flight frequency. The connections were, in a sense, the random result of the high-frequency flight schedule. Southwest's evolving route system and flight schedule are considered in more detail later in this chapter.

3.5 Hub-and-Spoke

The H&S route system became the post-deregulation standard in the United States and is employed by most of the largest airlines worldwide. It is much more complex to design and operate than the point-to-point and linear systems. As route structure is the foundation of the airline's product, understanding the advantages,

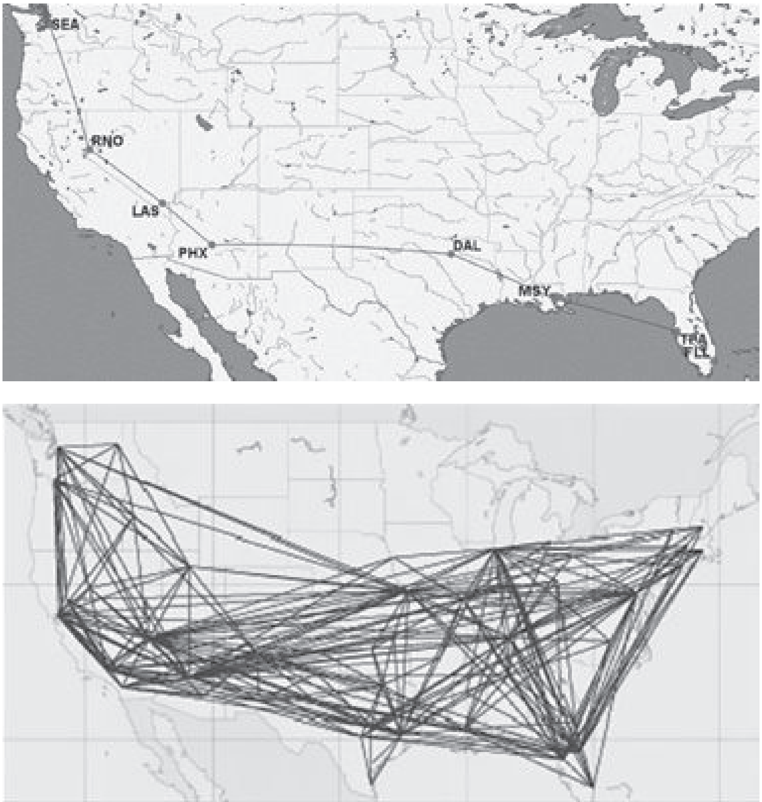

Figure 3.3 Linear Routes in Southwest Airlines' Network. (b) from MIT/ICAT (used by permission).

disadvantages, and operation of the H&S system is essential to understanding the airline industry.

The H&S is optimized when providing air service to a wide geographical area and many destinations. Passengers departing from any spoke city who are bound for another spoke city in the network are first flown to the hub airport, where they transfer to a second flight to their destination. Thus, passengers can usually travel between any two cities in the route system with one connecting stop at the hub, or, as one author described it, "from anywhere to everywhere" (Hansson, Ringbeck, & Franke, 2002, p. 1). While one connection is the norm, large network carriers often have several hubs, so some itineraries require two connections.

3.5.1 Operation

To visualize the operation of the H&S system, return to the wheel analogy. At the beginning of the day's flight operations, aircraft are positioned at each spoke city on the wheel. Aircraft depart these spoke cities so as to arrive at the hub in a short time window. In airline parlance, these inbound flights are termed a *bank* or *wave*. With all of the inbound flights parked at gates at the hub airport, passengers whose destination is not the hub city change to the aircraft that will depart shortly for their spoke city destination. Simultaneously, baggage and cargo are transferred to the appropriate outbound aircraft. After sufficient connecting time, usually about 45 minutes for domestic operations and longer for international flights, aircraft depart, again within a tight time window, for the spoke cities. This sequence of arrivals, connections, and departures is known as a *complex*.

A large U.S. domestic airline will operate eight to ten complexes throughout the day. At the conclusion of the day's operations, aircraft will again be positioned at the spoke cities ready to begin the next day's operations. Actual H&S operations are not as orderly as this. Some aircraft terminate at the hub and originate the next day's flying from the hub. Not all spoke cities are served by every complex; international destinations are usually served less frequently than domestic cities. There are many variations on the basic concept, some of which are explored later, but the defining characteristic of the H&S system is the ability of passengers to make convenient connections to their destination at the airline's hub airport.

Some complexes for large airlines will integrate international and domestic flights with aircraft ranging from the largest wide-body aircraft to the smallest regional jets and turboprops. While tight arrival and departure sequences are desirable to minimize passenger connection times, airport and air traffic control limitations cannot accommodate nearly simultaneous arrivals or departures of many flights, so some adjustments are required. The following sequence is typical:

- Flights from international cities arrive first, allowing time for passengers to clear federal immigration and customs before transferring to domestic flights. Sometimes international terminals are separate from domestic terminals, so passengers might need additional connection time. Many international destinations are served by wide-body aircraft, which require more time for ground servicing.
- Next to arrive are flights on regional aircraft, first turboprops and then regional jets. Terminals and gates for regional flights at many airports are less conveniently located, so that additional transfer time is needed.
- Last to arrive are the domestic mainline jets. These aircraft might have through-flight passengers onboard, so short turnaround times are desired.

For the departing bank, the sequence is reversed, with domestic jets, regional jets, turboprops, and finally international departures.

3.5.2 Advantages

The many advantages of the H&S system make it the choice of all large U.S. carriers except Southwest and the predominant route system worldwide.

3.5.2.1 Minimizes Required Flight Segments

The H&S system serves network destinations with the lowest number of flights. As shown in Figure 3.4, to achieve total connectivity between the five destinations consisting of four spoke cities and one hub, only eight flight legs are needed (four in each direction). In comparison, 20 flight legs are needed (ten in each direction) to achieve total connectivity for the same number of cities using the point-to-point system. Consequently, for any given level of frequency and number of destinations, the H&S requires the lowest number of aircraft. With the price of a mainline aircraft beginning at around $60 million, minimizing the number of aircraft is a major financial consideration.

The H&S system combines passengers bound for many destinations on a single flight to the hub airport. In Figure 3.4, a flight from spoke city #1 to the hub at #3 will include passengers destined to spoke cities #2, 4, and 5 as well as the hub itself. As the system grows, additional flight frequency and/or the use of larger aircraft positively affect both supply and demand. Passengers prefer to use a single airline for their entire journey, so the ability of an airline to offer service to many cities of varying sizes confers a competitive advantage.

3.5.2.2 City-pair expansion

The number of city-pairs served by an H&S system is given by the formula $[N(N–1)]/2$, where N is the total number of destinations (including the hub city). The five destination network in Figure 3.4 comprises ten city-pairs: $(5 \times 4)/2 = 10$ city-pairs, where the city-pairs are 1–2, 1–3, 1–4, 1–5, 2–3, etc. A large airline network might serve 100 destinations from a single hub comprising 4,950 city-pairs. Adding a new destination strengthens the product offering. Adding one new city to this existing hub network creates 100 new city-pairs available for sale. The additional (or marginal) cost of adding a new city is low in comparison to the number of new markets. However, the power of the additional city is not as great as the mathematics indicates, because some city-pairs involve such circuitous routings that passengers will opt for a competitor who offers less total travel time. For example, few passengers will choose travel from city 4 to city 5 on the H&S system in Figure 3.4 if more

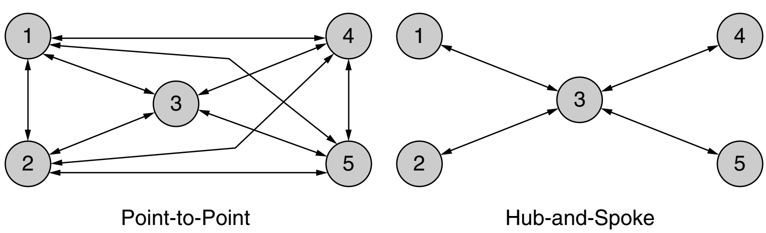

Figure 3.4 Flight Segments Required.

convenient service is available on a competitor. For a more concrete example, consider Copa Airlines, with its hub in Panama City. It's feasible to travel on Copa from Rio de Janeiro to Buenos Aires with a connection in Panama City, but nearly all passengers will choose another airline that offers non-stop service at a fraction of the total travel time. Consequently, Copa chooses not even to offer connections between many South American cities, focusing instead on service between North and South America with its centrally located hub. Nonetheless, the power to expand the H&S markets served by adding an additional city is substantial.

In the United States, post-deregulation carriers were quick to realize the competitive advantages of expanded destinations and geographical coverage. Network expansion encourages travel, increases connectivity, and improves asset utilization; consequently, the trunk carriers moved quickly to transform their route structures through growth, acquisition, and merger.

3.5.2.3 Consolidation of Demand

The fundamental advantage of H&S is the ability to consolidate the demand from many city-pairs on each flight segment. Passengers on each flight from a spoke city to the hub are destined for many cities across the airline's route system. This consolidation allows service to cities that would otherwise not be profitable. By combining the demand for many origin–destinations on a single flight, high frequency can be sustained if only two or three passengers are destined for each of many spoke cities. Consider, for example, an American Airlines flight from Albuquerque, New Mexico to its Dallas, Texas hub. Of the 123 passengers on board, 43 are going to Dallas, 2 will connect to Atlanta, 3 to Boston, 2 to London, and the remaining 71 to 28 other destinations. With a large, established network, a new destination or spoke city can be added if it generates only a few passengers per day to each of the many destinations in the network. Thus, a network carrier can profitably serve smaller cities that a point-to-point or linear carrier cannot.

Large network airlines such as Delta derive as much as 40% of total revenue from small city markets (those generating less than 50 passengers per day), whereas LCCs Spirit and Frontier obtain less than 5% of their revenues from small cities. The emergence of the smaller-capacity regional jet beginning in the 1990s allowed network carriers to further expand service to smaller cities. Of the more than 400 commercial airports with two or more scheduled departures per day in the contiguous U.S. states, about 80% are dependent on network airlines for service (Lott & Taylor, 2004).

The traffic from the domestic route network also makes long-haul international flights economically viable. In 2012, American Airlines filled about 80% of the seats on its Los Angeles–Shanghai flights, but only 45% were occupied by local traffic between the two cities. The remainder were occupied by passengers connecting from other American domestic destinations (Boyd, 2013).

3.5.2.4 Passenger Convenience

As destinations grow and more passengers funnel through the hub, flight frequency can be increased. High frequency allows the passenger to match flights with desired itinerary times. This choice of departure and arrival times is particularly valued by business travelers. Passengers prefer to use a single airline for their entire journey, so the ability to service many cities of varying sizes confers a competitive advantage. As compared with a journey requiring a change of airline, passengers making a single hub connection benefit from closely timed flights, single check-in, more convenient gate and facility locations, and reduced risk of lost baggage. Knowing that an airline likely serves a desired destination saves the passenger search and transaction costs. Familiarity with the airline's product lessens uncertainties and increases loyalty, particularly when linked to loyalty programs.

On the supply side, economies of traffic density lower seat-mile cost. Larger aircraft can be utilized, as the number of passengers per flight segment increases because seating capacity increases faster than operating and capital costs. Finally, to the extent that demand patterns of city-pairs are not highly correlated, total demand is smoothed. A decrease in demand in one city-pair may be offset by an increase in another. Both of these effects allow the network carrier to provide service over a wide geographical area, which is only feasible with the H&S system.

3.5.2.5 Hub Dominance

As an airline's hub system grows, the airline comes to dominate its hub city(ies). With domination comes a degree of market power, enabling the carrier to extract a fare premium on flights to and from the hub. In the wake of U.S. deregulation, this premium was often estimated at 20% or more, although it appears to have lessened recently (Borenstein, 2011). The reason for the hub premium has been debated, with many critics claiming near-monopoly pricing. It's also possible, however, that passengers are willing to pay a premium for the higher flight frequency and convenience that the hub carrier provides.

Delta's Cincinnati hub provides a somewhat perverse example of the hub premium. Delta's Cincinnati passengers can sometimes obtain a cheaper fare by driving to Dayton or Louisville to board a flight back to Cincinnati and then connect to their destination than by purchasing a ticket directly from Cincinnati. For one example, a leisure fare on the non-stop flight from Cincinnati to Atlanta was $539, while the fare from Dayton to Atlanta with a connection in Cincinnati was less than half, at $256.

3.5.2.6 Competitive Strength

Hub airlines also exercise considerable influence over airport operators, which can be used to impede competition through control of airport facilities. When faced with a new entrant to its hub threatening an existing market, the airline's hub airport can be defended by adding flights with more attractive service, offering greater frequency, and matching or undercutting any new competitor's fares. This competitive advantage results in the *fortress hub*. Aggressive competitive responses are potentially anti-competitive and illegal, although such a claim has never been won in a U.S. court. In arguably the most flagrant example, in 1993, Reno Air, a small new entrant airline, started service from Reno, Nevada to Minneapolis-St Paul (MSP), home to Northwest Airlines. Even before the service started, Northwest announced a new service from MSP to Reno plus additional flights from Reno to Seattle, Los Angeles, and San Diego overlaying the heart of Reno Air's route system. In the face of Northwest threat, Reno Air dropped its MSP flights after only three months, but subsequently filed a suit against Northwest for anti-competitive practice. The suit was eventually dropped with no legal decision reached.

3.5.2.7 Widespread Distribution

Advertising and distribution also benefit from the H&S system. The H&S carrier can advertise many destinations served from any metropolitan area, thus spreading the cost of the advertising over many daily flights. An LCC utilizing a point-to-point system, on the other hand, may serve only a few destinations from a large city such as Los Angeles. Large-scale advertising is often not economically feasible until the base of flights is large.

3.5.2.8 Attractive FFPs

Finally, frequent flier programs (FFPs) that encourage passenger loyalty are more effective when the airline serves many destinations, particularly a variety of desirable vacation areas. Business passengers value their mileage awards, which allow free travel—awards that would likely be viewed as kickbacks in other settings—and want the ability to use the awards for travel for vacation.

3.5.3 Disadvantages

For all their marketing advantages, H&S systems are expensive to operate compared with point-to-point and linear systems. Additional costs are incurred in both aircraft operation and passenger handling. The strength of the H&S system, the ability to channel many destinations through a hub airport, is also the source of its weakness. Typically, 40% of all H&S airline passengers have the hub city as their origin or destination. The remainder only pass through the hub to make outbound connections. This additional stop, as compared with point-to-point service, increases costs.

3.5.3.1 Infrastructure and Labor

Extensive facilities and substantial personnel are needed solely to accommodate connecting passengers. The passenger service agents, gates, lounges, baggage facilities, and ramp and maintenance personnel dedicated to passenger connections are not necessary in point-to-point flights. At times between the connecting complexes, many of these assets and personnel are idle.

3.5.3.2 High Flight Operations Expense

The intermediate stop at the hub imposes a flight operations expense. Each of the two flight segments connecting a passenger's origin and destination is shorter than a single non-stop segment. Short segments are more expensive to operate. The aircraft achieves lower block speeds because of additional taxi time and maneuvering for takeoff and landing. More time spent at lower altitudes increases fuel burn. Flight crew pay is based on block time, as are some maintenance costs. Other maintenance costs vary with the number of takeoffs and landings (cycles), so these increase with the intermediate stop.

3.5.3.3 Pacing Spokes and Circuitous Routing

Route system geography also drives higher cost. The wheel analogy often employed to explain the H&S concept implies that all spokes are at an equal distance from the hub, but this is not true. The distance from the spokes to the hub varies greatly. In order to meet the timing of the next inbound bank, aircraft operating from the closer spoke cities must await the return of aircraft from the most distant cities. The longest spoke flight in a complex thus becomes the pacing spoke. Consequently, aircraft and crews must sit idle at many close-in spokes as the connecting complexes cycle through the day. Scheduling techniques, particularly for carriers operating many complexes per day, can mitigate this poor asset utilization, but limits remain.

Consider a major U.S. domestic hub such as Denver, with a predominantly east–west orientation. Spoke cities lie at different distances and flight times from Denver. Chicago and Boston are two examples in United Airlines' route system. Because the purpose of the hub is to connect passengers, inbound flights must all arrive within the complex times. In the east outbound wave, flights leave from Denver for Chicago, Boston, and other cities, then return, arriving at Denver to make up the westbound wave. In order for the Boston and Chicago airplanes to arrive inbound to Denver at the same time, the Chicago airplane must lie idle in Chicago, allowing the Boston airplane to travel a much greater distance. This idle ground time in Chicago decreases attainable aircraft utilization.

Second, the hub is directly in line with only a few city-pairs. All other passenger itineraries require circuitous routing to the hub, lengthening the total mileage flown and flight time, with an attendant increase in cost.

3.5.3.4 Lengthy Complex Times

As an airline grows its network operations at a hub, it can outgrow the hub's capacity and cause rapidly escalating costs. The most obvious cause is flight schedule–imposed hub congestion. Flight delays increase as the airport nears capacity. Arrivals and departures are limited by the available taxiways and runways. Inclement weather requires greater aircraft spacing, particularly for landing. Arrival rates are halved at some airports when weather permits only instrument approaches. Taxiways and gates become crowded. Terminal space, especially in older terminals, is taxed. Essentially, the hub carrier creates its own traffic congestion by scheduling ever more flights in each complex. The corrective step is often to extend the complex time, which further lowers aircraft and crew utilization.

The larger the number of aircraft in a complex, the longer are the inbound and outbound waves, because the airport infrastructure has limited capacity. Although the dominant airline bears most of the cost of congestion delays, other airlines can be caught up in the waiting lines as well. Airlines have often been accused of scheduling more arrivals and departures than the airport can handle in the allotted time.

3.5.3.5 Mixed Fleet Requirement

The H&S system lends itself to serving cities of greatly varying size and demand. Typically, these include a range from small cities only a few hundred miles from the hub to large international cities thousands of miles away. Short segments to small cities are best served by small mainline or regional aircraft, whereas long-haul international flights are usually served by wide-body aircraft. The fleet of a large network carrier may consist of aircraft with seating capacities ranging from 50 to 350 or more. As fleet commonality decreases, costs increase to train pilots and mechanics, inventory varied parts, and acquire and maintain fleet-specific support equipment. Aircraft and crew scheduling is more difficult and constrained as fleet complexity grows. Learning curves are more slowly exploited.

3.5.3.6 Susceptibility to Delays

Finally, H&S spoke systems are highly susceptible to delays. A delay on one or a few inbound flights can spread as outbound flights are held for connecting passengers. Disruptions that affect the entire hub, particularly weather, but also radar or computer outages, often propagate rapidly through the entire flight operation. Multiple hubs provide some opportunity for mitigation.

3.5.4 Bottom Line

The cost to handle a connecting passenger in an H&S-dominated system is 30% to 45% higher than with a point-to-point system, a disparity that costs H&S airlines billions of dollars annually (Lott & Taylor, 2004). To earn a profit, these carriers attempt to maximize revenues by offering a full array of services. The high frequency and geographical scope of the H&S system are particularly valuable to business travelers. In return for full service, business travelers pay a fare premium. Without this fare advantage, the large H&S carrier cannot compete with lower-cost rivals.

3.5.5 Examples of H&S Route Systems

Two examples of airlines operating H&S systems illustrate the many features of this architecture. Both are smaller airlines, because the size and complexity of larger airline route structures obscure important points.

The first example is Etihad Airways, the national airline of the United Arab Emirates and the smallest of the three rapidly expanding Persian Gulf airlines (the others are Emirates and Qatar Airways). Etihad Airways operates a global, predominately east–west, H&S route system (Figure 3.5a). Flights are timed to arrive in waves at the Abu Dhabi hub so that passengers can transfer to outbound flights across the system. As Etihad Airways president and CEO James Hogan explains, "We are quite literally at the center of the world. We can fly to all points of the world nonstop" and thereby connect any two destinations via one stop in the United Arab Emirates' capital (quoted in Karp, 2013, p. 1). Emirates and Qatar Airways make a similar case for their hubs at Dubai and Doha.

With few exceptions, Etihad's flights are medium to long haul. Operating this route structure requires a mixed fleet of varying capacity and range capability. As of 2014, Etihad's fleet of 110 passenger aircraft is comprised of Airbus 320, 330, 340, and 380 series and Boeing 777 and 787s, plus a few freighter aircraft from both manufacturers. On order are Airbus 350s and 380s as well as Boeing 787s (Etihad Airways, 2014). While this diverse fleet illustrates the requirements of a global route structure for a mixed fleet, a reduction in the number of fleet types, usually termed *fleet rationalization*, would increase efficiency and reduce cost.

The Persian Gulf carriers operate two or three connecting complexes per day. Their rapid growth over the last ten years poses a serious competitive threat to other global carriers, particularly the European airlines, whose valuable connections to Asia are under pressure (O'Connell, 2011a). Faced with this competitive threat, U.S. and European airlines have complained that the Gulf airlines are unfairly subsidized by their national governments. The Gulf carriers responded that their governments understand the importance of the airline industry and adopt policies that support growth, whereas the United States and the European Union impose heavy taxes and burdensome regulations.

Copa Airlines, introduced earlier to illustrate circuitous routings, is a second example. Figure 3.5b displays an archetypal H&S network. Copa's Panama City hub is centrally located in its primarily north–south network, allowing Copa to provide convenient flights between destinations in North and South America with a single connection in Panama City. In contrast to a global carrier such as Etihad, Copa is able to operate a fleet with just two types, 68 Boeing 737s and 23 Embraer 190s.

(a)

Figure 3.5 Examples of Hub-and-Spoke Systems. Etihad June 2016 route map courtesy of Etihad Airways.

(b)

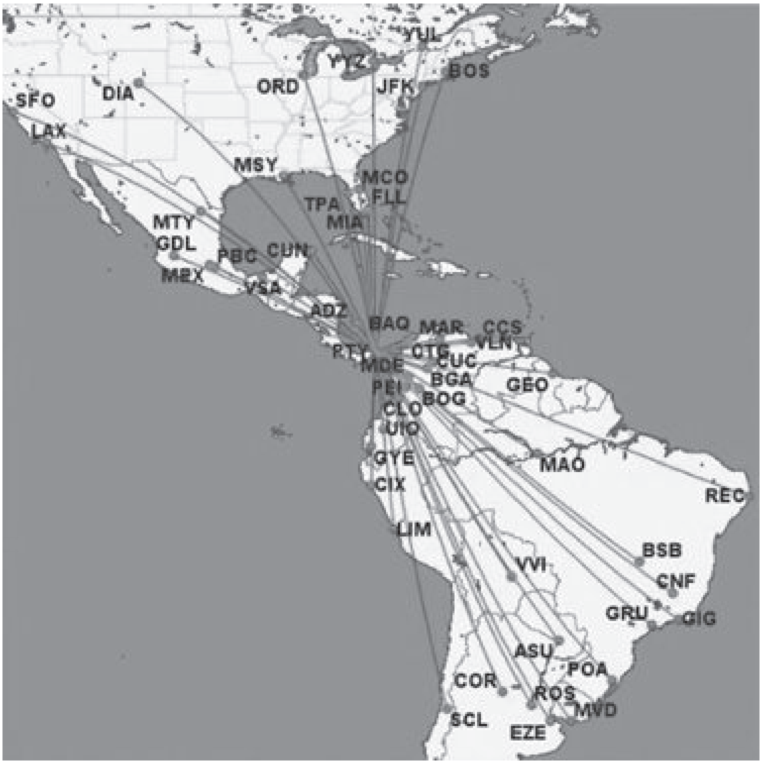

Figure 3.5 Continued.

Copa has a long history, having been founded in 1947 by a group of Panamanian businessmen in partnership with Pan American World Airways. There have been several ownership changes over the years, including a ten-year period when Continental Airlines held a 49% stake. Today, Copa is a public company listed on the New York Stock Exchange. In 2005, Copa acquired the Colombia domestic and regional airline AeroRepublica, which it renamed Copa Airlines Colombia (Centre for Aviation, 2015).

3.6 Hub-and-Spoke Variations

3.6.1 Hybrid Route Systems

Examining the three generic route systems in isolation is useful for illustration; however, pure generic structures are, in fact, rare. Larger airlines operate hybrid systems, usually with a mix of all three generic systems, although the H&S predominates at most carriers. JetBlue is an example. Figure 3.6a shows an H&S route system emanating from New York's JFK International Airport. After establishing its New York–based route system, JetBlue entered Boston, employing a predominately mostly point-to-point system, as shown in Figure 3.6b.

(a)

(b)

Figure 3.6a and b JetBlue Route Systems.

3.6.2 Multiple Hubs

The operation of a single H&S system is complex enough, but large network airlines often utilize several hubs in order to provide service across broad geographical areas and to cities of varying sizes and air travel demand. Following the merger in 2004, Air France/KLM adopted a twin hub strategy, developing both the Amsterdam and Paris hubs. In the United States, the three comprehensive network carriers all operate multiple hubs. Delta Air Lines provides a good example. Delta has seven U.S. hub cities, as shown in Figure 3.7: Atlanta, Georgia (ATL); Boston, MA (BOS); Detroit, Michigan (DTW); Minneapolis, Minnesota (MSP); New York, New York (LGA and JFK); Salt Lake City, Utah (SLC); and Seattle, WA (SEA). Delta operates foreign hubs in Amsterdam, Paris, and Tokyo (Delta Air Lines, 2015).

This system of multiple hubs makes service to smaller distant cities feasible with an itinerary including connections at two hubs. One such itinerary is pictured for a passenger traveling from Columbia, South Carolina to Sacramento, California. The passenger would travel from Columbia to Delta's Atlanta hub on a regional jet, then from Atlanta to Salt Lake City on a wide-body Boeing 767 aircraft, and finally from Salt Lake City to Sacramento on an Airbus 320 single-aisle jet.

On the other hand, because of much higher demand between Atlanta and Los Angeles, a passenger from Columbia to LAX would make only a single connection in ATL. Delta offers frequent non-stop service from ATL to LAX.

Figure 3.7 Delta Air Lines Multiple Hubs.

For an airline offering service to many cities across a wide geographical area, multiple hubs can reduce circuitous routing. Minneapolis, for example, is better located to connect cities in the north-central United States to many other Delta destinations than is Atlanta. Multiple hubs also relieve congestion that results from scheduling many flights to only one or two hubs. Hubs evolve with an airline's growth and route strategy. Delta has recently dropped some domestic hubs and added others. Its hubs increased as a result of mergers, including Western Airlines in 1987 and Northwest Airlines in 2010. Prior to the latest merger, many interested parties, certainly including a host of politicians, sought assurances that all of the hubs would be maintained and not downgraded, assurances that Delta provided. Marketplace realities, however, especially in the aftermath of the Great Recession of 2008, forced Delta to renege. Cincinnati was deemphasized in favor of the larger and more lucrative hub at Detroit. At its peak in 2004, Delta operated 595 daily departures at Cincinnati, but these eventually dropped to just over 100. Memphis was less fortunate, suffering a reduction from 240 flights per day at the peak in 2009 to only 60 flights per day by the fall of 2013. Memphis also ceased to operate as a Delta hub. On the other hand, Delta increased operations at both New York LaGuardia and Seattle, transforming both into hubs, La Guardia for domestic connections, whereas Seattle serves to connect U.S. and international destinations. Similarly, United Airlines' 2010 merger with Continental Airlines left it with too many U.S. hubs. Continental's former hub in Cleveland competed directly with United's Chicago hub. Cleveland was dropped as a hub, with total daily departures reduced from 200 to 60 (Bhaskara, 2014).

Multiple hubs are one solution to the increased costs and inefficiencies as congestion mounts at hub airports. Two other variations have also met with success, particularly at U.S. domestic hubs. Directional and rolling hubs are discussed next.

3.6.3 Directional Hub

As hubs grow, the marginal costs caused by increased congestion will at some point outweigh the marginal benefits from increased connectivity and frequency. The profitability of large hubs depends on high business fares. But, in the new millennium, with business travelers less willing to shoulder high fares in return for the high frequency the hub system provides, the economics of tightly designed connecting complexes became less attractive.

In order for an H&S system to provide convenient passenger connections, flights from all spoke cities must arrive and depart the hub airport in a tight time window. With the *omni-directional* hub, flights arrive at the hub from all spoke cities for the connecting complex. But as the network grows with the addition of new destinations, the hub can quickly become congested with aircraft and passengers. Expensive traffic and processing delays become inevitable.

A *directional hub* is one method to reduce the congestion, delays, infrastructure, and personnel requirements. In a directional hub, only flights from spoke cities on one geographical side of the hub airport are scheduled to arrive for a complex. After the transfers of passengers, baggage, and cargo are complete, flights then depart for spoke cities on the opposite geographical side of the hub.

Icelandair provides a simple example of an international directional hub (Figure 3.8a). A daily west-to-east complex is formed by flights leaving the North American destinations in the late afternoon or evening to arrive in Reykjavik early the next morning. After time to service the aircraft and for passengers to transfer to outbound flights, these same aircraft depart for European destinations. For example, a passenger traveling from Denver to Frankfurt would depart Denver on flight 670 at 5:20 pm local time, arriving in Reykjavik at 6:35 am. Flight 520, which may or may not be on the same aircraft, then departs Reykjavik for Frankfurt at 7:25 am, arriving at 12:50 pm. Similarly, a daily east–west complex is composed of aircraft that depart European destinations in midafternoon,

(a)

(b)

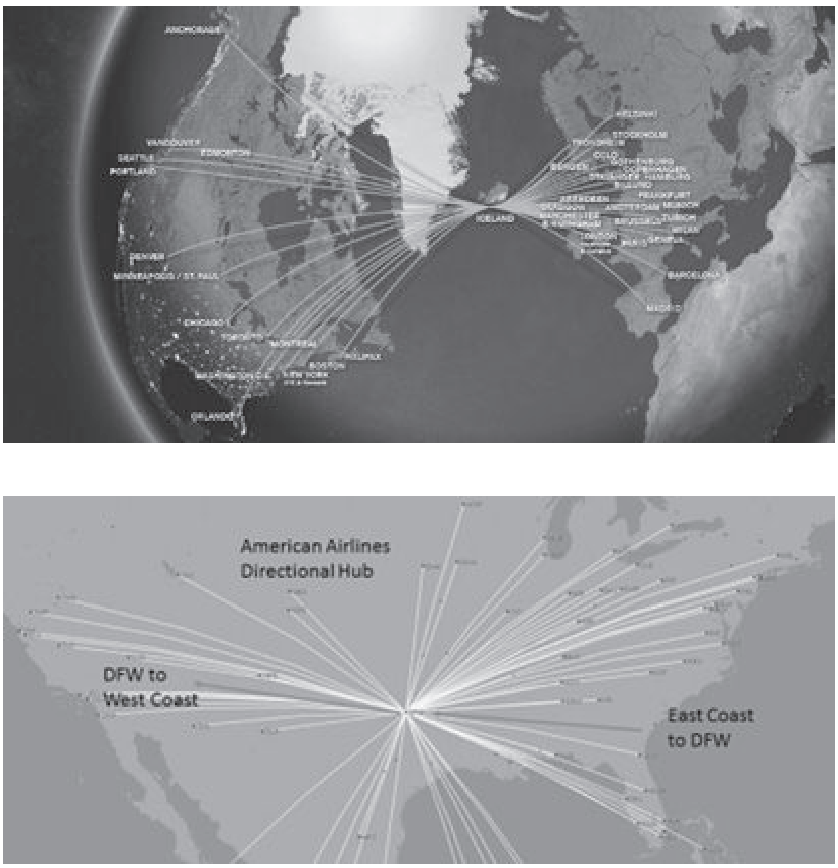

Figure 3.8a and b Directional Hub-and-Spoke Systems.

arriving in Reykjavik only an hour or so later, local time, due to the time zone changes. Aircraft then depart for North America. Our passenger returning from Frankfurt to Denver departs at 2:00 pm, arriving in Reykjavik at 3:35 pm. With a 1 hour 10 minute connection, she then departs Reykjavik, arriving Denver at 6:38 pm. This system of directional complexes is driven more by customer preference for arrival and departure times when crossing many time zones than by operational efficiencies, although these are significant, but illustrates the directional hub concept.

American Airlines' directional hub system at Dallas-Ft Worth (DFW) is more complex. Figure 3.8b is a simplified depiction. Note that spoke cities are mostly aligned to the east and west of Dallas. With an omni-directional hub, passenger connections would be provided between all spoke cities, but many connections would involve lengthy, circuitous routing. For example, a passenger could travel between Seattle and Los Angeles with a connection in Dallas, but few passengers would do so because frequent non-stop service is available. Therefore, there's little revenue potential from offering connections for city-pairs that require lengthy routings. With a directional hub, flights would depart the east spoke cities, arriving in DFW for a connecting complex. After sufficient time for passengers and their baggage to transfer to outbound flights, the same aircraft would then depart for west spoke cities. This directional hub provides convenient, one-stop service between any east spoke city and any west spoke city; however, connections between east spoke cities are not provided. This east-to-west directional hub would then be followed by a west-to-east directional hub. Six to eight daily complexes are typical for U.S. carrier directional hub systems. While this directional hub structure is common in the United States, omni-directional hubs predominate in Europe and Asia (Serpen, 2011).

Compared with an omni-directional hub that services all spoke cities, a directional hub reduces the required infrastructure and personnel at the hub by up to 50%. Consider a hub that serves 100 spoke cities. Using an omni-directional hub, 100 flights would converge at the hub for each complex. These aircraft would require 100 gates and all the equipment and personnel to support the arriving and departing flights. These gates and personnel would then be relatively idle until the next complex. Employing a directional hub, 50 flights would arrive for the directional complex, reducing the number of gates and ground staff needs by half. Shortly after these 50 aircraft depart, a directional complex operating in the opposite direction would arrive. Flight and ground operations are spread more evenly throughout the day.

The directional hub is not without disadvantages. Some revenue will be lost from the reduction in connectivity. The loss is minimal if the spokes are arrayed at opposing sides of the hub, but this ideal is rarely fully realized. Referring again to American's DFW hub in Figure 3.8, some spoke cities are north and south of DFW. In an east–west directional hub design, some marketable connections between these cities would be lost or inconvenient, so some revenue would be lost.

3.6.4 Rolling Hub

The *rolling hub*, also known as *depeaking*, is another approach to reducing hub costs and increasing efficiency. In a rolling hub, arriving and departing flights are spread more evenly through the day with less emphasis on the closely timed connecting complexes. This results in fewer constraints on flight schedules, higher aircraft utilization, better employee productivity, and fewer hub infrastructure requirements, but at the cost of longer connecting times for passengers.

American Airlines was the first airline to implement depeaking at its Chicago O'Hare hub in June 2003, followed six months later at the Dallas-Ft Worth hub. The flight frequency histogram (Figure 3.9) compares American's flight schedule at DFW before and after the implementation of the rolling hub. In August 2001, prior to depeaking, the ten daily peaks in flight frequency correspond to the connecting complexes. In March 2003, by spreading arriving and departing flights more evenly throughout the day, peak frequencies fell by more than half. These results were due in part to implementing more pronounced directional flow at Dallas and in Chicago, somewhat blurring the distinction between the rolling and directional hubs.

American gained the equivalent of 11 aircraft by improving aircraft utilization at Dallas and another five in Chicago. Other asset utilization improvements were attained with flight crews, gates, and ground crew as a result of depeaking. The process saved American an estimated $100 million annually (Goedeking & Sala, 2003);

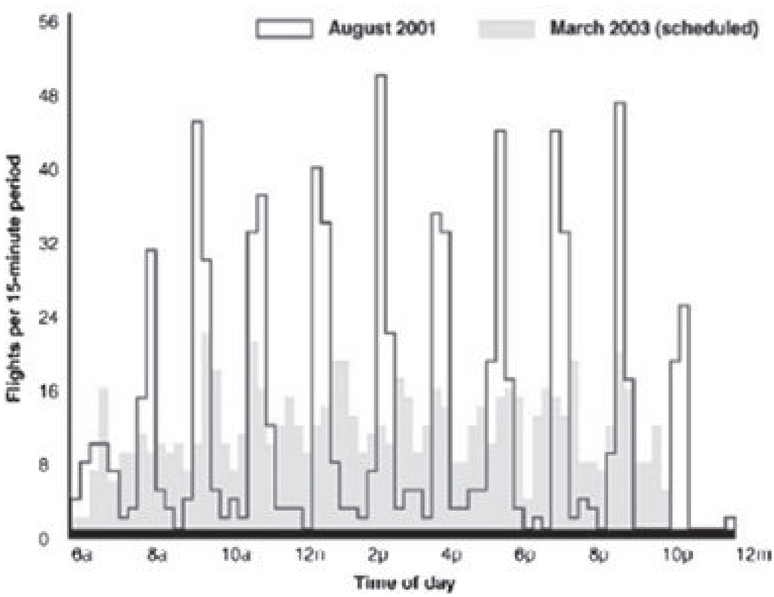

Figure 3.9 Effect of Rolling Hub at Dallas-Ft Worth.

Source: Tam & Hansman, 2003. Used with permission.

however, passenger convenience suffered. Some connections were lost entirely, and the average passenger connection time at Dallas-Ft Worth increased by approximately 11 minutes.

When Delta restructured under bankruptcy in the fall of 2004, depeaking played a central role in restructuring. At Atlanta, Delta lowered flight operations from 80 to 66 per hour, but increased the total number of daily flights from 970 to 1,051. Depeaking was also employed at its secondary hubs at Cincinnati and Salt Lake City. Both of these airports received more flights a day, but fewer per hour, with Cincinnati going from 590 to 619, and Salt Lake City from 318 to 376. Most of the increase was on Delta Connection carriers ("Hubs rejig will open door for rivals," 2004). As noted previously, the increase in Cincinnati flights was temporary, as the Cincinnati hub was subsequently downsized.

Depeaking can improve productivity and efficiency, but it's not without downsides, especially in the presence of a strong competitor. Cost savings are relatively easy to measure, but the loss of some connectivity will adversely affect revenue. American's experience at O'Hare, where United Airlines also operates a hub, is instructive. As American's rolling hub freed up airport capacity, United further concentrated its connections. United's competitive response contributed to American losing around four market share points in Chicago. In Dallas, where American has scant competition, it suffered a market share loss of only 1% in the relevant timeframe (Goedeking & Sala, 2003).

As the American and Delta examples illustrate, a rolling hub can be implemented at airports where the hubbing carrier offers hundreds of daily flights, because the high frequency ensures that most city-pairs will continue to enjoy convenient connections. Still, some city-pair connections will be lost entirely, and the quality of other connections will suffer. The schedule must protect high-volume, high-yield markets, whereas less profitable markets can be compromised to optimize productivity. At smaller hub airports with less frequency, this loss of connectivity renders the rolling hub uneconomic. Hubs best suited to depeaking are characterized as highly directional, short haul, high volume, and with limited airport capacity, whereas hubs that are multi-directional, long haul, and with a high dependence on connectivity are least suited to depeaking. Most European hubs are not well suited to depeaking, although Lufthansa depeaked its Frankfurt hub, and Scandinavian did so at Copenhagen and Oslo (Katz & Garrow, 2013).

As with most strategic decisions, depeaking involves a compromise between cost and revenue. Depeaking reduces costs but sacrifices some revenue from lost or unattractive connections. Following the merger of American Airlines and US Airways in 2013, American's new management determined that the revenue losses outweighed the savings and decided to return to the earlier system of tight connecting complexes, *re-banking* in American's terminology (Maxon, 2013). Miami was the first hub re-banked, in August 2014. American forecast higher revenues from the increased connections. A flight from Columbus, Ohio to Miami, for example, might have 20 possible connecting flights under the earlier depeaked schedule but as many as 45 under the new schedule. With this increase in connectivity from all flights, passenger demand and revenue should increase substantially. But re-banking also raises cost. At Miami, American hired 67 more gate agents, 150 baggage handlers, and other ground workers, and purchased more belt-loaders, dollies, and tugs (McCartney, 2014). The increased costs can be estimated with reasonable precision, but improved revenues are more difficult to forecast.

Judging its experience at the Miami hub a success, American re-banked both its Chicago and Dallas hubs in 2015. United also reversed its earlier depeaking strategy, re-banking its Denver and Houston hubs in 2014, followed by Chicago O'Hare hub in 2015, nearly in unison with American. In its new schedule, United shortened connection times but retained directional flows (Unnikrishnan, 2015), which demonstrates that rolling and directional hubs are separate, distinct strategies that can be implemented individually or jointly.

The optimal hub strategy depends on the broader economic conditions. Depeaking was implemented in the wake of the 2001 recession, when management focused on reducing costs. The decision to re-bank in 2014 occurred as the U.S. and, to a lesser extent, the world economy were recovering from the Great Recession of 2008. Faced with severe recession, managements tend to hunker down and reduce cost. When the economy is growing, opportunities for higher revenue become more important.

3.6.5 Tailored Complexes

Hub operations can be tailored to meet specific objectives. For example, intense competition from LCCs, especially Ryanair and easyJet, has rendered intra-European flights unprofitable for Europe's comprehensive network airlines. Among the responses to this challenge is a redesign of the connecting complexes. Air France operates six daily complexes at its Paris-Charles de Gaulle (CDG) hub. Although there is significant short-haul flying built into the CDG hub, the complexes are arranged so that intra-European connections are unattractive. Instead, short-haul European flights are designed to feed international flights. The first morning complex includes inbound long-haul flights connecting to short-haul European destinations. The late-morning outbound wave is focused on North American flights, whereas the early afternoon complex is designed so that inbound European flights feed long-hauls to North America and Africa (Flo, 2013). This complex schedule illustrates how the flow of aircraft to and from the hub supports the most profitable passenger connections.

3.6.6 Legal, Financial, and Capacity Restrictions

Some congested airports are subject to legal restrictions that limit the number of operations, often by hour. A slot is the legal authority to conduct an aircraft operation, either a takeoff or a landing, at a restricted airport. In the United States, currently the three New York airports (Kennedy, LaGuardia, and

Newark) and Washington Reagan airport are restricted by the Federal Aviation Administration. Washington Reagan is further restricted by a so-called "perimeter rule," which limits non-stop flights from Reagan to 1,250 miles or less. This was initially instituted when Washington Dulles opened in order to force long-haul flights to utilize the new Dulles airport. Since its inception, the mileage has been modified a couple of times, and several allowances for "beyond perimeter" flights have been approved on a case-by-case basis. Chicago O'Hare is under a somewhat less formal cap on operations. In Europe, many of the largest airports are slot restricted, with the allocation of slots governed and administered by the European Community. London's Heathrow Airport, one of the best airports for international connections, has been operating at near capacity for more than a decade, with flight operations limited by its two runways. Despite the recognized need to expand airport capacity and many studies, as of 2015, there was intense opposition to a plan to add a third runway, with the outcome in doubt. With the rapid growth of Asian airlines, many hub airports are operating at near capacity, including Singapore, Kuala Lumpur, Manila, and Bangkok.

In the United States and the European Union, policies promote access to restricted airports by new carriers with the objective of increasing competition. Slot restrictions may significantly limit the operation of connecting complexes.

A second means of controlling congestion favored by most economists is variable airport pricing that would impose higher airport landing fees during hours of peak demand. In theory, this would cause airlines to alter flight schedules so that less valued and lower-profit flights would be moved to hours of less demand. In 2008, the Bush administration announced a national policy that encouraged congested airports to vary landing fees based on demand for airport operations, but, under intense opposition from U.S. airlines, the proposal was not implemented. Economists believe that varying pricing would result in the most efficient allocation of airport capacity, but the debate continues.

3.7 Hub Airport Requisites

Successful hub airports share several characteristics:

- The city must have a large population and a strong economic base. In addition to the service to spoke cities that the hub supports, the hub city must be a significant destination in its own right. Typically, 40% or more of the passenger traffic should have the hub city as either origin or destination. For example, about 40% of Lufthansa's long-haul passengers originate or terminate at its hubs in Frankfurt and Munich, while about 60% are transfer passengers (O'Connell, 2011b).
- The hub must be centrally located so that routes can be efficiently developed to and from the spoke cities, avoiding extensive circuitous routings. For an airline with a large and geographically dispersed route, multiple hubs can reduce circuitous routings.

- Airport infrastructure and local transportation must be sufficient to support the hub operations. As noted above, the lack of adequate runways, taxiways, terminals, and gates to support the hub complexes is restricting the growth of airline services in many world regions.

3.7.1 Competing H&S Systems

Airlines compete intensely in most of the world's largest markets, competition that benefits passengers with lower prices and expanded services. With each large airline merger come complaints that fewer carriers will reduce competition and harm consumers. The analysis often draws on fears of reduced competition because of a likely reduction or elimination of competition on overlapping routes, where a route is understood to be a flight between two cities. This analysis, however, is too simple and misleading, because airlines compete in city-pairs, which may or may not be served by overlapping routes.

Demand for airline flights is derived from each passenger's desire to travel from one location to another, not by the airports or routes available to fulfill the passenger's travel needs. Except for short flights, passengers usually have a choice of airlines, schedules, and route structures. Figure 3.10a shows two greatly simplified H&S systems, one centered at Denver (DEN) and the other at Dallas-Ft Worth (DFW). Note that the only overlapping route is between the two hubs. Both airlines fly between DEN and DFW, but each airline's route system connects all of the city-pairs and the airlines compete for the same passengers. Thus, competition may be intense despite the lack of overlapping routes. This competition among hubs creates many rivalries within the domestic U.S. market. Similarly, but on a larger scale, the rapidly expanding Persian Gulf carriers compete with European hubs for long-haul international travel (Figure 3.10b).

Most large cities are served by more than one commercial airport, so in analyzing competition between city-pairs, it's important to consider all of the airports within the *catchment* area. London, for example, is served by six commercial airports, with Heathrow being the most desirable for long-distance flights. Five commercial airports serve Paris. In the United States, the Washington, D.C., area has three major airports—Washington Reagan, slot and range restricted, but closest to the centers of government in the capital; Dulles in Northern Virginia; and Baltimore-Washington in Southern Maryland. For a business traveler, a nonstop flight from Dulles may not be an acceptable substitute for a similar flight from Reagan, as Reagan is much closer to the city center and federal government offices. But the vast majority of travelers in the United States are leisure passengers, for whom both Dulles and Baltimore-Washington are substitutes (Bhaskara, 2013).

3.7.2 Hub Failures

In a 2003 speech before the Aero Club of Washington, then Delta Air Lines CEO Leo Mulin observed that the United States had too many hub airports

Figure 3.10 Competing Hub-and-Spoke Systems.

and predicted that several would be shuttered. He noted there were more than 30 hubs across the United States, with eight in the Midwest alone. A passenger traveling from San Francisco to Tampa had more than 50 connecting possibilities (Lott, 2003). Indeed many hubs did close, frequently as the result of network reorganization following mergers. American Airlines acquired Trans World

Airlines in 2000 and found that TWA's St. Louis hub competed with, rather than complemented, American's Chicago O'Hare hub. American downsized the St. Louis hub, mostly substituting smaller regional jets for mainline aircraft.

As discussed earlier, Delta's substantial reduction of its Cincinnati hub and dropping of Memphis as a hub followed its merger with Northwest Airlines in 2008. Continental's hub in Cleveland was shuttered following the merger with United Airlines in favor of United's Chicago O'Hare hub. The merger of America West with US Airways followed a similar pattern. America West's former hub in Las Vegas was dropped as flights were consolidated at the Phoenix hub.

Some hub cities have repeatedly failed. Kansas City was tried by TWA, Eastern Airlines, and finally Vanguard. All these airlines failed and have passed into history. Finally, a host of secondary hubs have closed in recent decades. These include American Airlines at Raleigh-Durham, North Carolina and San Jose, California; Trans World Airlines at Atlanta; and Continental Airlines at Denver.

3.8 Evolving Route Systems

The airline industry is dynamic, and route systems are not static but constantly evolving with changing market conditions. Route systems are modified as the result of hub failures, but new hubs arise occasionally as well.

3.8.1 Southwest Airlines Route System

Southwest's evolving route system offers an especially illuminating example of the up- and downsides of route system design. Figure 3.11 shows Southwest's routes from its Chicago Midway focus city. Note the characteristic H&S design rather than

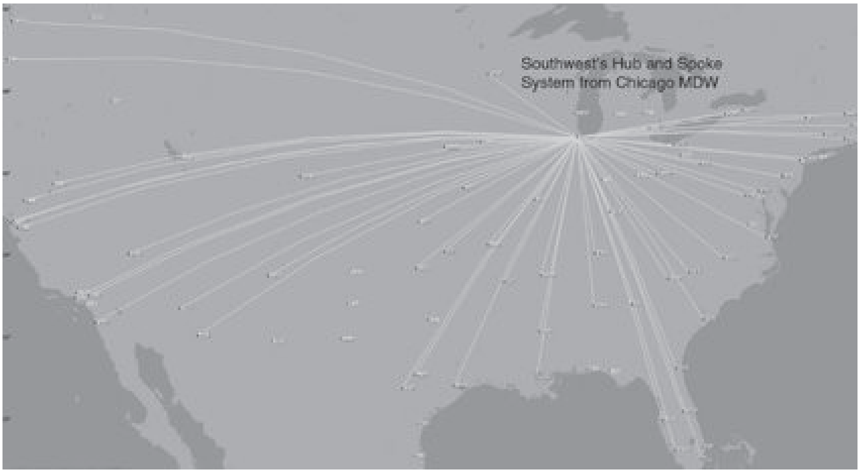

Figure 3.11 Southwest Airlines Chicago Midway Route System.

the point-to-point system for which Southwest is well known. Responding to the changing competitive environment and its own growth, Southwest has deviated from the LCC business model it pioneered in the early 1970s. The adoption of a traditional H&S route system in some parts of its network is perhaps the most profound change. Although Southwest has long offered connections at its focus cities, these connections arose randomly from high flight frequency rather than by the careful planning required to operate connecting complexes at hub cities. Beginning in 2009, however, Southwest altered its traditional flight schedule to increase passenger connections with a program it dubbed "Intentional Connect Opportunity," in other words, an H&S schedule at Chicago. Instead of its famed short-turns, aircraft were initially scheduled on the ground at Midway for a minimum of 45 minutes.

The complexity of H&S operations resulted in unaccustomed challenges. By 2010, Southwest dropped from its usual first or second on-time ranking to eighth place among the largest U.S. carriers and has remained in roughly that relative position through 2014 (U.S. Department of Transportation, 2015). As CEO Gary Kelly explained in 2012,

> The other thing that has happened since 2009 is we have had a much more forceful push for connecting itineraries, and we push very hard for that in 2010 and 2011. It worked very handsomely … On the other hand, it is more challenging operationally to handle connections, and so we are still in the process of tuning that. So we have pulled back in a sense since 2011 with our push for connecting passengers. You have seen the operational benefit, and I do think that there are some revenue opportunities there.
>
> (Kelly, 2012)

An interesting contrast is the Atlanta, Georgia hub that Southwest acquired in its merger with AirTran. Southwest has dropped service to several smaller cities and spread flights throughout the day with the aim of increasing utilization and capturing more local traffic. Southwest has termed this change "de-hubbing," even though an estimated 40% of passengers on Atlanta flights will still connect to other Southwest flights when the transition is complete (Centre for Aviation, 2013).

Reflecting on Southwest's evolving route structure, aviation consultant Michael Boyd summarized:

> In a very real sense, Southwest is becoming a multi-hubbed airline. There's DEN, BWI, BNA, MDW, MCI, SLC (Denver, Baltimore-Washington, Nashville, Chicago, Kansas City, Salt Lake City) and an emerging DAL (Dallas Love) that are experiencing increasing connect traffic. The linear, point-to-point Southwest system is melting away.
>
> (Boyd, 2010)

Despite the problems, the gains in connectivity have been impressive, with 40% of its passengers connecting network-wide. At Chicago Midway, Southwest's largest airport with over 220 daily departures, 55% of passengers connected to other flights (Bhaskara, 2013).

3.8.2 Delta's LaGuardia Hub

Southwest has restructured its flight schedule across its existing network to increase connectivity. In contrast, in 2001, Delta Air Lines began developing a new domestic hub at a most unlikely airport, New York LaGuardia. LaGuardia is geographically constrained with only two intersecting runways, one of which becomes unusable in high winds. Taxiways are limited and become congested at peak hours. Much of the terminal space is old and inadequate. Delta is forced to operate from three separate terminals connected by a bus service. Finally, the New York airspace is the most congested in the United States, leading to frequent air traffic control delays. So Delta faces daunting challenges in establishing a high-frequency hub at LaGuardia.

In early 2011, Delta and US Airways agreed to swap takeoff and landing slots at New York LaGuardia and Washington Reagan National airports. In the deal, approved by the Department of Transportation, Delta acquired 132 slot pairs (a takeoff and a landing) from US Airways at LaGuardia, while US Airways acquired 42 slot pairs from Delta at Washington Reagan National. With this acquisition of slots, Delta began building a mostly north–south domestic hub at LaGuardia, serving some 60 cities. Recognizing that closely timed connecting complexes are impractical because of the capacity limitations at LaGuardia, Delta spread its flights throughout the day in what is essentially a rolling hub. Delta's managing director for LaGuardia noted, "We won't have masses all coming at once. There's no more space to be had at La Guardia. This is it" (quoted in McCartney, 2012).

Delta's objective is to garner the largest market share in New York, the biggest single aviation market in the world. With careful scheduling, a $100 million dollar investment in upgrading its LaGuardia terminals, and experience in running overcrowded hubs, Delta expects to become the leading airline in New York. Along with its primarily international hub at New York Kennedy, in 2012 Delta operated 432 daily flights from New York. This compares with American's 208 but falls just short of United Airlines' 453 flights, most from Newark Liberty International Airport in New Jersey (McCartney, 2012).

3.9 Summary

An airline's most critical strategic choices are the destinations it serves and the route structure design connecting these cities. The three generic route system architectures, point-to-point, linear, and H&S, vary in complexity and cost of operation. Point-to-point is simple and the least costly. The H&S is complex to design and operate, but allows a broad geographical coverage to cities of greatly varying size. The linear system falls somewhere in between. Most large carriers, as well as many smaller low-fare airlines, choose the H&S system despite the cost of operation because it allows many destinations to be served on each flight to one or more hub cities, where passengers transfer to a second flight to their destination. This combined demand is sufficient for profitable service to cities too small to support point-to-point or non-stop service. Because of the predominance of the H&S route system in both domestic and international air travel, students and practitioners must appreciate the marketing advantages and operational complexity this route architecture poses. Table 3.1 compares the point-to-point and H&S systems.

Table 3.1 A Comparison of Hub-and-Spoke and Point-to-Point Systems

Attribute	*Point-to-Point*	*Hub-and-Spoke*
Scope	Each route serves a single city-pair. Routes may be widely dispersed.	Optimized by connecting service to a wide geographical area and many destinations.
Connectivity	No connections provided (although some may arise randomly as focus cities develop).	Most passengers, typically about 60%, connect at the hub airport(s) for flights to their destinations.
Dependence	Flights operate independently.	Flights are highly dependent in order to provide passenger connections.
Market Size	Requires high-density markets with at least one city of the pair being a high-traffic destination.	Efficiently serves cities of varying sizes, including cities with too little demand to be profitably served by point-to-point routes.
Demand	Only varying frequency and pricing are available to counter demand variations.	Varying demand in one or more city-pairs may be offset with demand from other city-pairs.
Frequency	Supports a large range of frequencies, from several per day to only a few per week.	Generally high frequency, tied to the connecting hub complexes.
Pricing	Both business and leisure pricing depend on the city-pair demand characteristics.	Dependent on business travelers at high fares with excess capacity filled with discounted fares to leisure travelers.
Asset Utilization	No network constraints on utilization.	Limited by network geography, timing of complexes, and capacity of hub airports.
Cost of Operation	Lowest cost per available seat mile per city-pair.	Hub connections significantly increase cost per available seat mile, which is somewhat offset by the use of larger aircraft.
Fleet Requirement	Suited to a single aircraft type.	Range in city demand usually requires a mixed fleet.

Source: Adapted from Cook and Goodwin, 2008.

Route structure and the destinations an airline chooses to serve are the foundations of its product, but the product offering includes many other features. This is the topic of the next chapter.

Note

1 Airline route maps are representative of specific airlines but are simplified for the purpose of illustration. Unless otherwise noted, route maps have been created using Great Circle Mapper.

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Review Questions

1. What are the three types of route structure? Define or illustrate each.
2. What are the advantages and disadvantages of a point-to-point route system?
3. Southwest provides the best example of a linear route system. What are the advantages and disadvantages of this system?
4. What are the advantages and disadvantages of the H&S system?
5. How do aircraft routings and passenger connections differ in a directional versus an omni-directional hub? Why are directional hubs less expensive to operate?
6. What is a "rolling hub" and what savings does it provide in comparison with a traditional H&S operation?
7. What is the difference between a rolling hub and a directional hub?

8 Why does point-to-point service cost less to operate than connecting service through a hub?
9 What are the requirements for a successful hub city?
10 Why are H&S systems essential for air travel to most U.S. cities that now have airline service?
11 Why do all large H&S carriers have several different aircraft types (particularly different capacities) in their fleets?
12 Air fares between a major hub city and a spoke city are often higher than for another city-pair of comparable distance and city sizes. Why?
13 How can airlines that do not operate any of the same routes be competitors?

Chapter 4

Product Offering

Having considered in Chapter 3 how an airline chooses a route system architecture to connect its destinations, this chapter examines the other product features an airline decides to offer its customers. This choice ranges from basic transportation, sometimes labeled *no frills*, offered by some low-cost carriers such as Europe's Ryanair to exclusively first class service proffered by a few highly focused airlines. Most large *comprehensive network carriers*, in contrast, offer a variety of products from premium service in the first class cabin to economy coach class with limited amenities and privileges. A critical part of the network carrier product, especially in the United States, is the regional airline that provides service under contract on a network carrier's lower demand routes. The product an airline chooses to provide depends largely on the passenger segments it wishes to serve. The airline product is one of four variables in the *marketing mix*. The others are price, promotion, and place (or distribution). Price and distribution are addressed in later chapters.

4.1 Strategic Choices

4.1.1 The Marketing Concept

In the early twentieth century, firms emphasized efficient production of consumer goods, perhaps best illustrated by Henry Ford's mass assembly line production of the Model T. Later, as mass production became commonplace and consumers' demand for basic goods was satisfied, marketing philosophy shifted to an emphasis on sales. After World War II, as the variety of consumer goods and services exploded, marketers began to realize that producing and selling with little regard to what the consumer wanted was not a sustainable path to profits. Modern marketing theory holds that a company facing intense competition, as do airlines in the United States, Europe, Asia, and increasingly throughout the developing world, must determine customers' needs and wants and then offer a product satisfying those desires at a price that yields a profit. This is known as the *marketing concept*. Any company that fails to satisfy customers' needs will lose market share to more able competitors.

The supersonic airliner is a classic example of a failure to observe the marketing concept. The Anglo-French Concorde was built because it was technologically feasible and a statement of European aeronautical expertise. But the designers didn't seem to consider whether a sufficient number of passengers were willing and able to pay higher fares necessary to cover the aircraft's operating costs to save two to three hours on transoceanic flights. Only 20 aircraft were built. British Airways and Air France flew the Concorde on limited routes for 27 years beginning in 1976, but only because the British and French governments covered much of the acquisition costs. Taxpayers subsidized the development and sales of an aircraft few would use for travel.

So, what do airline passengers want? Lots of things: low price, many destinations, high flight frequency, non-stop service, expansive seat room, easy airport access, quick check-in, assigned seating, passenger lounges, attentive in-flight service, excellent in-flight food, in-flight entertainment, and new, large jet aircraft.

Doganis (2010) lists five key product features that affect a passenger's choice of airlines: price, schedule, comfort, convenience, and image. The majority of airline passengers travel for vacation or to visit friends and family, so price is the most important criterion for choosing an airline (see Figure 4.1). But, while leisure passengers comprise the majority of passengers, business travelers often generate a greater proportion of total revenue. For business passengers, schedule convenience will often weigh most heavily in their choice. Whether an airline emphasizes price or schedule should be determined by the target passenger segment(s) and will vary by route. For business markets, high flight frequency would be an important competitive weapon. In vacation markets, the same airline might choose less frequency but utilize larger aircraft with high-density seating to lower seat-mile costs. Segmentation may be extended to several more dimensions in an effort to precisely determine the wants and needs of small passenger

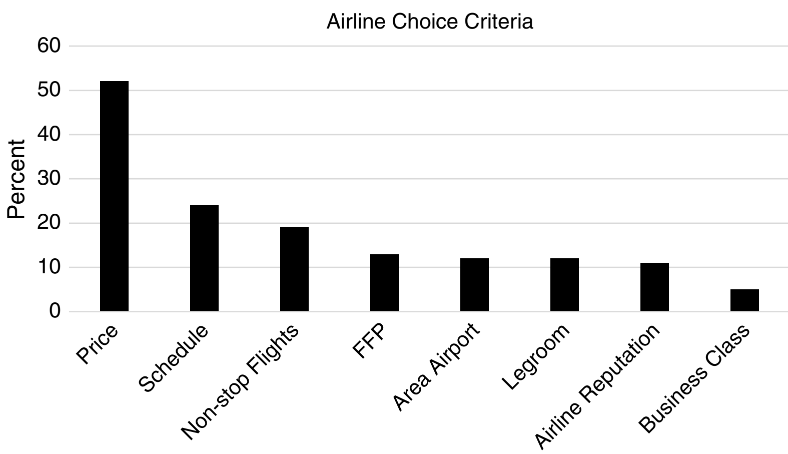

Figure 4.1 Passenger Criteria in Airline Choice.

Sources: Authors' computation based on passenger surveys from Toluna Omnibus Surveys, Airbus, and Elliott.

segments. With extensive data available from a passenger's travel history and frequent flier information, specific product offers might be tailored to the individual passenger. For example, an airline might offer a golf package to a frequent flier known to be an avid golfer.

Still, airlines struggle to meet all these wants. An airline, for example, cannot offer low prices with an array of expensive amenities and still be profitable. Rather it must decide what passenger segments to serve and carefully balance price with the product features.

4.1.2 Generic Strategies

Many business strategists believe that corporate strategic decisions must be based on a core concept defining how the firm can best compete in the marketplace. Three generic strategies were developed by well-known Harvard business school professor Michael Porter: cost leadership, differentiation, and focus. By pursuing one core strategy, the firm attempts to obtain a sustainable competitive advantage.

Cost leadership

A firm pursuing cost leadership attempts to maintain the lowest cost production for a given level of quality. This strategy involves determining the core product features customers demand and delivering these with minimum resources, high efficiency, and high volume. Customers, of course, want other product features but a large segment will trade extra features for a lower price. Passengers won't sacrifice safety for a lower price but many will accept high-density seating for a cheaper fare. Examples of firms pursuing cost leadership include Walmart, whose slogan, "Always the lowest price," captures this generic strategy. Southwest Airlines is probably the best-known airline example, but Europe's Ryanair is actually more dedicated to this generic strategy.

Differentiation

A differentiation strategy creates unique products for varied consumer groups. Tailored product features create brand loyalty which translates into the ability to charge a premium price. As with the cost leadership strategy, differentiation can be pursued on a broad, industry-wide scope, or on a narrower basis. With a broad scope, a firm provides tailored products for many customer segments and exploits synergies in producing several different, but closely related, products. General Motors is a classic, though now less dominant, example of a corporation that produces a product for every large consumer segment ranging from Chevrolet to Cadillac. Toyota is another example from the automobile industry. In the airline industry, most comprehensive network airlines such as American, Air Canada, or British Airways offer a product for each consumer group from highly restricted economy coach to first class.[1]

Focus

The focus strategy attends to the needs of a particular market segment, usually one not well-served by firms pursuing the cost leadership or differentiation strategies. A niche strategy is another apt term. Focus strategy firms concentrate on a single product and seek unchallenged specialization. Continuing with the automobile industry examples, Rolls Royce comes to mind. Early in the twenty-first century, several new entrant airlines such as Eos and MAXjet began all business class service between New York and London meeting with some early success. The airline history, however, is replete with attempts to cater exclusively to business travelers, all of which eventually failed. Perhaps not surprisingly, so did Eos and MAXjet. In the cargo industry, FedEx limits its business to small packages, a focus strategy.

4.1.3 Industry Evaluation: Porter's Five Forces

Continuing to follow Porter, he suggests that the starting point for choosing a strategy is an evaluation of the industry along five dimensions or forces of competition.

Figure 4.2 illustrates how opposing market forces determine the degree of competition among competing firms within an industry. For the airline industry in the United States, Europe, and increasingly in Asia, these forces vary from moderate to high strength resulting in intense competition. Each force is summarized below.

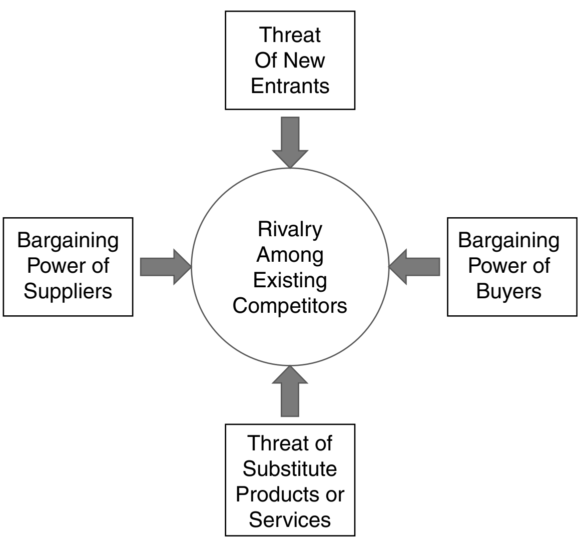

Figure 4.2 Evaluating Industry Competition.

Threat of new entrants

Medium. In the mature economies of North America and Europe, there are few new entrant airlines, but in the developing economies, new entrants, especially low-cost carriers, continue to emerge.

Bargaining power of suppliers

High. Aircraft and engine producers are concentrated oligopolies and airports are local monopolies. Labor unions are powerful in most countries. Global distribution systems are still powerful but direct distribution is a rising alternative. The price of fuel, the largest expense for most airlines, is determined by global market forces leaving airlines little power to bargain for lower prices.

Threat of substitute products or services

Low to Medium. Although there are no substitutes for rapid, long-distance travel, high-speed rail is a competitor for short-hauls in Europe, Japan, China, and the U.S. northeast corridor. For short distances, the automobile is a strong substitute. Web-conferencing is also a competitor for some business travel.

Bargaining power of buyers

High. Although there are millions of individual passengers, information on airline products and prices is now rapidly available, cheap, and transparent because of Internet distribution. Switching costs are low and many leisure passengers view the airline coach seat as a commodity.

Rivalry among existing competitors

High. Even though most markets are oligopolies, airlines are highly competitive. Limited product differentiation and a perishable product provoke price competition.

This framework suggests that the airline industry is intensely competitive and, therefore, a challenging environment for sustained airline profitability. In order to survive and prosper, airlines must design and produce a product that yields some competitive advantage. Porter suggests that airlines should choose one of the three generic strategies; however, the emergence of the hybrid airline challenges this academic recommendation.

Dimensions of product choice

An airline has a broad range of product choices with which to meet passengers' wants and needs. The product decision process begins with the airline's strategic vision. This vision, from which it intends to exploit some market opportunity, is the subject of strategic management and beyond the scope of this text. With an overarching vision and a choice from Porter's strategies, the airline should next evaluate passengers' wants and needs and then target some segment(s) of passengers for service. With these strategic decisions in place, Figure 4.3 depicts a series of specific product choices.

Geographic scope

Geographic scope can range from a very limited area to worldwide. Comprehensive network carriers serve major business and popular vacation destinations around the globe, some through their global alliance partners, ensuring that a customer is not forced to seek another carrier to satisfy travel needs. In contrast, some small airline route structures are very limited. Two airlines operating in the Hawaiian Islands provide an interesting contrast. Mokulele Airlines serves just eight destinations within the Islands whereas Hawaiian Airlines has expanded from its origin as an intra-island carrier to a predominately long-haul airline serving Hawaii with connecting service from Asia and Australia to the U.S. mainland.

Geographical scope is tied to the choice of cities to be served. Some airlines choose primarily vacation and holiday destinations—the European tour operators are an example—whereas others target business centers. The larger carriers serve both.

Routes vary greatly in passenger demand. Regional airlines serve mostly low demand routes connecting smaller cities to major hubs, usually under contract with large network carriers. In contrast, dense routes have high passenger demand.

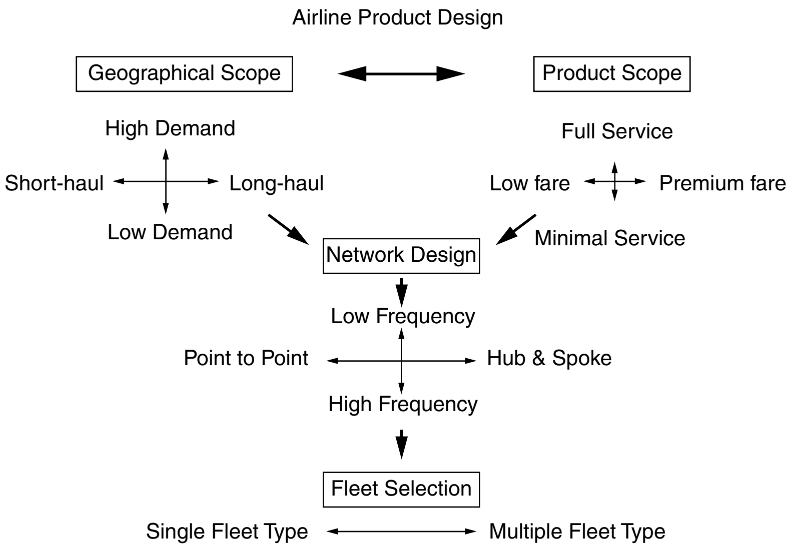

Figure 4.3 Airline Product Design. Adapted from Holloway, 2002.

The New York–Los Angeles market is one of the largest city-pair markets in the world. Several airlines offer nearly hourly service.

Product scope

Product scope choices range from no frills, basic air transportation to all first class, or a combined offering with several products designed to match the needs of most passenger segments. Of the airlines offering core transportation, Ryanair is perhaps the best-known example. Amenities are few and for those Ryanair charges extra. Reservations are available only from the airline's website; the passenger must print boarding passes or pay a substantial fee. All flights are point-to-point; connections to other Ryanair flights are not offered. Comprehensive network carriers typically offer three cabin classes—coach, business class, and first class—although some airlines have dropped first class opting instead for upgraded business class and two economy classes. Singapore Airlines, long recognized for a high-quality product, features a broad product scope on its Airbus 380 aircraft boasting four cabins including individual suites, business class and two levels of economy class. To appeal to the high-end traveler, suites are fully enclosed for what Singapore describes as an unprecedented level of privacy, fitted with a standalone bed, and provide the passenger with exquisite dining and non-stop entertainment (Singapore Airlines, 2013). At the other end of its product offering, the lowest level economy class is intended for passengers whose first priority is a low price.

More recently, the big-3 Gulf carriers have raised the bar in extreme luxury. Etihad was first with the introduction of its Residence product, a three-room suite made up of a double bedroom, private bath and shower, and a lounge and bar area. With premium passengers comprising only 6% of the total, this is a niche segment which may do more for the airline's reputation than the bottom line (Aspire Aviation, 2015).

Network design

Route structure options are examined in Chapter 3 and range from point-to-point to hub-and-spoke with most large carriers actually incorporating some elements of all three generic designs. Ryanair, easyJet, and Allegiant are purely point-to-point airlines whereas the comprehensive network carriers such as Delta, British Airways, and Emirates operate mostly a hub-and-spoke system. Fight frequency also varies by market and carrier. Frontier and Spirit Airlines serve many U.S. and nearby international markets only a few days a week whereas high demand markets are served many times per day. Southwest Airlines, for example, operates eleven daily flights between Los Angeles and San Francisco, California.

Fleet Selection

Fleet selection will follow from the targeted passenger segment(s), product scope, and network design. If the network includes cities of greatly differing sizes and/or routes of varying lengths (domestic and international cities), several aircraft types may be required. Before beginning a decade-long and painful restructuring, American Airlines operated 14 fleet types in 30 configurations tailored to specific markets. It has since simplified or rationalized its fleet eliminating half of the fleet types and configurations, but it still offers products carefully customized to specific markets.

Determining the appropriate dimensions of product scope is an iterative process as decisions on one dimension will influence others. For example, a decision to serve a market with high frequency will influence the optimal size of aircraft.

Airlines can be characterized by their product. Along a spectrum are comprehensive network carriers, regional airlines, hybrid carriers, and low-cost-airlines. Each is discussed in detail in the next section.

4.2 Comprehensive Network Carriers

At one end of a continuum are the comprehensive network carriers (CNC). Air China, British Airways, and Delta Air Lines are examples of comprehensive network carriers. These airlines offer a broad product scope including the following (O'Connell, 2011):

- Service to hundreds of destinations via a global hub-and-spoke route system. Through one of the three global airline alliances, service is extended to many more worldwide destinations. CNCs serve primary airports favored by business travelers occasionally supplemented with additional service to secondary airports. Several daily frequencies are offered in most city-pairs providing passengers with flights that meet their desired travel times.
- Distribution is available through a wide array of channels that includes travel agents, online travel agents, airline call centers, and websites and social media. Higher priced tickets offer the flexibility to change or cancel reservations.
- Amenities offered to business and frequent customers include airport lounges, fast track security, preferential boarding, and limousine service.
- Aircraft are configured with two or more cabin classes with a vast portfolio of in-flight products in business and first class such as flat beds, quality food and beverage, advanced in-flight entertainment systems with multiple channels, internet and mobile phone connectivity. Economy cabin service is less expansive. The coach cabin is increasingly divided into two sections with more seat room and service in the premium economy coach section.
- Loyalty programs include frequent flyer awards and incentives to travel agents.
- The fleet numbers hundreds of aircraft with several different types to meet route requirements that vary greatly in length and demand. Regional airline partners operating smaller aircraft extend the network coverage from hub airports to smaller cities.

4.2.1 Differentiation

Though CNCs provide a product for most segments of the market, profitability depends on capturing business travelers who represent only 10 to 15 percent of long-haul passengers but account for up to half of the revenue for airlines such as Lufthansa and British Airways (Mouawad, 2013). To compete for the business passenger, business class upgrades, such as fully flat beds on international flights or even in-flight suites, are intended to retain business passengers and lure other airlines' most valuable passengers. But creating a lasting difference and competitive advantage is usually fleeting as most such upgrades can be duplicated by competitors. Recently many carriers have eliminated first class cabins in favor of expanded, more spacious and expensive business class approaching what used to be first class. To capture the business travelers whose companies will not pay for business class but will allow an upgrade in coach, many airlines have added a premium economy section in coach. The section, priced between economy and business class, always offers more, but other features vary considerably by carrier and route (Boynton, 2012).

A product innovation first introduced by the low-cost carriers but increasingly implemented by comprehensive network airlines in economy class is product unbundling in which product features previously included in the ticket price are now available only for an additional fee. Fees for checked baggage are the most ubiquitous, but a myriad of others have arisen such as fees for early boarding, seat selection, beverages and snacks, and a host of others. Upon exiting bankruptcy in 2005, Air Canada offered an alternative in which product amenities are bundled into several fare and cabin classes. Figure 4.4 is an extract from Air Canada's Book Travel website for a flight from Toronto to Ft. Lauderdale. Five fare options range from $200 to $1,078 depending on the level of service desired. The Tango, Flex, and Latitude fares are for the economy cabin but vary with included features whereas the two Executive Class fares are for the business cabin. The cheapest fare, Tango, buys only basic transportation, a seat on the flight. Tickets are non-refundable and any change in itinerary incurs a substantial charge. Each higher fare provides more features and conveniences. The service for Executive Class is identical but the Executive Class Lowest fare is non-refundable.

In contrast with an unbundled product which makes many passengers complain of being "nickeled and dimed," Air Canada's product is transparent. Air Canada claims this fare/cabin class offering increased revenues and is profitable. If imitation is any judge, American Airlines agrees having implemented a similar system in 2013. On a typical domestic flight, American offers seven fare preferences ranging from a highly restricted economy fare to first/premium full fare.

As an aside, Figure 4.4 also reveals the occasional inconsistency of airline pricing. The second line shows connecting service through Montreal is priced higher than the non-stop flight but is much less desirable. The first flight of the connection leaves Toronto at 30 minutes past midnight arriving in Montreal where the passenger is treated to a 7 hour and 20 minute middle of the night layover!

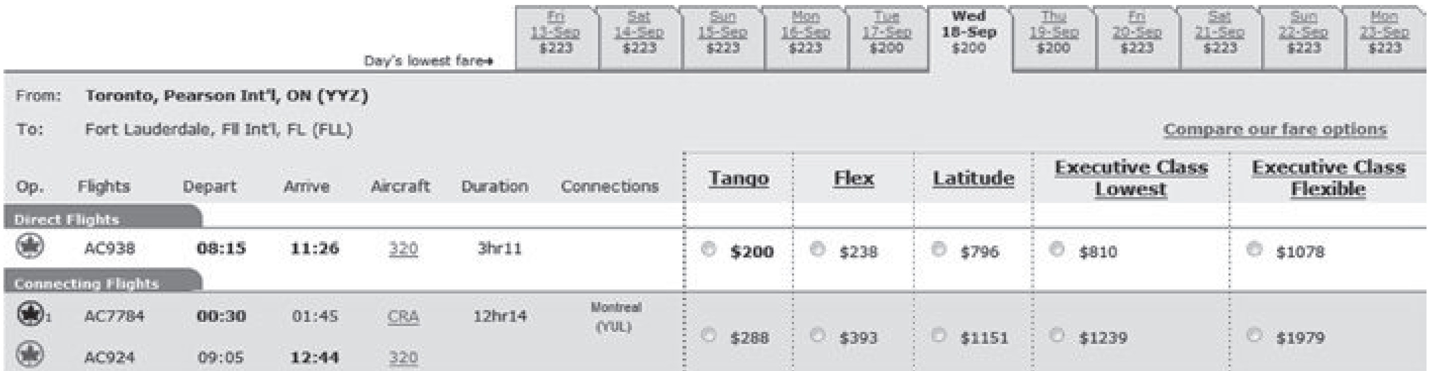

Figure 4.4 Air Canada's fare options. Reproduced with the permission of Air Canada.

The total trip time is 12 hours and 14 minutes versus 3 hours and 11 minutes for the non-stop flight.

4.2.2 Delta Air Lines

Delta Air Lines is chosen to illustrate CNC product scope in detail. Delta is the world's second largest carrier in 2014 measured by operating revenue, total passengers, and fleet size (Air Transport World, 2015) offering service to 324 destinations on six continents and transporting some 170 million customers each year. With 2014 annual revenue exceeding $40 billion, Delta employs nearly 80,000 employees worldwide and operates a mainline fleet of more than 800 aircraft. The fleet comprises Boeing models 717, 737, 747, 757, 767, 777; Airbus 320 and 330 models; and McDonnell Douglas MD-88 and MD-90s.

The airline is a founding member of the SkyTeam global alliance and participates in joint ventures with Air France-KLM, Alitalia, Virgin Atlantic, and Virgin Australia. It also has an equity stake (part ownership) in Aeromexico, China Eastern, Gol, and Virgin Atlantic. Including its worldwide alliance partners, Delta offers customers more than 15,000 daily flights, with hubs in Amsterdam, Atlanta, Boston, Detroit, Los Angeles, Minneapolis-St. Paul, New York-LaGuardia and JFK, Paris-Charles de Gaulle, Salt Lake City, Seattle, and Tokyo-Narita (Delta, 2016).

Depending on the route, Delta offers first class, business class, premium economy, and economy class service. Onboard amenities also vary by fleet type and route but include Wi-Fi and on-demand audio and video.

Delta Connection, Delta's branded regional airline service, operates more than 2,500 daily flights that supplement Delta's 5,000 daily mainline flights. Delta's wholly-owned subsidiary Endeavor Air and regional airline holding companies Republic Airways, SkyWest, and Trans States, all of which are the result of earlier acquisitions and mergers, operate Delta Connection flights.

4.3 Regional Airlines

Comprehensive network carriers typically outsource many of their smaller destinations to wholly-owned subsidiaries or independent regional airlines. The predecessors to today's regional airlines, once known as commuter airlines, have been around for more than 50 years providing feeder service to larger carrier networks. The first such partnership between the U.S. local service carrier Allegheny Airlines, now part of American Airlines through a series of mergers, and Henson Airlines began the world's first *code share* agreement in 1967. Henson and other commuter airlines operated small capacity turboprop aircraft that passengers often found undesirable, but with the introduction of the regional jet in the early 1990s, regional airlines were able to greatly expand their capabilities. As part of restructuring in the early years of the new millennium, U.S. legacy carriers retired their older, inefficient mainline jets in favor of smaller regional jets operated by their regional partner airlines. While capacity did not increase, the number of aircraft and frequency was more than double that of the grounded fleet. Regional airlines now operate nearly 50% of all U.S. domestic flights. Figure 4.5 shows the explosive growth of the U.S. regional airline revenue passenger miles from 1980 through 2010. Note the rapid rise in the early years of the new millennium during the first stages of legacy airline restructuring. But revenue passenger miles then peaked and have not grown since. The average number of daily departures peaked in 2005 and then began a gradual decrease reflecting the introduction of larger capacity aircraft into the regional airline fleets.

The regional airline provides an extension of the comprehensive network carrier's product, not a separate product offering. Indeed, the industry publication *Aviation Daily* terms these airlines "network extenders." Yet, regional airlines are distinct from the larger partners. Regional carriers:

- May be subsidiaries of the network carrier such as American Airlines' Envoy or independently owned. Skywest Airlines is the largest example.
- Lease or rent aircraft and crews to one or more network partners with other elements of the airline operation, including scheduling, pricing, promotion, and distribution, managed by the network partner.
- Operate under a separate airline operating certificate and government regulatory oversight from the network carrier.
- Do not usually operate under their own name but instead are branded by the network carrier and operate under the network carrier's flight code, for example, Delta Connection or American Eagle, so that few passengers are aware that a regional airline is operating their flight.
- Have lower cost structures, primarily from lower employee wages and higher productivity, than the network carrier.
- Operate a fleet of regional jets ranging in capacity from 30 to 90 seats.

Figure 4.5 Regional Airline Passenger Miles Growth.

Data source: Regional Airline Association 2015 Annual Report.

The network carrier and the regional airline both benefit from the outsourcing arrangements. The network carrier is afforded lower cost access to small and moderate size markets increasing passenger feed to its hubs. By contracting with independent regional airlines, the network carrier benefits from competition for contracts and the ability to quickly react to market changes and opportunities. The regional airline, on the other hand, obtains many of the benefits from the network carrier including brand recognition and creditability, marketing and distribution coverage, premium pricing, purchasing power, network efficiencies, and loyalty programs. However, the regional carrier is subject to the control of its major airline partners with little ability to operate outside of these contractual partnerships. Chaffing under these constraints, regional airlines have occasionally struck out on their own but never successfully.

4.3.1 Fleet

The original regional jets (RJ) introduced in 1993 had a seating capacity of 30 to 50 passengers. Canada's Bombardier Aerospace and Brazil's Embraer are the leading manufacturers. Compared with mainline jet aircraft, the early regional jet models offered lower trip costs, but higher cost per available seat mile (CASM) than the mainline jets they replaced. Even with its higher seat mile costs, however, the RJ was very attractive in many smaller markets. By offering higher frequency without adding capacity, the RJ was suited to the needs of the business traveler willing to pay higher fares for convenient, frequent service. Of course, seats that would otherwise go unsold are offered at discounted fares.

As the regional airline industry grew and matured, larger aircraft began replacing the first generation of regional jets. Figure 4.6 shows two generations, the 50 seat Embraer 145 and the second generation, 90-seat Embraer 195 introduced in 2004. With much more favorable economics than the first generation, the newer Embraer aircraft have made their way into mainline operations as well as upgrading regional airline fleets.

Canada's Bombardier offers competing models and is developing a new C Series aircraft with a capacity of 100 to 149 seats. These newest aircraft will compete with Embraer's upgraded models and new entrants from China and Japan. These new and upgraded aircraft have little in common with the earlier regional jets which were distinct from Airbus's and Boeing's smallest mainline aircraft. Instead, the new models will compete with the Airbus 320 and Boeing 737 series.

Regional airlines play a surprisingly large role in the air transportation system, one belied by the terms regional airline and regional jet. SkyWest Airlines route system operated under contract for its partners is displayed in Figure 4.7. This system is not regional but rather spans the Continental United States and extends into Canada, Mexico and Caribbean. SkyWest also operates extensive service for Alaska, American, Delta, and United Airlines. In 2013, the U.S. regional airlines operated 12,000 flights per day or 52% of the nation's passenger flights and

Figure 4.6 Embraer 145 and 195.

carried about 25% of all domestic passengers.[2] More than 400 U.S. communities rely exclusively on regional airline service.

Although few airline passengers would recognize SkyWest as a major airline, it's actually one of the largest in the world operating a fleet of 339 aircraft, providing service to 193 cities, and employing 10,100 (SkyWest, n.d.). SkyWest's partnerships with Alaska, American, Delta, and United Airlines are typical of the role regional airlines play in the U.S. and Canadian airline industry.

Regional airlines fill several roles for their network partners. First, regional jets replaced larger, older, and less efficient mainline jets retired from major carrier fleets. As the legacy carriers targeted on international market development in recent years, widebody jets previously in domestic service were switched to international routes. Regional airlines filled the domestic void with regional jets. Using SkyWest's partnership with United as an example, SkyWest flights support United's domestic hubs in San Francisco, Denver, Houston, and Chicago. Regional jets have been employed to expand the network on long, thin routes. Note, for example, routes from Chicago to the Canadian cities of Edmonton

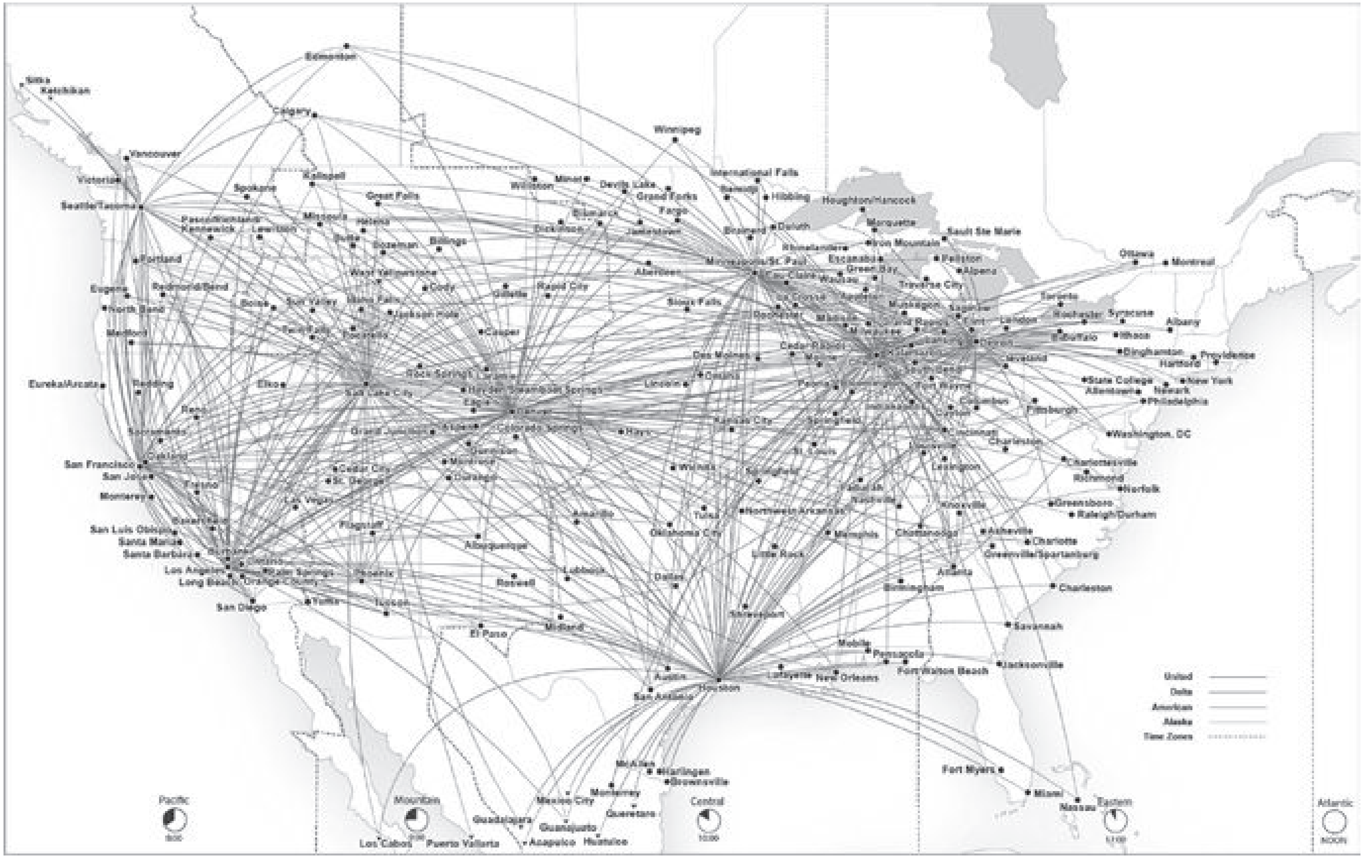

Figure 4.7 SkyWest Route System as of June, 2016. Courtesy of SkyWest Airlines.

and Calgary. Many of the routes shown on the SkyWest route map are not flown exclusively by SkyWest. Rather, United may fly some routes during peak demand with mainline aircraft and with SkyWest operating flights at lower demand periods. This allows United to offer high frequency without significantly increasing capacity which would drive lower yields (an increase in supply results in lower prices if all other factors are unchanged).

With the introduction of regional jets, industry analysts anticipated they would be used in point-to-point service bypassing major hub airports. But, an inspection of Figure 4.7 shows that this role has gone mostly unfilled. One exception is the use in high-density shuttle markets in the Northeast corridor and in California in which the regional jet predominates.

Turboprop aircraft, the early backbone of regional airline fleets, have mostly been replaced by regional jets but have seen a recent, although modest, resurgence. The turboprop has better fuel efficiency and operating economics over segments under about 500 miles. Alaska Airlines' wholly owned regional subsidiary Horizon Air is retiring its regional jets in favor of Bombardier Q400 turboprops. Similarly, the Canadian carrier WestJet launched its wholly-owned regional subsidiary Encore with the Q400.

4.3.2 Regional Airlines Worldwide

Regional airlines first developed a substantial presence in the United States, but they now occupy an important place in the industry elsewhere in the world. The European Regions Airline Association, the representative of Europe's regional airlines, lists more than 50 airline members (ERA, 2015.). There are structural differences between the regional airlines in the United States and those in Europe and Asia. U.S. network airlines partner with several owned and independent regional airlines whereas elsewhere regional airlines typically feed traffic only to their parent company. Lufthansa Cityline, for example, operates solely to support Lufthansa and Australia's Sunstate Airlines serves only Qantas (O'Connell, 2011).

4.3.3 Upheaval

The first decade of the twenty-first century was the boom years for U.S. regional carriers. Contracts paid the regional airline a fixed fee for each flight with the network carrier assuming the risk of varying revenues and for most costs including fuel. These *fee for departure* arrangements were so favorable that regional airlines were often more profitable than their network partners. But regional airlines have recently fallen victim to the wave of the bankruptcies, consolidations, and restructuring of U.S. legacy carriers that began early in the new century. Several factors have led to a regional airline upheaval:

- The small capacity of the earlier regional jets was less than optimal for economy, but a result of *scope clauses* in collective bargaining agreements between network carriers and their pilot unions. By limiting the capacity and number of aircraft that regional airlines could operate on behalf of their larger airline partners, major airline pilots sought to protect their work. Consequently, the first regional jets were built to accommodate these labor agreement restrictions but sacrificed economic efficiencies of larger aircraft, especially fuel economy. During restructuring through bankruptcy, legacy carriers won contractual concessions allowing outsourcing to larger aircraft.

- Restructuring has increased the efficiency of legacy carrier operations reducing the cost advantage of regional airlines.
- Rising fuel prices have rendered the first-generation regional jets uneconomic in many markets which were previously profitable. For example, a Bombardier 50-seat CRJ-200 takes 19 gallons of fuel to fly each passenger 500 miles whereas a larger current generation mainline jet would use just 7.5 gallons per passenger over the same distance.
- As these aircraft reached the age at which major overhauls are needed, most have been retired.
- With the merger of US Airways and American Airlines, the number of surviving legacy carriers is reduced to three. A new breed of airline executives has focused on profitability rather than market share. Unprofitable routes have been dropped, most to smaller destinations served by regional airlines. On other routes, consolidation reduced competition so that larger aircraft can be substituted for the smallest regional jets.
- Finally, network carriers forced their regional partners to bear more market risk under new *pro-rate agreements* where the regional carrier receives a portion of the ticket revenue but assumes the full cost of operating the aircraft (O'Connell, 2011).

The net result has been a series of failures, bankruptcies, and mergers within the regional airline industry that mirror those of the legacy carriers. Delta Air Lines shuttered its 35-year-old Comair subsidiary in 2013 while simultaneously rescuing Pinnacle Airlines, itself a product of several mergers, from bankruptcy. Delta plans to reduce the number of 50-seat regional jets, which peaked at 500 in 2008, from 350 in 2013 to 125 or less in the next several years, but will increase the number of larger second generation regional jets. With the acquisition of 88 Boeing 717s from Southwest, it will also bring previously outsourced routes back to its mainline operation.

Mesa Air Group, a leading force in the growth of 50-seat jets, was forced into bankruptcy from which it emerged as a shadow of its former self with just a handful of contracts. More recently, Republic Airlines entered bankruptcy in early 2016. Earlier missteps, the ill-fated acquisition of Midwest and Frontier Airlines, contributed to its descent into bankruptcy. Republic blamed a pilot shortage for its inability to fulfill partnership agreements with network carriers. Similarly, Continental Airlines sold its Express Jet subsidiary to SkyWest. American Airlines has its Envoy Airlines group up for sale.

Many small communities fear the loss of all air service as the restructuring of the regional airline industry continues. Well known industry analysis Michael Boyd predicts that "By 2018, about 100 fewer airports will be served, but that doesn't mean 100 communities won't have air service, you have to drive a little farther to get access to and from the rest of the world, but in most cases, it's not onerous" (quoted in Jones, 2012).

4.4 Low-Cost Carriers

Arguably the most important driver reshaping the global airline industry over the last 30 years is the emergence and rapid growth of the low-cost airlines (LCC). From a mix of plan and circumstance, the LCC business model was developed by Southwest Airlines. In 2000, only the United States and Europe had a sizable LCC presence, but by the end of the decade, LCCs were operating in South America, the Middle East, India, Asia, and Australia. Today, new LCCs are sprouting quickly, especially in Asia, but the attrition rate is also high.

Although the total number of LCCs will vary by the criteria used to classify airlines, one listing includes more than 110 worldwide (Wikipedia, 2015).

With lower costs than comprehensive network carriers, LCCs have been able to profit at lower prices. Traditional carriers have lost market share but low prices have also stimulated passenger demand for air travel resulting in the rapid growth of LCCs. As Figure 4.8 shows, LCCs have captured more than 50% market share in Southeast Asia with Asia, Europe, and Latin American market shares now exceeding those of North America.

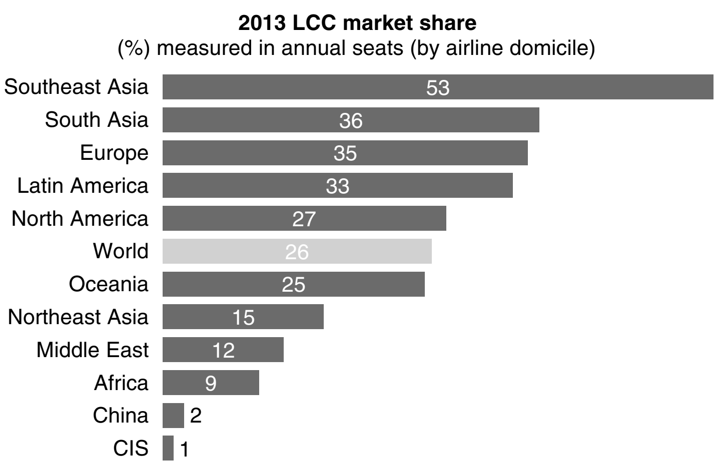

Figure 4.8 Growth of Low-Cost Carriers.

Sources: Boeing, 2015.

4.4.1 Business Model

The LCC business model stands at the other end of the continuum from the comprehensive network carrier. As developed and perfected by Southwest and copied by many other airlines, the archetypal model offers a simple product supported by relatively simple operations. The model includes the following features (Doganis, 2006):

- Fares are lower than traditional airlines and usually one-way, non-refundable, transparent, and simple. Prices may increase with approaching departure date, but usually, only a single fare is available at any given time. Ticketing is point-to-point without connections to other flights.
- There is no interlining, code-sharing or alliances with other airlines.
- Loyalty programs, if any, are simple and not shared with other carriers.
- Distribution is direct via the airline's website avoiding travel agents and global distribution systems.
- Aircraft are configured in single-class with high-density seating.
- Seating is open; passengers board and take any available seat.
- Minimal in-flight service consists of snacks and drinks available for purchase.
- Routes are relatively short averaging 400 nautical miles, often to secondary and uncongested airports. Flights operate on a point-to-point route structure. Flight frequencies are high in dense markets but the model can also support low frequency.
- Aircraft and other asset utilization are high with aircraft utilization exceeding 12 hours per day. Flight schedule extends beyond peak demand hours with some flights operating at inconvenient times. Airport turn-times are short, usually around 25 minutes.
- A single fleet type, most often either the Boeing 737 or Airbus 320 series aircraft, reduces training and maintenance costs.
- Personnel may be well paid, enjoy profit sharing and bonuses, but have few restrictive work rules and are highly productive.

Airlines incorporating all aspects of this model and with a continuing focus on cost control can achieve costs approaching half of comprehensive network carriers. Several other factors have also aided the rapid growth of LCCs. The emergence of Internet distribution channels and airline websites has greatly improved the ability of passengers to find and compare airline schedules and fares (fare transparency). Especially since the recession of 2001, a substantial portion of business travelers has been willing to seek and use LCCs for business travel. Finally, LCCs have grown to a sufficient mass to provide an alternative to network carriers in nearly all major domestic markets in the United States, Europe, and Asia.

4.4.2 Ancillary Revenues

À la carte pricing or unbundling was pioneered by LCCs but the practice quickly spread to most airlines. Checked baggage fees were the first to be implemented followed by fees for nearly every other imaginable product feature. In 2014, ancillary fees for the worldwide airline industry were estimated at $38.1 billion, up some 1500% since 2007 (IdeaWorksCompany, 2015). Table 4.1 lists ancillary fees for Spirit Airlines, the most aggressive and successful airline in pursuing ancillary revenues.

Because of their size, the CNCs earned the highest ancillary revenues in 2014 with United Airlines topping the list at $5.9 billion. As a percentage of total revenue, however, all the top 10 airlines were LCCs. Spirit Airlines lead this group with 38.7% of its total revenues garnered from additional fees (IdeaWorksCompany, 2015).

Ancillary revenues have become a critical part of the business plan of LCCs and make substantial contributions to profits. Spirit Airlines argues that passengers should only have to pay for product features they use and value; thus, ancillary fees provide passengers with options and variety they value. Less obvious is the effect of these fees in reducing costs. If beverages, for example, are provided at no additional cost, most passengers will gladly accept the offer. When faced with a charge, however, most decline. The airline reaps substantial savings. Similarly, fees for checked baggage reduce the amount of bags that passengers bring on their trips. Spirit's fee for carry-on baggage resulted from an unintended consequence of its checked baggage fees. To avoid checking bags, passengers resorted to carrying more bags aboard. With high-density seating, overhead storage space for carry-ons was inadequate so that carry-on bags were often moved to the belly cargo space near scheduled departure time. Departure delays increased. Spirit solved this problem by charging more for carry-ons than for checked bags.

Table 4.1 Spirit Airlines Ancillary Fees

Product Feature	*Fee*
First checked bag	$21 to $100 depending on when the payment is made. $100 is applicable to a bag carried to the gate without prior arrangement
Additional bags	$31 to $100
Overweight bags	$25 to $150 additional
Carry-on bag	$26 to $100
Reservation center booking	$15
Passenger usage charge (applies to all bookings)	$8.99 to $17.99 each way
Printing boarding pass	$10
Assigned seats	$1 to $50
Larger seats	$12 to $199
Snacks	$1 to $10
Drinks	$1 to $15
Pets in cabin	$110 per pet container each way
Unaccompanied minor child	$100 each way
Insurance	$14 to $21

Source: Spirit Airlines, 2015.

Airlines also boost ancillary revenues by selling third party products, especially rental cars and hotel rooms and packaged tours. Customers find that booking these other travel needs at the same time as their air travel directly from the airline website is convenient and efficient. The airline, of course, earns a commission on each sale.

4.4.3 LCC Examples

Despite the rapid growth and financial success of LCCs, only a few of the airlines typically classified as LCCs incorporate all or most of the elements of the business model. One analysis of the top 20 European LCCs found that only two, Ryanair and Wizz Air, closely adhered to the model (Klophaus, Conrady, & Fichert, 2012). Ryanair and AirAsia are two examples of airlines incorporating nearly all elements of the LCC model.

Ryanair

Though not as celebrated and certainly not as admired as Southwest Airlines, the first low-cost carrier, Europe's Ryanair is probably the best example of an airline dedicated to the low-cost carrier business model. Ryanair is the world's second largest LCC behind Southwest measured by available seat miles (The Airline Monitor, 2014). It modestly describes itself as, "Ryanair is Europe's favourite airline, operating more than 1,600 daily flights from 72 bases, connecting 189 destinations in 30 countries and operating a fleet of more than 300 new Boeing 737–800 aircraft". (Ryanair, 2013).

After struggling financially in its first several years of operation, Ryanair adopted Southwest's business model in 1990. Today, it operates a strictly point-to-point route system serving mostly secondary airports. There are no connections to other Ryanair flights or interlining agreements with other airlines. Airport turn-times average 25 minutes. Distribution and sales are via its website; there is an additional charge for using any of its airport offices for booking, check-in, or printing boarding passes. Tickets are non-refundable. Ryanair operates a single aircraft type and model, the Boeing 737–800, configured in coach class, high-density seating for 189 passengers (Barrett, 2011).

Ryanair claims that its focus on efficiency and low cost has resulted in impressive productivity. It transports 9,738 passengers annually per staff member versus only 1,000 passengers per employee for British Airways and cites unit costs 13% less than Spirit Airlines, the U.S. low-cost leader.

Air Asia Group

Low-cost carriers made a later appearance in Asia but, like their predecessors in the United States and Europe, have grown rapidly. Of the more than 50 Asian

LCCs, India, Japan, Korea, and Thailand each is home to five or more (Wikipedia, 2015). The AirAsia Group is a good example of the Asian LCCs.

From an airline with two aircraft and six routes in early 2002, AirAsia has grown to the largest Asian low-cost airline serving 65 destinations in 18 countries. With a fleet of 172 Airbus 320s and an equally sized order book, AirAsia employs a staff of 8,000. AirAsia is committed to the LCC business model's key components that it lists as high aircraft utilization, no frills, streamline operations, basic amenities, point-to-point network and lean distribution systems (AirAsia, 2013). Unlike the United States and Europe which are large, single aviation markets, the Asian market is splintered by many countries, each with their own economic restrictions on airline operations and foreign airline ownership. To expand beyond Malaysia in the face of these restrictions, AirAsia established associated airlines and across the region: AirAsia Behad, AirAsia Indonesia, Thai AirAsia, Philippines' AirAsia, AirAsia India, and AirAsia Zest. Then there are several AirAsia X brands, the long-haul LCCs addressed in the next section. Local partners in these associated airlines do not always share a commitment to the LCC model. In 2013, AirAsia Japan was dropped because of a disagreement over business philosophy with joint venture partner All Nippon Airways.

4.4.4 Long-Haul LCCs

The LCC model was designed for short-haul flights and is not well suited to long-haul flights as several of the features of the model that yield cost savings on shorter flights of under three hours are less effective in long-distance flights. High aircraft utilization is easier to achieve on long segments as the aircraft are airborne for several hours between stops, although longer airport turn-times are needed to service the larger aircraft operated on long segments. Long-haul flights usually require passenger feed from a hub-and-spoke system to provide sufficient demand to operate profitably. Secondary airports may not provide the needed feed traffic or have the facilities to support long-haul flights. Passengers are willing to sacrifice in-flight services and amenities on shorter flights but are more demanding as flight time increases. Finally, many flight operations costs where LCCs enjoy an advantage over CNCs including crew, ground service, and distribution are a smaller portion of total operating costs on longer flights. Fuel costs, for which LCCs have no advantage, become proportionately greater. These factors suggest that the prospects for long-haul LCCs are not promising; indeed, two early attempts at extending the model to long-haul operations, Hong Kong's Oasis and Macau's Viva Macau, failed. More recently, however, AirAsiaX and Qantas subsidiary Jetstar have enjoyed greater success.

AirAsiaX was established in 2007 as an affiliate carrier of the AirAsia group to focus on long-haul segments. As of 2014, it served 14 destinations in Asia, Australia, and the Middle East with a fleet of 26 Airbus A330-300 aircraft. Consistent with the LCC model, AirAsiaX operates a single fleet type, utilizes low-cost airports, and doesn't code-share with other carriers. On the other hand, aircraft are configured with a small premium cabin and in-flight services include meals. It shares distribution and ticketing with AirAsia and benefits from AirAsia feed traffic. Over half of AirAsiaX's passengers connect ("Long-haul, low-cost," 2015).

JetStar, which operates independently of its parent, has been successful while parent Qantas has struggled. It flies mostly to tourist destinations but also substitutes for Quantas on routes where lower cost is essential to profitability. Qantas is pushing the Jetstar brand across Asia through Jetstar Asia based in Singapore, Jetstar Pacific in Vietnam, and Jetstar Japan based in Narita. Another off-shoot planned for Hong Kong suffered a sudden death in 2015 when the Hong Kong government refused to grant it an air operator's certificate.

The most recent entry into the long-haul LCC niche is Norwegian who began transatlantic operations with the Boeing 787 Dreamliner between the United States and Europe in 2013. Norwegian has aggressive growth plans to expand to Asia and the Middle East. The airline raised the ire of U.S. airlines and the U.S. Airline Pilots Association by obtaining an air operator's certificate in Ireland from which it benefits from the Open Skies agreement between the United States and the European Union. Singapore Airlines' wholly owned, medium to long-haul, LCC subsidiary Scoot announced in 2015 that it would begin Singapore-London service. This seems a curious decision given that both Oasis and later AirAsiaX were unsuccessful with London routes and that parent Singapore Airlines serves London from Singapore (Leo, 2015).

Whether low-cost, long-haul can be integrated with the traditional short-haul LCC model and extend beyond Asia is an open question. The number of potentially profitable, long-haul, point-to-point markets is limited, so traffic feed is essential to long-haul LCC expansion. WestJet has begun limited service between Canada and Europe, but WestJet is moving steadily away from its LCC roots towards a full-service, network carrier. Brazil's Azul operates between several Brazilian cities and Florida using Airbus 330 aircraft, but JetBlue's long-rumored long-haul service has not begun. Similarly, Ryanair CEO Michael O'Leary has often stated his intent to serve North America, but has yet to announce a start of service.

4.4.5 LCC within Comprehensive Network Carriers

With LCCs grabbing market share and depressing ticket prices in the United States, Europe, and increasingly elsewhere in the world, it's not surprising that CNCs have attempted to compete by establishing LCC subsidiaries. The idea has been tried many times in the United States but has never succeeded. The most recent attempt was United's Ted—the last letters of United, or, as critics often claimed, the end of United. Ted began flying out of United's Denver hub in 2004 to compete with the LCC Frontier Airlines which was also headquartered in Denver. Ted was quietly withdrawn from service in 2009. This was United's second attempt at an airline within an airline. Its Shuttle by United operated from

1994 until 2001. Similarly, Delta tried twice with Delta Express and Song which failed as did Continental with Lite and US Airways' Metrojet.

Not to be deterred by the U.S. examples, however, LCC subsidiaries of CNCs have proliferated elsewhere. Air Canada tried Zip and Tango in an attempt to compete with Canadian LCC WestJet. Both failed. Perhaps believing in the 3rd time charm, Air Canada established a subsidiary named Rouge in 2013. In Europe, International Airlines Group, the holding company for British Airways and Iberia, established Iberia Express and purchased Vueling to compete in Europe where Iberia's high costs are uncompetitive. Vueling's cost structure is some 40% below Iberia's. Lufthansa has both Eurowings and Germanwings and Air France/KLM operates Transavia. The three European airline groups are expanding their LCC subsidiaries in an effort to compete with pan-European LCCs Ryanair and easyJet. A host of Asian carriers establishing LCC offshoots includes Garuda's Citilink; Philippine Airlines' Airphil Express; Korean Air's Jin Air; Asiana Airlines' Air Busan; Thai Airways' Nok Air; All Nippon's Peach, and Malaysia Airlines' Firefly (O'Connell, 2011). In Japan, both Japan Airlines and All Nippon Airways have new LCC subsidiaries. ANA entered into a joint venture with AirAsia which failed in 2013. AirAsia Japan was rebranded Vanilla Air and is now a wholly-owned subsidiary of ANA. JAL, for its part, is a member of a joint venture with Qantas and Mitsubishi in Jetstar Japan.

Singapore Airlines is notable in operating four subsidiaries intended to meet the needs of different passenger segments: Singapore Airlines for long-haul premium service, Silk Air for medium-haul premium service, Scoot for long-haul budget service; and Tiger (partly owned) for budget service in medium-haul markets.

In many cases, the LCC subsidiary is set-up to circumvent the high labor costs and restrictive work rules that burden the parent; nevertheless, the business models of CNC and LCCs are so different that an LCC subsidiary under a central management may not maintain the focus on cost control essential for LCC success. If subsidiaries are not fully separated, the CNC parent risks confusing its brand. Labor unions, fearing loss of jobs and wage competition, often fiercely resist establishing or expanding an LCC subsidiary. The Air France/KLM pilots struck in 2014 in opposition to the management's plan to expand Transavia. In a telling comment when announcing to the decision to shut down the AirAsia Japan joint venture with ANA, AirAsia CEO Tony Fernandez mused, "I think what's very clear is that full-service airlines cannot run low-cost-carrier airlines." (quoted in Hookwy & Bellman, 2013).

4.5 Hybrid Airlines

The distinction between comprehensive network airlines at one end of a spectrum and low-cost carriers at the other is useful for elucidation but simplistic. The dearth of airlines fully embracing the LCC business model suggests that many airlines are positioned elsewhere along a continuum of product offerings. Faced with intense competition and low profit margins, airlines frequently modify their product in an attempt to exploit perceived gaps in the market and secure sustainable profits. Consequently, the sharp line that once divided network carriers from low-cost carriers has blurred as CNCs shed amenities and embrace unbundled products and à la carte pricing while LCCs have increased connectivity and upgraded in-flight service. Many carriers that can't readily be classified as either CNC or LCC have been termed *hybrid* carriers, a name that is unimaginative but descriptive.

Hybrids occupy a large range on the spectrum of product offerings and are, therefore, difficult to define with a list of business model characteristics. Hybrids do not have the extensive international route networks of comprehensive network carriers but do typically have marketing arrangements with other airlines including code sharing. The in-flight product is higher quality than the bare-bones of LCCs including features such as greater legroom, in-flight entertainment, higher quality meal and beverage service and, in some instances, a business or first class cabin. There are many hybrid airlines to choose as examples, but short profiles of two very similar U.S. airlines and one German carrier are illustrative.

4.5.1 Alaska, JetBlue Airways, and Air Berlin

Alaska Airlines has more than an 80-year history whereas JetBlue is a relative newcomer having begun operations in 1999, but the two carriers share many similarities. Their route structures are nearly mirror images. Alaska's routes extend from Alaska down the U.S. West Coast and into Mexico via hubs in Seattle, Portland, and Los Angeles. It also serves Hawaii, some cities in Canada and the U.S. Midwest and East Coast. JetBlue's route structure is concentrated on the East Coast with extensions to major western cities, into the Caribbean and the northern reaches of South America. Both carriers extend relatively limited networks with many domestic and foreign codeshare partners. The carriers have not joined a global alliance.

Alaska and JetBlue target higher-end leisure and cost-conscious business travelers (Centre for Aviation, 2013b) and serve a mix of destinations attractive to each segment. Both use traditional GDS-based distribution as well as direct distribution through call centers and websites. Each offers a frequent flier loyalty program. Both have a quality product that rivals the best of the U.S. CNCs. JetBlue provides free Direct TV in all seats, a product innovation it introduced first.

Alaska standardized its fleet with the Boeing 737 but operates several models including some older generation 400 series. All aircraft are configured in two cabins with first and economy classes. JetBlue's fleet, on the other hand, consists of two fleet types: the Embraer 190 and Airbus 320 and 321 models. Aircraft were all single-class until a premium business class was introduced in 2014 on a sub-fleet of A-321s dedicated to transcontinental service. Seat room is better than

LCCs where high seat density confers a cost advantage but decreases passenger legroom. Spirit Airlines, for example, configures its A-320 aircraft with 178 non-reclining seats versus 150 for the identical aircraft at JetBlue.

Though both airlines are competitive on price, service quality is equally, if not more, important. Both have won many passenger service awards.

Alaska and JetBlue are of similar size with 2014 annual revenues between five and six billion dollars. Alaska has a record of enviable profits but JetBlue's record, consistent with the greater industry, is less impressive.

In 2013, JetBlue's then CEO Jeff Barger explained the hybrid model by stating that JetBlue has no desire to mimic either the ultra-low-cost model of Spirit Airlines or that of network carriers. During a 2013 earnings call, Barger assured analysts, "There is room for more than two models on the industry landscape and we are proving that" (JetBlue, 2013).

Germany's second largest airline after Lufthansa, Air Berlin, provides a puzzling and less-successful comparison to Alaska and JetBlue. In a telling comment describing his hybrid carrier, CEO Stefan Pichler explained that Air Berlin is "not a low-cost carrier, and we are not a network carrier. We are a multi-hub airline" (quoted in Gubisch, 2015, p. 12). Pichler, the 4th CEO in as many years, then disparaged the low-cost model opining that winning customers with low prices was a short-term strategy that generated no customer loyalty as passengers eagerly jump to any other airline offering a lower price.

Despite its parochial name, Air Berlin operates both short and long-haul flights, mostly within Europe, but with limited service to Asia-Pacific, the Middle East, North Africa, and North and Central America. Its fleet of 149 aircraft comprises five different types from four manufacturers ranging from Airbus 330s to Bombardier Q-400 turbo-props. Unlike the Alaska and JetBlue, Air Berlin is a member of the oneworld global alliance.

With what industry magazine *Airline Business* bluntly called an "incoherent business model," it's not surprising that the airline has been loss making for most of the last ten years leading to several unsuccessful turnaround strategies (Gubisch, 2015, p. 12). In 2011, Etihad Airways added Air Berlin to its stable of equity partners by taking a 30% stake, a step that promises a more successful future.

As these examples make clear, the hybrid airlines have no distinguishing business model but are better categorized by what they are not: comprehensive network airlines or low-cost carriers.

4.6 Focus Carriers and Tailored Products

The focus strategy is the third of Porter's generic corporate strategies. The airline industry offers several examples of carriers whose product is designed to meet the needs of a small segment of passengers or niche market. In addition to their mass market product offering, CNCs often tailor a product to serve a niche market.

4.6.1 All Inclusive Charter Airlines

Charter airlines offered low-fare air travel long before the emergence of today's low-cost carriers. In the U.S. regulated era, supplemental carriers competed with scheduled carriers for leisure travel, primarily to vacation destinations in Florida and to Las Vegas. The supplemental carriers did not survive under deregulation, but charter airlines continue to have a strong presence in Europe where they dominate holiday routes between Northern Europe and the Mediterranean.

European charter airlines grew in the 1960s and 1970s from their ability to avoid restrictive Air Service Agreements (also known as bilateral agreements) between countries that limited capacity and set fares for scheduled carriers. European tour operators contracted with charter airlines to provide the air portion of all-inclusive holiday packages. Charter air travel rates were 40% to 70% less than competing service on scheduled airlines. With this competitive advantage, tour operators often provided the only air service between the United Kingdom and Germany to the Greek Islands or Turkish resorts.

More recently, tour operators have acquired many of the formerly independent charter carriers to form large all-inclusive tour companies. Thomas Cook is one example. The company has a long history dating to the mid-1880s when cabinet-maker Cook began organizing rail tours in the United Kingdom. Through a series of acquisitions and mergers, the Thomas Cook Group grew to the second largest European travel company behind TUI Travel. It operates nearly 100 aircraft and serves over 19 million customers annually. Its customer brands include Thomas Cook, Sunset, Airtours, Neckermann, Condor, Ving, Direct Holidays and My Sunquest, among others.

4.6.2 All-Business-Class Service

An all-business-class airline seems an obvious niche that could be profitably exploited. The concept is compelling: offer a high-quality business product in major business markets at a fraction of the fare charged by the major incumbents and attempt to capture or create enough traffic to fill a low-density cabin (Boyd, 2007). Not surprisingly, it has been tried in the United States but with only limited success. Of the several examples, the small U.S. carriers Midway Metrolink and Midwest Express are notable. Both configured DC-9 aircraft with 2-by-2 seating in all business class. Midway dropped the concept after a few years but Midwest Airlines was more successful and continued until it encountered serious financial problems during the 2001 recession. With a lower cost structure than competing CNCs, the airlines could underprice business class service in major business markets. Later attempts at international all-business-class service from New York to London by Eos Airlines, MAXjet and Silverjet also failed.

The all-business-class model suffers from several weaknesses. First, business travel fluctuates by day of the week. In order to fill otherwise empty seats on weekends and mid-week, the airline resorts to discount fares which are not profitable with low-density seating. Second, there are only a few markets with sufficient business demand to support all-business-class service, and these markets are frequently best served by airports with slot restrictions. London's Heathrow is the prime example. With only a few potential markets, the all-business-class airline cannot expand to reach an economic fleet size. Then, many business travelers prefer to travel on one or two major airlines in order to maximize frequent flier benefits. The all-business-class airlines served too few markets for the frequent flier programs to be attractive for most business travelers. Third, the success of comprehensive network carriers depends on attracting high fare business passengers. If the all-business-class airline is successful in capturing any significant portion of this segment, larger rivals can retaliate with increased service and lower prices, exactly what American Airlines did when faced with competition from Eos in the New York–London market.

The history of failure has not deterred others from trying all premium service. Two all-business-class airlines operate between Paris and New York. British Airways subsidiary Open Skies operates premium class service between Paris Orly and New York area Newark and Kennedy airports while independent La Compagnie flies from Paris Charles de Gaulle and Newark. Both use Boeing 757 aircraft.

4.6.3 Tailored Products

In contrast to establishing an all-business-class airline, CNCs and some hybrid carriers offer a highly tailored product in a few city-pairs. The transcontinental markets between New York and San Francisco and New York and Los Angeles are hotly contested because many passengers are top level executives or celebrities who want a premium product and are willing to pay substantial premiums. Fares in these markets routinely exceed $4,000 round-trip. Frequent non-stop service is provided by the three major network carriers—American, Delta, and United—plus hybrids JetBlue and Virgin America. United was the first to shake-up this market when it replaced B-767s with the smaller, narrow-body, B-757s. It removed 70 seats from these aircraft to incorporate three classes of service including a high-end business class. Although United lost market share, yields increased substantially. In 2014, American introduced new A-321 aircraft dedicated to these markets configured with only 102 seats. JetBlue joined the battle by deploying its own dedicated fleet of A-321s with a business class section featuring lie-flat beds and a few private suites. The two class cabin is a first for JetBlue, but needed to match United and Delta which also have flat-bed business class on the routes (McCartney, 2013).

A couple of tailored products are notable for long-segment lengths. From 2004 until 2013, Singapore Airlines operated an Airbus A-340 equipped with just 100 seats in all business class from Singapore to New York Newark Liberty Airport, the world's longest airline route. The Chinese carrier Hainan Airlines operated Airbus A-330 aircraft between Hong Kong and London with 34 lie-flat seats and 82 reclining business class seats, but it discontinued the service (Centre for Aviation, 2013a).

In addition to its Open Skies subsidiary, British Airways provides another example of a highly tailored product. Despite the failure of Eos and Silverjet in the New York–London market, or perhaps because of it, British Airways offers its "Club World London City" service with Airbus 319 aircraft configured with just 32 spacious, lie-flat bed seats.

Qatar Airways has deployed a 40-seat Airbus A319 between Doha and London Heathrow. SAS has a similar offering between Stavanger and Houston using a Boeing 737–700, although the service is contracted to another airline. These tailored products likely have a better opportunity for success being part of a larger airline with established brand name, awards program, and some critical mass.

4.7 Cargo Airlines

Most cargo airlines also follow a focus strategy; however, the economics of air freight are quite different from that of passenger transport. As with passenger airlines, analysis of cargo carrier business models begins by exploring the wants and needs of cargo shippers.

Cargo or air freight is often time sensitive, but, unlike passengers, shippers are indifferent to routing as long as delivery is on time. Depending on demand, the aircraft routing between a cargo origin and destination may be changed frequently with intermediate stops added or deleted. In contrast to passengers who almost always travel round trip, freight transport is one way resulting in uneven directional demand. Demand from Asia, especially China, to the United States and Europe is typically much higher than in the opposite direction. This imbalance leads to low prices and well under-capacity loads for aircraft returning to Asia. Finally, freight varies greatly in size, weight, and handling requirements. Animals are often shipped by air and obviously require careful handling. Hazardous goods (radioactive, corrosive, flammable, infectious, etc.) require special handling. Most hazardous material air transport is restricted to freighter aircraft. These shipments are labeled "cargo aircraft only" or CAO.

Air shipment of cargo is several times more expensive than via ground or sea transport, so there must be some compelling reason for a shipper to choose air transport. Time is one factor. Transport of goods from Asia to the United States via ship, for example, takes several weeks versus 24 hours or so via air. Perishable goods such as vegetables and flowers must be shipped by air to avoid spoilage en route. Demand is often seasonal. Likewise, natural disasters and political crises create an immediate demand for goods such as medical supplies and emergency shelter.

Routine air shipment can be economical for high-value items by weight. Computer parts, for example, are often air shipped to low wage countries for assembly with finished goods air-shipped back to the United States. Business contracts and other legal documents are other examples. Consumer goods ordered online may be shipped by air.

Inadequate roads and railroads in undeveloped countries may make air transport an expensive but viable alternative to ground shipping. Theft of cargo is another problem that can be mitigated with air shipment (Doganis, 2010).

Three distinct types of air cargo carriers meet shippers' differing needs: combination, integrated, and all cargo carriers.

4.7.1 Combination Carriers

Combination carriers are passenger airlines, mostly CNCs, that also offer freight services with cargo carried in belly holds of passenger aircraft. In addition to belly capacity on passenger aircraft, some European and Asian carriers also operate dedicated freighter aircraft on both scheduled and charter flights; however, the substantial belly-hold capacity of wide-body aircraft flown on many international routes has reduced the need for a separate fleet of cargo aircraft. Most combination carrier freight is managed by freight forwarders who consolidate cargo from many shippers. Cargo typically accounts for 5% to 10% of the flight revenue but varies greatly by airline.

4.7.2 Integrated Carriers

Integrated carriers, also called express carriers, operate worldwide, door-to-door networks, mostly shipping small packages. Packages are transported across a global, multiple hub-and-spoke system with a mixed aircraft fleet ranging from small turboprop aircraft to wide-body jets. For door to door delivery, a much larger fleet of ground delivery vehicles is also required. Delivery time is guaranteed. Sophisticated tracking systems allow the carrier and its customers to see the location of any package in the system in near real-time. The industry giants are FedEx and UPS with DHL having a strong international presence. DHL attempted, but failed, to establish a strong U.S. domestic position.

4.7.3 All-Cargo Airlines

All-cargo airlines operate only freighter aircraft, mostly converted former passenger airline aircraft. The all-cargo airlines are relatively small with a substantial component of their business derived from long-term contracts to CNCs, mainly Asian carriers. This model, similar in some ways to the role of regional airlines in U.S. domestic service, is known by the acronym ACMI which stands for aircraft, crew, maintenance, and insurance. The larger carrier provides all other functions including marketing, scheduling, ground services and, critically, fuel. CNCs find that all-cargo airlines offer a more flexible and cost-effective cargo service than providing the service with its own crew and aircraft. Atlas Airlines and Polar Airlines, actually under the same holding company, are examples of all-cargo airlines.

4.8 Summary

In the new millennium, comprehensive network carriers in all corners of the world find their yields depressed and market share under attack from aggressive low-cost carriers. Faced with high costs and lower prices, CNCs have been forced to reevaluate and modify their product offerings. Short-haul routes have been contracted to regional airlines or LCCs created within an airline. Following the LCC practice of product unbundling, CNCs have resorted to baggage fees, fees for blankets, reduction in food service, and a growing number of other fees for product features previously included in the ticket price. These changes have not been well-received by passengers.

The largest low-cost carriers also face a rapidly changing environment. In the United States and Europe, large underserved and overpriced markets that once presented opportunities for expansion have been filled. There's little low hanging fruit. Expansion is often in markets already served by other airlines competing on low fares. Smaller markets that still command high yields are too thin to serve with point-to-point routes, so connecting traffic is essential to enter these markets. Finally, LCCs are envious of business travelers willing to pay high fares for quality service.

Faced with these market realities, both CNCs and LCCs have adopted many of the product features of the other. Table 4.2 summarizes the evolving products. The result is a fading of the distinction between the comprehensive network carrier and the low-cost carrier with hybrid carriers occupying the middle space. This continuum of product offerings serving a broad range of consumer wants and needs is typical of mature, competitive industries. The automobile industry is an example. There's a car to satisfy nearly any driver's desire.

A look at the world's largest airlines illustrates the geographic and business model scope of the airline industry. Table 4.3 lists the largest 25 airlines ranked by aircraft fleet size. Other measures such as revenue passenger kilometers, enplaned passengers, or total revenue would alter the rankings, but many of the same airlines would remain. The top three are unchanged when measured by operating revenue, revenue passenger kilometers, or enplaned passengers. Two of the rankings are probably a surprise. Southwest is the 4th largest airline in the world, second if measured by passenger enplanements, and the regional carrier SkyWest Airlines is 8th.

The world's three largest airline markets—the United States, Europe, and China—are represented with ten, five, and three airlines respectively in the top 25. These top 25 airlines also illustrate the dispersion of the business models covered in this chapter. Comprehensive network carriers predominate with 14. There are two low-cost carriers, one in the United States and one in Europe; three regional airlines, all in the United States; one hybrid airline; and two integrated cargo carriers.

The airline jargon is often confusing, exacerbated by an inconsistency across airlines. This chapter offers a typology of airline business models, but the terms employed are not universally accepted. Comprehensive network carrier is

Table 4.2 Fading Distinction between CNC and LCC

Low Cost Carrier Attribute	*LCC Product Evolution*	*CNC Product Evolution*
Unit Cost Advantage		Restructuring has narrowed the cost gap
Point-to-Point Routes	Increasing connectivity	Maintains flow traffic advantage
Limited geographical coverage	Establishing code-shares, establishing affiliate airlines	Members of global alliances
Service to secondary airports	Recent expansion has emphasized primary airports, e.g. Spirit Airlines and JetBlue	
High Aircraft Utilization		Depeaking and rolling hubs increase utilization
Direct Distribution	Adding GDS-based distribution	Pushing website booking and sales
No Frills Service	Adding in-flight entertainment, seat room, business class	Unbundling, eliminating food service and other in-flight amenities in coach class, dropping first class
Low, simple fares	Applying revenue management	Eliminating restrictions
Single aircraft type	JetBlue, Allegiant using two or more types	Reducing fleet types

Adapted from Meehan, D. (2006). Aviation industry outlook for 2006

Table 4.3 World's Top 25 Airlines

	Airline	*Model*	*Aircraft*		*Airline*	*Model*	*Aircraft*
1	American Airlines	CNC	965	14	Turkish Airlines	CNC	242
2	Delta Air Lines	CNC	796	15	UPS	ICC	237
3	United Airlines	CNC	706	16	Emirates Airline	CNC	233
4	Southwest Airlines	Hybrid	693	17	Air France	CNC	233
5	FedEx	ICC	609	18	easyJet	LCC	212
6	China Southern Airlines	ICC	487	19	JetBlue Airways	Hybrid	207
7	Express Jet	RA	377	20	ANA	CNC	200
8	SkyWest Airlines	RA	339	21	Envoy Air	RA	191
9	Air China	CNC	328	22	Air Canada	CNC	175
10	China Eastern Airlines	CNC	307	23	TAM	CNC	165
11	Ryanair	LCC	317	24	Japan Airlines	CNC	158
12	Lufthansa Airlines	CNC	274	25	Aeroflot	CNC	157
13	British Airways	CNC	260				

Source: Air Transport World, July 2015. Business models: comprehensive network carrier (CNC), low-cost-carrier (LCC), regional airlines (RA), hybrid, integrated cargo carrier (ICC).

descriptive, but other terms including full-service airline, full-service network carrier, full-fare airline, major airline, and legacy carrier are common. Low-cost carrier is widely used but budget airline, low-fare airline, discounter, no-frills carrier, and the latest, ultra-low-cost carrier, will also be seen. Regional airline is common but not descriptive. Small jet provider and network extender are more descriptive but not in wide use. Hybrid is a recent term that, fortunately, seems almost universal.

The remnants of the old CAB classification system create another potential confusion. The CAB classified airlines by total revenue into three categories: major, national and regional. Regional and major are still in some use, but generally do not directly refer to total revenue.

As we have seen in the previous chapter, an airline must make a strategic choice of network architecture to connect the destinations it chooses to serve. Similarly, it has a wide choice in the product it provides ranging from no-frills, basic air transportation to an augmented product with lavish in-flight and ground amenities. Like most businesses, airlines cannot profitably serve all passenger wants and needs; therefore, an airline identifies those passenger segments it plans to serve and tailors a product for those needs. Michael Porter's popular generic strategies are helpful in conceptualizing an airline's choice of competitive scope. There are many examples of the striking variety of airline services, for example, Ryanair's low-priced, core air transportation with some extra services available, but only at an additional charge, to the unsparing service provided by many international carriers such as Singapore Airlines. Recently, many airlines, led by Air Canada, have packaged their services so that passengers can choose a level of service desired with corresponding prices.

This and the previous chapter address the airline product. Two related topics are covered next: developing a flight schedule and managing daily flight operations.

Notes

1 This explanation of differentiation as applied to the airline industry differs somewhat from Porter's original concept. The strategy as described here is also known as "full-line generalist."
2 Authors' computation based on U.S. Bureau of Transportation Statistics and Regional Airline Annual Report for 2014.

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Review Questions

1 What is the "Marketing Concept" and why do marketers consider it essential in a competitive economy?
2 List some things (product attributes) airline passengers want from their flight.
3 Why can't an airline offer a passenger everything she wants?
4 Define Porter's three strategies. Provide an airline example of each.
5 What are the typical characteristics of a low-cost carrier product such as Ryanair's?
6 How has Southwest traditionally kept its costs low?
7 What is product differentiation, why is it important, how can airline differentiate its product (for example, American Airlines)?
9 Allegiant is a non-traditional U.S. airline. Use the Competitive Dimensions to summarize its competitive strategy. (Allegiant Air at: http://www.allegiantair.com)
10 Explain how the distinction between LCCs and comprehensive network carriers is fading in the U.S. domestic market.
11 How does air freight differ from passenger transportation?
12 List the three types of cargo carriers.

Chapter 5

Flight Schedule Development and Control

An airline's product—the destinations served, the route structure connecting those destinations, and the features included with the core air transportation service—is frequently reviewed and refined. Occasionally airlines undertake a significant overhaul of their product as the U.S. comprehensive network carriers have done in the wake of the financial crises of the first decade of the new millennium. But the airline's flight schedule is under continual revision with major changes typically published twice a year for the winter and summer seasons and more frequent minor changes. Following an overview of the airline planning process, the first section of this chapter addresses the complex task of developing a flight schedule.

Once the flight schedule plan is completed, it falls to the operations managers to operate the schedule on a daily basis. As any frequent air traveler knows, flight schedules are subject to disruption for many reasons. The methods available for tactical flight schedule management are the subject of the second half of this chapter.

5.1 Airline Planning Process

Airline planning encompasses strategic forecasts developed by a small staff to short-range tactical planning involving several departments and many managers. Figure 5.1 is a flow chart of the airline planning process. Strategic plans extend out five or more years. Because of long lead times to acquire new aircraft, development of the fleet plan and new aircraft orders follow directly from the long range plan. Product planning, including partnerships with other airlines ranging from code-sharing to joint ventures, emerges from the airline's strategic vision and perceived growth opportunities. These strategic decisions are made by airline's executive management and, at large airlines, supported by a dedicated planning staff.

At large airlines, preliminary market evaluation begins some years in advance of implementation, but decisions to enter or exit a specific market are usually finalized one to two years out.

Flight schedule development builds on the existing schedule and begins about one year in advance of operation. The final product is the airline's timetable: a listing of all city-pairs served, flight numbers, departure and arrival times, and aircraft type. Printed timetables, whose origins date to the early days of ocean

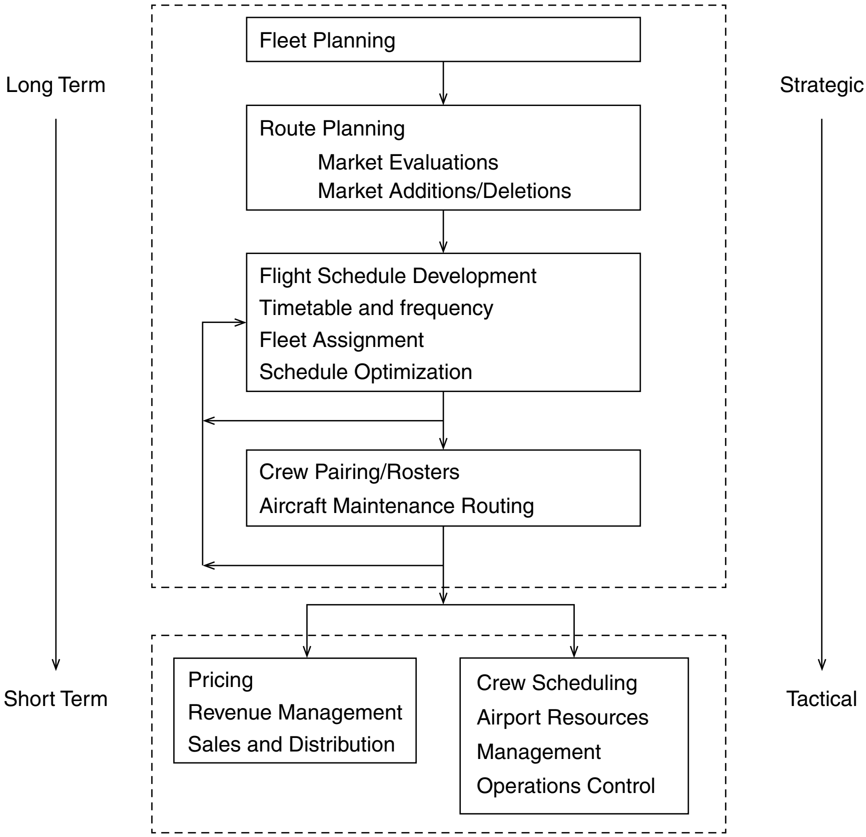


Figure 5.1 Airline Planning Process.

shipping and later to railroads, were once ubiquitous but are now rare. The electronic versions may be found on some airlines' websites.

Once the flight schedule is finalized, the operating departments are charged with its execution. A centralized group of managers and staff coordinate the daily activities of pilots and flight attendants, mechanics, and station personnel during routine flight operations and implement revised plans when the flight schedule is disrupted by weather, mechanical failures, and a host of other unplanned events.

The following sections discuss each step in the airline planning and control process.

5.2 Strategic Planning

5.2.1 Long-Range Plan/Fleet Selection

Long-range planning extending out 5 to as much as 20 years begins with a corporate vision and mission statement. Some airlines target aggressive annual growth of 15% or more while mature airlines subordinate growth to emphasize return on investment and shareholder wealth. SWOT analysis, an acronym for strengths, weaknesses, opportunities and threats, is a common framework for long-range planning. These topics are beyond the scope of this text and left to books on strategic management.

Because of the time required to obtain new aircraft, fleet planning is often contemporaneous with long-range planning. For large airlines, new aircraft orders of several hundred aircraft are common with deliveries spread over 5 to 10 years. New aircraft may be slated for growth, upgrade and replacement of the existing fleet or, more commonly, for both. Fast-growing Emirates Airlines illustrates the close connection between the strategic plan and aircraft acquisition:

> During 2010, in line with the airline's strategic growth plan, Emirates significantly increased its order for new aircraft. Underscoring its incredible growth, the airline is currently the world's largest operator of both the Airbus A380 and Boeing 777. Emirates' current order-book stands at more than 230 aircraft, with a total value of approximately USD 84 billion as of November 2011. In combination with what is already the youngest and one of the most modern fleets in worldwide commercial aviation, this commitment to the future reflects our goal to develop Dubai into a comprehensive, global, long-haul aviation hub.
>
> (Emirates Airlines, n.d.)

5.2.2 Product Planning

The next step in the planning process identifies markets for potential expansion and, less frequently, for deletion. US LCC Spirit Airlines, which had 100 new aircraft on order as of mid-2015, claims to have identified 500 new routes that met its criteria for (a) large markets with more than 200 passengers per day each way, (b) high average fares, and (c) potential to achieve a 14% operating margin (Spirit Airlines, 2015). While targeting expansion, Spirit has not been shy to drop markets that fail to meet its financial expectations. Southwest Airlines offers a somewhat different perspective. Speaking to investors in late 2012, CEO Gary Kelly explained that planned and potential expansion of its service to Mexico, Canada, and the northern tier of South America could support substantial fleet growth. "If you added up all of the opportunities that are represented by that route map (of potential international routes), on a rough base of 700 airplanes there are 200 or 300 airplanes' worth of growth opportunities, all else being equal." Unlike Emirates and Spirit, however, Southwest is a mature carrier that has shifted its focus from growth to return on investment. Kelly went on to explain that further expansion was subject to meeting a 15% return on invested capital (Compart, 2012).

Facilities to support expansion plans also require long lead times. Much of this responsibility falls to airport operators. To support its rapid airline industry growth, China's 12th five-year plan includes building 20 new airports by 2015 (Mitchell, 2014). In contrast to much of the rest of the world, U.S. airlines play a major role in airport terminal design, construction, and finance. For example, Southwest Airlines is fully funding the construction of a new international terminal at Houston's Hobby Airport ("Houston Airport System," n.d.).

The widespread restructuring of U.S. airlines in the first decade of the twenty-first century and later in European carriers should have been part of strategic planning, but circumstances often compel these decisions with much less lead time. Ironically, airlines don't consider bankruptcy as part of a strategic plan, yet it has been the driving force in all U.S. legacy airline restructuring.

As the time horizon shortens to between one and three years, market evaluations become more detailed. Decisions include product upgrades and pricing policies, code sharing agreements and alliance participation, and predicting competitors' behavior. Potential new destinations and routes are evaluated in detail resulting in the selection of new service between 12 and 18 months in advance of the first flight, although, for competitive reasons, public disclosure is usually withheld until much closer to the start of new service. Some existing routes may also be dropped on a somewhat shorter timeline. Chapter 4 covers product choice; partnerships and alliances are the subjects of Chapter 9.

5.3 Flight Schedule Development

The flight schedule is the airline's core product designed to solve the customer's time-space problem. Recalling the Marketing Concept, the flight schedule is designed to meet the customer's need for travel to some distant place at a certain time. The flight schedule, sometimes known as the schedule of services, lists the destinations or routes operated, the flight frequency and times, and type of aircraft assigned to each flight. The schedule development task falls broadly under the marketing discipline, but many airlines have a specialized schedule planning or airline planning department.

Except for new entrant airlines, each new flight schedule is a revision of the previous schedule. Route structure architecture is a long-term commitment, but service in some markets will evolve. A hub-and-spoke carrier, for example, may add point-to-point service in some city-pairs as traffic grows or in response to competitive pressure. A change from tightly-timed connecting complexes to a rolling-hub is a more extensive and complex schedule revision. Passengers, however, appreciate schedule stability, so airlines operate many flights at the same times and with the same flight number for years. Because most airlines accept reservations up to one year before the flight, work on flight schedule revision extends from more than a year out to a few months prior to flight. Booked passengers must be notified of schedule changes implemented after reservations have been made.

Printed hardcopies of the flight schedule or timetables were once the primary means of providing flight information to potential passengers, but the Internet has rendered the printed timetable obsolete. But electronic timetables, though voluminous and cumbersome to use, are available on many airline websites. Figure 5.2 is an excerpt from a 1978 Alitalia timetable showing flights to and from Singapore, Stockholm, Stuttgart, Sydney, Tananarive (Madagascar), Teheran, Tel Aviv, and Tokyo. Reykjavik, Iceland to Denver, Edmonton, and Frankfurt. The timetable shows the origin and destination, days of week on which the flight operates, times and flight number, aircraft type, class of service, and whether non-stop or requiring a connection. The timetable is the final product of the flight schedule development process.

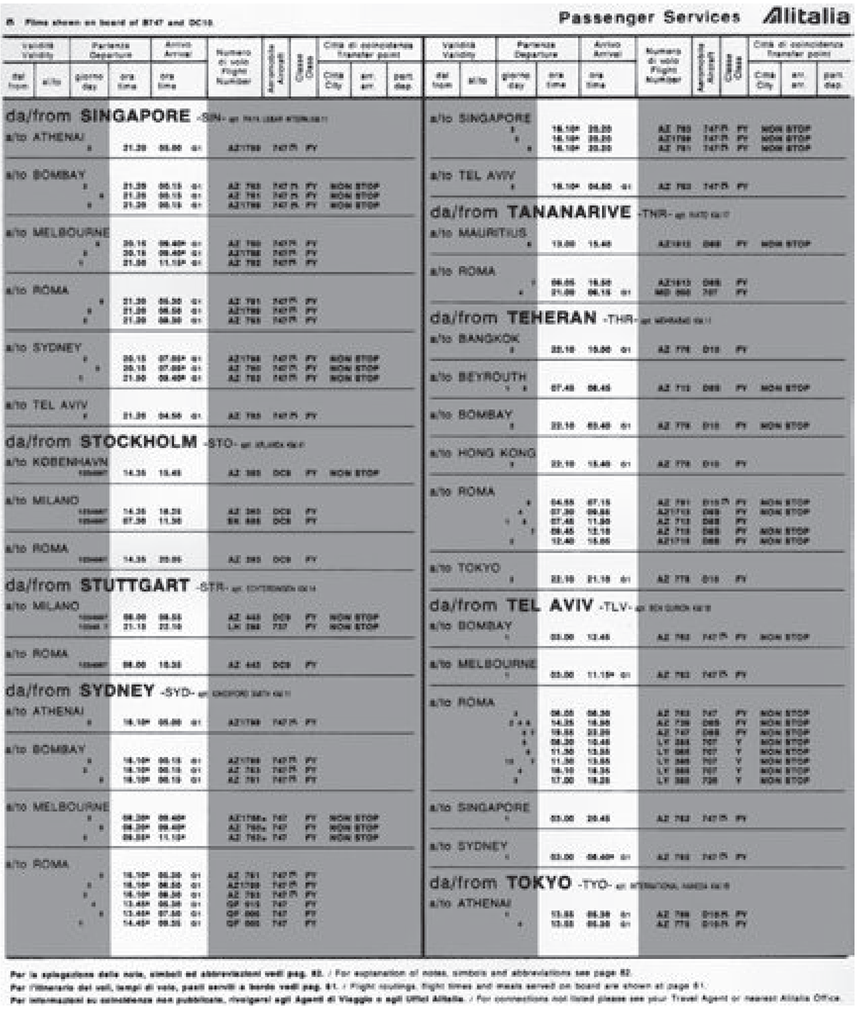


Figure 5.2 Alitalia Timetable.

Source: Wikimedia Commons.

5.3.1 Objectives

Development of the flight schedule is an extremely complex task, not only because of the vast number of variables and possibilities to be considered, but also because of the required trade-offs among revenues, costs, reliability, and constraints. Figure 5.2 depicts four often conflicting objectives the schedule planner attempts to balance. Each objective is considered next (Figure 5.3).

Revenue

The flight schedule seeks to maximize network revenues by matching flights and capacity with passenger demand. Passengers rate flight schedule convenience as the second most important criterion in choosing an airline, but for the high yield business segment, it's often the primary consideration. An airline targeting the business passenger must offer flights when the passenger wishes to travel with sufficient capacity to meet peak demand. Business travelers also favor frequent service in the event that travel plans change. In business markets, frequent morning and late afternoon/evening flights are essential to meeting passenger desires, but some off-peak service is also needed. For markets with aggressive competition, high flight frequency is a competitive weapon. Sometimes even minor departure and arrival time changes can add to the competitive attractiveness of the schedule and increase market share. Non-stop service (point-to-point) may be a competitive necessity in some markets even when such service bypasses the airline's hub airports thus reducing connections in other markets. For routes with less

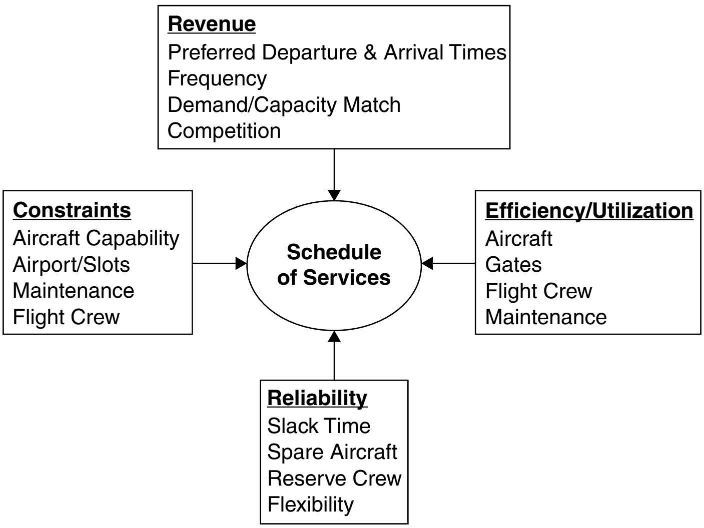


Figure 5.3 Flight Schedule Objectives.

competition, such as those to smaller cities, high frequency is less important, but morning and late afternoon/evening service is still important.

Revenue potential increases with the number of city-pairs serviced, so hub-and-spoke carriers must maximize connections through hub airports with the most profitable markets having the most convenient connections. Passengers prefer non-stop flights, but if a connection is unavoidable, connecting flights that do not require a change of aircraft (called *direct* flights in airline terminology) are most desired. The planner must consider the aircraft flow across the hub to maximize same aircraft connections and hence schedule convenience.

The schedule is a compromise between flight capacity and frequency. Is it more profitable to operate one 400-seat aircraft twice a day or a 100-seat aircraft eight times per day? One solution is to offer a higher capacity mainline aircraft during peak demand supplemented with regional jet service during off-peak times.

Optimal departure times for international flights will be determined by the length of the flight and time zone changes. Most passengers do not favor late evening arrivals. From the United States, late afternoon departures allow for morning arrivals in Europe and lower South America. The Gulf airlines operate early morning connecting complexes for their long-haul international flights in order to provide mostly daylight departure and arrival times in Asia, Europe, and the Americas.

Unit Cost and Utilization

The schedule planner lowers the cost per available seat mile (CASM or unit cost), the standard measure of airline production cost, with high utilization of aircraft, crew, and other assets. High utilization spreads fixed costs over more available seat miles (ASM), thus lowering the CASM. Aircraft capital costs, for example, are fixed regardless of the hours flown. If the aircraft is leased, the lease payment is made monthly whether the aircraft is flown many hours per month or only a few. Similar reasoning applies to maintenance facilities, airport gates, and terminal space.

Higher aircraft utilization not only lowers unit costs but also increases revenue potential as revenue is only generated when an aircraft is flying. LCCs enjoy a substantial advantage over their network competitors in utilization which partly explains their success. The Airbus A-320 aircraft is operated by both LCCs and network airlines. The Airline Monitor (2013) reported that U.S. network carriers obtained an average of 10.1 block hours per day for the A-320 whereas LCCs flew the aircraft nearly 30% more at 12.9 hours per day. LCCs are able to attain higher utilization because the point-to-point and linear route structures are not constrained by hub-and-spoke timing. LCCs also often begin flight operations earlier in the morning and continue later at night than network carriers. This strategy lowers unit costs and increases revenue, but suffers from flights at undesirable, low-demand times.

High pilot and flight attendant utilization per day lowers flight crew cost per segment and requires fewer total crewmembers to operate the flight schedule.

Prior to legacy carrier restructuring, network carriers averaged about 50 flight hours per month per pilot whereas Southwest Airlines pilots flew an average of near 70 flying hours per month.

Similarly, high utilization of airport facilities such as gates and ground support equipment lowers unit costs. The cost of maintenance hangars and specialized equipment is mostly fixed, so high utilization lowers unit costs.

Reliability

The flight schedule is subject to disruptions, particularly for weather and aircraft mechanical problems. The schedule must incorporate sufficient slack resources to absorb delays and provide competitive on-time service. Without some slack, a schedule that looks good on paper may be disastrous in actual operation driving passengers to competitors. Slack can be built into a schedule in several ways. Some aircraft are spares, held out of the schedule to be substituted for aircraft that run late or suffer mechanical problems. Likewise, reserve flight crews, pilots and flight attendants, fill in for other crewmembers in the event of illness, illegality, or off-schedule operations. The schedule design should allow for aircraft substitutions. High flight frequency and the regular rotation of aircraft and crews through the network carrier's hub airports provide opportunities to swap or switch aircraft and crew members, a flexibility not enjoyed by a point-to-point system. Finally, slack time between arrivals and departures allows the airline to recover from late arrivals. The U.S. Department of Transportation ranks airlines by on-time arrivals and publishes the data monthly. Partly in response, U.S. airlines have increased scheduled block times. On-time arrivals statistics are improved but at the cost of lower utilization.

Constraints

The flight schedule must also be feasible given numerous constraints. For example, a schedule that requires more aircraft than the airline operates violates a constraint and is not feasible.

Aircraft have operational capabilities not suited to all routes. Different aircraft types have greatly varying range and load carrying capabilities. Several years ago, the U.S. carrier AirTran, for example, had to add a second fleet type in order to operate transcontinental flights because of the limited range of its Boeing 717 aircraft. Aircraft takeoff weight is restricted by altitude and temperature which can limit fuel, payload, and range. Flights operating from high elevation airports such as Bogota, Colombia (2,625 meters) suffer from takeoff weight restrictions. High summer temperatures in the Gulf region impose similar restrictions. Again, the adverse impact varies greatly by type of aircraft. If aircraft are scheduled to operate at near maximum range, strong headwinds may require an en route fuel stop or limit payload. Cargo and baggage may be left at the origin so that additional fuel may be uploaded to enable a non-stop flight. Of course, passengers will be displeased to find their luggage was not loaded on their flight.

Airport capacity is often limited by available runways, taxiways, gates, and counter positions. A few U.S. and many European airports are slot limited. Night curfews impose a similar limitation on the schedule planner.

Aircraft must receive regular maintenance which requires periodic removal from the flight schedule. Crewmembers are subject to maximum flight time and rest requirements arising from regulation and contractual provisions, although these constraints are often not considered in building the flight schedule. Instead, the flight operations department is left to manage these limitations once the schedule is finalized.

5.3.2 Fleet Assignment

The initial flight schedule may be developed without fully assigning specific aircraft types to each flight. British Airways, for example, operates 10 aircraft types (including those of its regional subsidiary) ranging in capacity from 469 seats on the Airbus 380 to 76 seats on the Embraer 170 (British Airways, n.d.). Even within a single fleet type, seating capacity may vary. Southwest Airlines operates only Boeing 737s but capacity varies from 137 on the B-737-300 model to 175 on the 800 model (Southwest Airlines, n.d.). The first consideration in fleet assignment is the aircraft capability for the route. Long-haul international routes will usually be operated by wide-body jets whereas regional jets are restricted to shorter routes. Within these performance limitations, the airline still has the flexibility to assignment aircraft with varying seat capacity and interior configuration. The objective is to match capacity with demand. Higher capacity aircraft should be assigned to the flights with the highest demand.

Changes to the fleet assignment can be made well after the timetable is finalized to meet changes in demand. A few airlines are working on dynamic scheduling which changes fleet assignments within a few days of operation. Dynamic scheduling is addressed in more detail shortly.

5.3.3 Trade-offs

Flight schedule development involves innumerable trade-offs because the objectives of maximizing revenue, minimizing costs, and enhancing reliability conflict. High aircraft utilization maximizes revenue and minimizes costs but also reduces slack which jeopardizes reliability. Spare aircraft generate no revenue while incurring high fixed costs, but assigning all available aircraft to flights substantially compromises the airline's ability to recover from disruptions. Operation of red-eye flights greatly increases utilization of aircraft, but ticket prices must be lowered to attract passengers to undesirable departure and arrival times. Business travelers value high flight frequency, but too much capacity will lower average price. Regional jets can be used to increase flight frequency without adding excess capacity, but the regional jet CASM may be twice that of larger mainline aircraft. The list of potential conflicts is long; the final flight schedule is the result of thousands of compromises.

5.3.4 Optimization

With each major schedule revision, a draft is circulated to operating departments for suggestions and approval. Departments may identify constraints that hadn't been considered. A station manager might anticipate gate conflicts due to airport construction. The flight operations department may point out that the assigned aircraft type will have payload restrictions on a particular route in high summer temperatures. The introduction of a new aircraft type introduces added complexity, for example, pilot training may have a longer lead time than schedule planners had considered.

The schedule development is an iterative process as revisions are made in response to inputs from the operating departments. Ultimately, the schedule is a compromise that imposes burdens on some operating departments or forces the schedule planners to accept a schedule that doesn't meet their objectives for efficiency and profitability. Aggressive scheduling often leads to messy recoveries from irregular operations, reducing revenues and damaging passenger relations and loyalty.

With so many conflicting goals and required compromises, producing a profit maximizing flight schedule is a daunting, seemingly impossible task. The cost of operations can be estimated with reasonable certainty—volatile fuel prices are the greatest unknown—but revenues are subject to many more variables and uncertainties. Software applications are available to identify optimal departure times, maximize passenger flows through the network, and model costs. Conceptually, a single software application should be able to produce an optimal schedule of services, it is just a large optimization problem: maximize profits subject to constraints. However, developing a single solution is beyond current technical capabilities because of the huge number of variables and complexity of the profitability function. Instead, separate applications focus on optimizing a single aspect of the schedule. A large network carrier would employ many applications. This listing of software applications provides an appreciation for the scope and complexity of the flight schedule development process and serves as a review of the schedule development process.

- Market Size—Estimates the total market demand in terms of passengers traveling in each city-pair. An international network airline might evaluate 30,000 origin and destination markets. Historical data, trends, seasonality, aggregate pricing, and other macroeconomic data are combined to create individual city-pair demand forecasts.
- Market Share—From the Market Size forecasts, the airline's individual market share is estimated. Based on its relative quality of service versus competitors, the software estimates the share of the market the airline can expect to capture.
- Fleet Assignment—Specific aircraft fleet types are assigned to the basic schedule of services so that capacity meets estimated demand subject to

constraints. Choices might involve a wide-body versus narrow-body aircraft on a particular route segment.

- Passenger Spill—Estimates the number of passengers who will not find an available seat given the proposed schedule.
- Through Assignment—Even if a stop at a hub is required to reach their destination, passengers prefer not to change aircraft. These *direct flights* provide some marketing advantage over a competitor requiring a change of aircraft. Because many aircraft routings are possible through the hub, optimizing through flights will affect passenger choice and potential revenue.
- Dependability Prediction—In practice, the schedule will be disrupted by weather, mechanical failures and a host of other problems. This application estimates the reliability of the proposed schedule in actual operation (Sabre Holdings, n.d.).

As each application is run, the schedule will be revised for a better solution resulting in an integrated, iterative process of schedule development, profitability forecasting, and fleet optimization.

5.3.5 The Passenger Service System

The flight schedule is stored electronically in the airline's Passenger Service System (PSS), its central information technology (IT) repository. The PSS is developed and customized by each airline; individual systems vary in sophistication and capability. Functions that typically reside within the PSS, in addition to the flight schedule, are passenger reservations (called PNRs for passenger name records), frequent flier awards, flight information system, check-in system and many more (Arciuolo, 2014). Passengers are familiar with the PSS from flight check-in when the passenger service agent accesses the system with a series of rapid-fire keystrokes, or, more recently, from direct interaction through an airport check-in kiosk. Unseen are the countless other airline employees who access the PSS continuously in performing their duties.

The "back end" of the PSS contains interfaces between the PSS and other internal IT systems that use PSS information for daily airline management. For example, some airlines extract data from the check-in or departure control system to compute the aircraft weight and balance for each take-off. Another is the airline's revenue management system that allocates the seat inventory to price classes. Revenue management is the subject of Chapter 7.

5.4 Asset Assignment

Once the flight schedule is finalized, operating departments begin assigning personnel and other physical assets needed to operate the schedule. Staff may need to be hired and trained, or additional airport gates and support equipment obtained. On the other hand, if flight frequency is reduced in some markets or transferred to a regional airline, personnel may be furloughed or transferred to other locations. Required lead times vary greatly. Hiring and training new pilots may require six or more months lead time but only a few weeks for some airport staff. Airport facilities for a new destination may be readily available or difficult to obtain. Many smaller and mid-sized airports often have counter and gate space available and actively seek expanded airline service. At the other extreme are slot controlled airports where access is restricted.

Before the flight schedule is ready for implementation, two important asset assignment tasks must be completed: (a) assignment of specific aircraft (tail numbers) to the flight schedule and (b) assignment of pilots and flight attendants to every scheduled flight. These tasks are completed concurrently between four to six weeks prior to the actual flight operation.

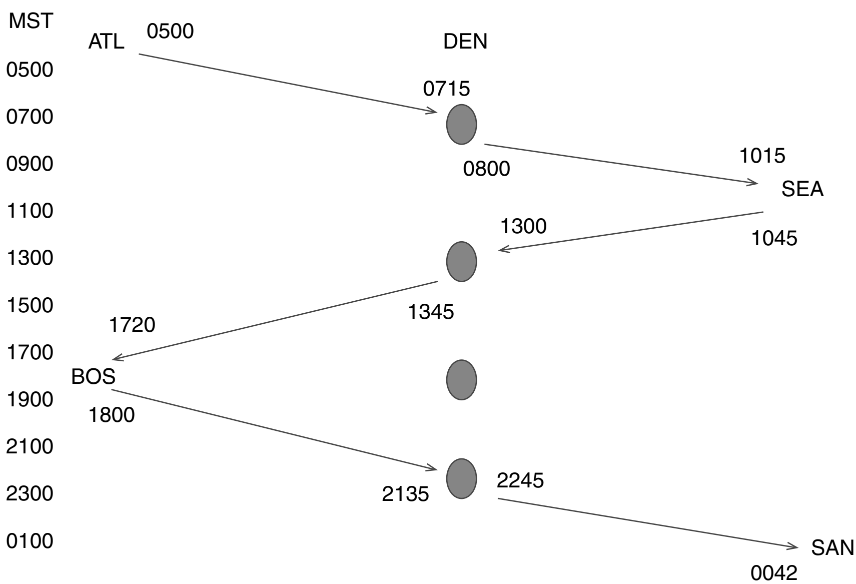
5.4.1 Aircraft Assignment

Assignment of individual aircraft to the flight schedule is the less complex of the two tasks. Maintenance requirements are the principal driver of assignments. Aircraft must undergo relatively simple inspections every few days and more complex routine maintenance every few weeks. The time interval for heavy maintenance in which major components are inspected, serviced or replaced varies by airline with most completing the required tasks in phases. The assignment of aircraft to the flight schedule must ensure that aircraft are routed to maintenance facilities when inspections and work are due. Frequently required routine inspections are performed at many stations, usually overnight, whereas a limited number of airline facilities are capable of heavier maintenance. For network carriers, heavy maintenance facilities are often at hubs.

Figure 5.4 shows a typical routing for one aircraft in one day. This aircraft originates in Atlanta and flies to the airline's hub at Denver for a connecting complex. Of course, aircraft from other spoke cities would arrive in DEN nearly simultaneously to make up the complex. Once passengers and baggage have been transferred from other inbound flights, this aircraft continues to Seattle. Again the aircraft returns to the Denver hub and then flies to Boston. Finally, the aircraft returns to the hub for a third connecting complex of the day before continuing to San Diego. Panel B displays the aircraft routing in a Station Time-Space Diagram. Local time is shown on the left-hand vertical scale. The blue dots at Denver represent complexes. Note that this aircraft transits Denver for three of the daily complexes, but misses the third of four daily complexes. A larger airline such as United Airlines, which also has Denver as one of its hubs, would operate several more daily complexes.

On completion of the day's flights, the aircraft remains overnight in San Diego where it will originate the next day's flying. For this small network carrier, the

Panel A: Single Aircraft Flight Assignment



Panel B: Time-Space Diagram for Aircraft Assignment

Figure 5.4 Aircraft Assignment.

aircraft would regularly transit the Denver hub but would likely fly to different cities on each subsequent day's flights. At some point, the aircraft would terminate a day's flying in Denver for scheduled maintenance.

5.4.2 Aircraft Flow Chart

For operational use, the flight schedule is displayed as an aircraft flow chart, similar to a Gantt chart. Figure 5.5 is a typical aircraft flow display. This example is patterned from one of the many airline software applications available from Lufthansa Systems and shows a portion of the flight schedule for Lufthansa Group member Swiss International Airlines. Each row displays the sequential flights for one aircraft over 2½ days from Monday through part of Wednesday. A graphical rectangle, called a puck, represents a single flight. The puck can be configured to display data of interest, including departure and arrival times, actual bookings, or special comments.

Looking more closely at Figure 5.5, time blocks are shown below the days of the week. These would normally be Greenwich Mean Time, but local times could also be selected. The origin and destination cities are displayed on each side of the puck with the flight number and departure and arrival times are within the puck. The first row shows the flight schedule for aircraft number 1. It departs Boston (BOS) at on Monday at 01:40 as flight number 53 arriving in Zurich (ZRH) at 08:55. The scheduled block time is 7 hours 40 minutes. The ground or turn time in ZRH is 2 hours 20 minutes, typical for a long-haul international flight. Over the visible portion of the screen, the aircraft continues from Zurich to San Francisco (SFO) as flight 38 and then returns to ZRH as flight 39 on Tuesday. Next the aircraft operates another round trip to BOS with the return to ZRH just visible on the far right of the screen. Similarly, aircraft 2 is scheduled to operate flights from SFO to ZRH, then to BOS and return to ZRH followed by a round trip to New York (JFK).

The flights for just seven aircraft are visible on this screen, but a large airline would have hundreds of aircraft of various types assigned to its flight schedule, so the manager could scroll down to view other aircraft, scroll right to see the later days of the week, or otherwise customize the view of the flow chart as needed.

5.4.3 Crew Pairings and Bid Lines

Assigning pilots and flight attendants to staff every flight in the timetable is an immensely more complex task than the assignment of specific aircraft to the schedule. First, a large airline might have 800 aircraft but more than 8,000 pilots and more than twice that many flight attendants. Second, aircraft assignment is subject to few restrictions whereas the scheduling of pilots and flight attendants is subject to legal and contractual requirements which are usually different for

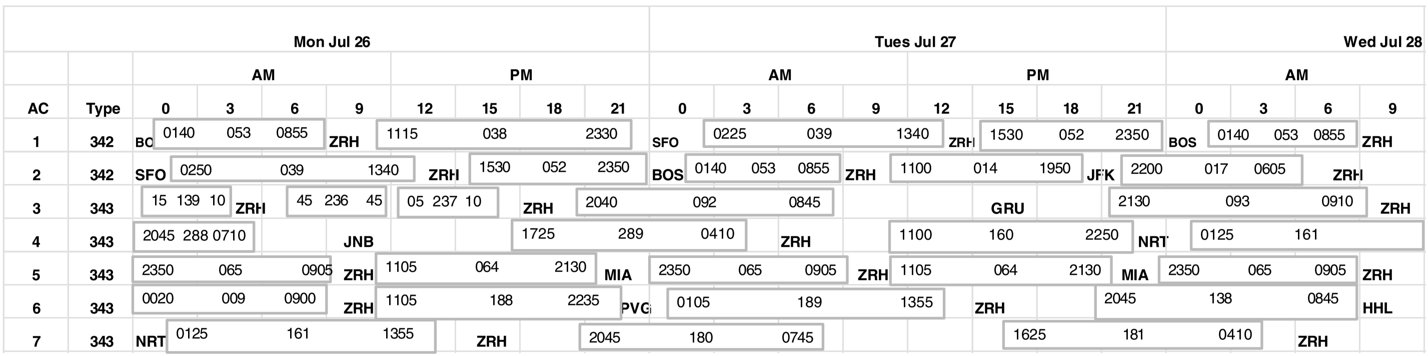


Figure 5.5 Aircraft Flow Chart.

Source: Courtesy of Lufthansa Systems.

pilots and flight attendants. After fuel, crew costs represent that single largest cost for airlines, so efficient crew scheduling can significantly reduce operating cost. Because crew scheduling is an ongoing, complex, and critical airline task, it was one of the first to draw attention from management scientists.

The first step in crewmember assignment involves building work schedules consisting of a sequence of flights that begin and end at the crewmembers' domicile. The length of the flight sequences—known variously as a pairing, trip, or rotation—ranges from one to several days. Multiple day pairings will include intervening rest periods, usually overnight. There are innumerable variations in the design of pairings with differing degrees of effectiveness, efficiency and cost. Pilots can only fly one aircraft type but flight attendants are usually qualified to operate all of the types in the airline's fleet. As with the flight schedule itself, compromises are required for accommodate conflicting objectives of minimizing cost while ensuring reliability. For example, daily pilot utilization might be increased by having pilots frequently change aircraft at a network carrier's hub airports, but if the crew's inbound flight is delayed, so too will be the next flight the pilots are scheduled to operate even if the aircraft for the outbound flight arrived at the hub on time. Pairings will differ for each crew domicile. For a large airline, thousands of different pairings will be required to cover the entire flight schedule.

Once developed, pairings are placed into monthly work schedules called bid lines, rosters, or lines of flying. At most airlines, crewmembers then bid for their preferred choice of bid lines which are then awarded by position and seniority. At a few airlines, crewmembers register their preferences for work schedules such as days off, times of day, etc. A software application then fills the monthly work schedule with pairings that meet these preferences. In this system of preference bidding, senior crewmembers tend to obtain work schedules that closely align with their preferences but leave junior crewmembers with schedules that are less desirable. These preference bidding systems provide substantial improvements in efficiency but have yet to be widely embraced by crewmembers.

In a simple example, Figure 5.6 shows how pairings and bid lines are developed from the aircraft flow chart. The daily aircraft flow chart (developed for illustration using MS Excel) shows just four aircraft of the same type. A single day's operation is shown. For simplicity, we assume the airline operates the same schedule every day of the week in contrast to Figure 5.5 where the aircraft flow must extend over several days because of the long international flights. In practice, however, even most domestic airlines operate a different schedule midweek and on weekends which introduces another level of complexity. Five pairings are shown for Panama City (PTY) based pilots with each shaded to correspond to individual flights in the flow chart. The simplest pairing is P101, a one-day work schedule consisting of two flights on aircraft #1, PTY to LIM and return. Pairings 201, 202, and 203 cover two days each while pairing 301 covers three days including a two-night stay in Mexico City required because the crew arrives in MEX too late at the end of day 1 to operate the originating flight from MEX the next morning.

AIRCRAFT FLOW CHART

FLIGHT CREW PAIRINGS

P101				
FLL	LGA	1030	1320	2:50
LGA	FLL	1510	1810	3:00
				5:50

P301				
FLL	SJU	1930	2215	2:45
	RON	SJU		
SJU	MCO	1415	1725	3:10
MCO	ORD	1850	2140	2:50
	R0N	ORD		
ORD	FLL	900	1200	3:00
				11:45

P302				
FLL	LGA	1400	1655	2:55
	RON	LGA		
LGA	FLL	645	950	3:05
FLL	SJU	1045	1330	2:35
	RON	SJU		
SJU	FLL	645	930	2:45
				11:20

FLIGHT CREW BID LINES

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Line # 1		101	301	X	X			301	X	X	302	X	X					
Line # 2					101	101	101					302	X	X				301

Figure 5.6 Flow Chart, Pairings, Bid Lines.

At the bottom of Figure 5.6 are two partial monthly bid lines built from the five pairings. Panama City-based pilots would bid on these and many more, perhaps hundreds more, for their monthly work schedules. Bid lines would typically be awarded about two weeks before the beginning of each month. Crew planners would then begin anew the task of building pairings and bid lines for the following month. While the development of pairings and lines requires sophisticated software, considerable management and specialized skills are also essential.

5.5 Tactical Management

When the assignment of aircraft and crewmembers to the flight schedule is complete, responsibility for the execution of the schedule is transferred to tactical or operations managers (refer again to Figure 5.1). The carefully crafted schedule will be subject to real world stresses including weather, aircraft mechanical failure, passenger and crew issues and a variety of other tribulations. Several departments—principally flight operations, maintenance and engineering, and airport services—work together to operate the airline's flights. Working in parallel, but mostly unseen, are marketing personnel who continually adjust prices and control the allocation of seat inventory in response to competitors' actions and ever changing demand. Others work to distribute the airline product through the airline's website, reservations offices, and third-party traditional and online travel agents. These functions are addressed in later chapters.

5.5.1 Airline Operations Control Center

The pilots, mechanics and station personnel who operate the airline's flights are scattered across the airline's route system. Historically, each of these employees reported to different managers who were frequently in different geographical locations resulting in "silos" with conflicting priorities and poor communication among the functional groups. Over the last few decades, airlines have moved daily operations managers and staff to a single operations center in order to improve coordination, communication, and tactical decision-making. The development of the *Airline Operations Control Center* (AOCC)—the name varies across airlines—is one of the major airline management evolutions ranking alongside network development and revenue management. Figure 5.7 is a diagram of the functions located within a typical AOCC along with a photo of American Airlines' AOCC, or Integrated Operations Center (IOC), as American terms it. Large AOCCs will be staffed by several hundred people, typically operating in three shifts and always open. American's IOC has 500 desks for the 1,500 people who staff all shifts (Speaker, 2015).

At the center of the AOCC are one or more operations controllers supported by personnel from several functional areas.

- Dispatchers are licensed professionals responsible for flight planning, issuing flight plans to captains, and following each flight's progress. The dispatcher

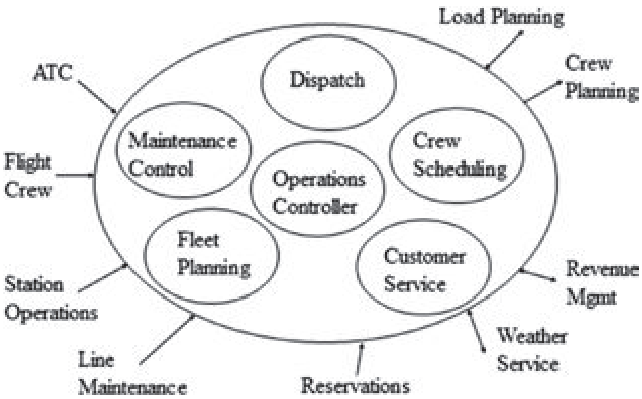


Figure 5.7. Airline Operations Control Center.

Photo from American Airlines.

and captain are legally jointly responsible for safe operation of the flight. Often working in conjunction with the dispatcher are load planners who track the passenger and baggage loading on each flight and issue instructions for the distribution of baggage and cargo to ramp agents and total weight and center of gravity computations to the captain.

- Crew schedulers track individual crewmembers as they move through the airline's route network, maintaining up-to-date status, and calling in reserve crewmembers or readjusting crewmember schedules as necessary when schedule disruptions occur.

- Maintenance controllers coordinate with line mechanics for aircraft maintenance, especially when malfunctions occur, ensuring that required parts are available to meet aircraft and mechanics have access to the appropriate aircraft maintenance program procedures to troubleshoot and correct malfunctions.
- The specific aircraft on the flight schedule must occasionally be reassigned because of disruptions to the schedule or unforeseen maintenance requirements. Fleet planners track individual aircraft to ensure that the aircraft schedule allows for required maintenance to be performed. Changes to the aircraft routing are made as required.
- Customer service staff ensure that changes to the flight schedule are communicated to station personnel and passengers and arrangements are made to accommodate disrupted passenger itineraries. The new American Airlines Robert W. Baker Integrated Operations Center includes a social media desk within the customer service function to provide passengers with immediate responses to flight problems via the various social media networks. Social media specialists have access to the most current operations information, but are often the first to know of operational issues affecting passengers (Hegeman, 2016).

As an aside, most passengers have at times been frustrated during flight delays because airport passenger service agents do not provide timely information about revised plans. Operations managers in the AOCC are developing required schedule revisions, but this process takes some time. In the case of an aircraft mechanical problem, maintenance personnel are not able to estimate the repair time until the troubleshooting procedures are complete, and these procedures take time. The AOCC manager cannot make a decision until the estimated repair time is received. In the interim, passengers wait impatiently for information.

A line mechanic is one of many other personnel not physically located within the AOCC who supply and receive information through the AOCC critical to operating the airline's daily flights. The AOCC also usually houses or is directly adjacent to a crisis center that is activated for incident, accident, or other major event.

The challenges faced by AOCC range from routine to crisis. Executing the flight schedule during normal operations requires extensive communication and coordination to ensure that a myriad of tasks is closely coordinated. Aircraft must be maintained and certified as airworthy; crews must be in the proper location for their next scheduled flight. Aircraft have to be fueled, cleaned, catered, and baggage loaded. Station personnel ensure that passengers are checked-in and boarded in time for the scheduled departure. These and other routine activities must be carefully orchestrated and completed simultaneously within a tight time window. Each day, minor modifications to the plan are required because of many small disruptions such as ill passengers, mechanical problems, and security. At other times, however, flight operations are subject to major disruptions, often weather related, requiring large-scale modifications to the flight schedule to return the airline to published service.

5.5.2 Flight Schedule Disruptions

The flight schedule can be disrupted by many forces of which weather is the most common. About 20% of U.S. domestic flights arrive more than 15 minutes behind schedule indicating some type of schedule disruption (Bureau of Transportation Statistics, 2015). Without sufficient slack in the flight schedule, one delay may cascade through the system. Hub-and-spoke systems are especially vulnerable to weather at a hub airport that can cause entire complexes to be delayed which then ripples throughout the airline's network.

Aircraft mechanical problems and air traffic control restrictions, again often weather related, are well-known to most passengers. Less obvious causes for delays include pilot and flight attendant absence, sickness, or legality restriction. At airports, ground support equipment may be unavailable due to mechanical problems. Airport construction can cause delays, especially when a runway is closed for repair or extension. In recent years, delays for security have been more prevalent.

Airlines and air traffic control are fully dependent on computer hardware and software to operate flights. Not surprisingly then, computer failure is a common cause of flight disruptions. On Christmas day, 2004, Delta Airlines' regional subsidiary Comair canceled all 1,100 daily flights, stranding 30,000 passengers, when the computer running its crew scheduling system failed. Several days were required to fully restore the schedule ("US Air, Comair Scramble," 2004).

Although the cost of flight delays is difficult to calculate with any precision, Airlines for America (n.d.) figured delays in 2012 cost the scheduled U.S. passenger airlines $7.2 billion or about 3.7% of total revenues. A more comprehensive estimate by the Federal Aviation Administration put the total bill at $32.9 billion in 2007 (Guy, 2010).

5.5.3 Managing Irregular Operations

When major disruptions to the flight schedule occur, a recovery plan must be developed and implemented with the objective of returning to the published flight schedule. Methods of achieving this result vary greatly depending on circumstances and individual airline culture and philosophy. American Airlines, for example, will sacrifice today's schedule to operate normally tomorrow. Differing and conflicting sub-goals, such as retaining revenue or minimizing passenger inconvenience, are difficult to balance and currently beyond the capabilities of software to solve or optimize. Like the schedule development process itself, compromises are necessary.

Operations managers have many recovery options which can be used singly or in combination depending on the severity of the disruption:

- Reserve Crews: Standby or reserve crews, a form of slack resource, may be assigned to replace crewmembers who are sick, become illegal for continued flight duty because of regulatory or contractual limitations, miss connections to their next flight, or to staff rerouted or additional flights. Some airlines maintain up to 30% of all crewmembers on standby or reserve status to preserve the flight schedule reliability.

- Aircraft Swap: Aircraft may be swapped to a different flight or route. This usually happens at the hub. A passenger announcement of a gate change is often evidence of an aircraft swap.
- Spare Aircraft: Just as the airline maintains reserve crews, it will also have a limited number of unassigned spare aircraft which can be substituted for late or broken aircraft or may inserted into the schedule for additional flights. This form of slack resource is, of course, expensive.
- Delay: Flights may be delayed but operate on the originally scheduled routing.
- Cancel: Flights can be canceled. Massive cancelations in anticipation of severe weather have become more common in recent years. In the United States, this is in part a reaction to Department of Transportation regulations imposing severe fines on airlines for flights that incur extensive delays while waiting for takeoff.
- Rerouting: Finally, aircraft can be rerouted with additional stops en route or two or more flights can be combined, and perhaps operated with larger capacity aircraft.

The possible alternatives are many and complex. A network airline with high flight frequency through its hubs has many more options to address irregular operations than does a low frequency, predominately point-to-point carrier. The judgment and experience of the operations controller are critical to a successful recovery. The operations controller must take into account several, often conflicting, objectives. For a network airline, 50% to 60% of all passengers connect at a hub in order to reach their destination. The controller must consider whether connecting flights will be available so that passengers are not stranded at the hub. Pilots and flight attendants must be in place with at least legally required rest to operate the following day. Consequently, late flight arrivals can result in delays the following day which continue through the network. Similarly, aircraft must also be in place for the following day's departures. Because pilots are usually only qualified to fly one type of aircraft, staffing for the following day must be considered in addition to the current day's operation. Maintenance requirements also restrict aircraft assignment options. Specific aircraft must be in place for required scheduled maintenance.

Several options are also available to get disrupted passengers to their destinations. Re-accommodation on a later flight, or, for airlines with multiple hubs, routing through another hub may be possible. Passengers can sometimes be accommodated on another airline (known as off-line accommodation). If passengers cannot be flown to their destination in a reasonable time period, they may remain overnight awaiting an available flight the next day, or in extreme situations, some days later. Most airlines maintain a database of their most valued passengers and will attempt to accommodate these passengers first. Much of the information in the database comes from the airline's frequent flyer program.

Most of these options are costly to the airline. The European Union has recently required airlines to pay for passenger expenses even in circumstances fully outside of the airline's control. In the United States, however, passengers are often surprised that their airline declines to take responsibility for making arrangements to get them to their destination. Each airline outlines its policies and responsibilities in the Contract of Carriage, a legal document that few passengers read.

Making optimal decisions for passenger accommodation and revenue projection involves a vast decision space, and any schedule change generally affects all functional areas. Controllers charged with developing and implementing the recovery plan must process an immense amount of information. This requires experience and aptitude. Computer-based decision support systems (DDS) are available at some airlines to assist with this complex planning.

5.5.4 Irregular Operations Examples

Though there are many examples of irregular operations and the difficulty in returning to the published flight schedule, JetBlue's operational meltdown that began with the Valentine's Day storm of 2007 is perhaps the most horrific. At the time, JetBlue's operational strategy was to operate all flights, no matter how late, reasoning that passengers would rather arrive late than have their flight canceled. With this strategy, JetBlue, unlike most other carriers, did not cancel flights in anticipation of winter snow storms. During the previous winter, this philosophy served it well when a projected major storm was less intense than forecast. JetBlue operated flights when other carriers did not.

During the Valentine's Day snow and ice storm of 2007, JetBlue again planned to operate all scheduled flights, but instead ended up letting "several flights sit for 10 hours, toilets overflowing, nothing to eat but snacks and, ironically, cabins so hot and stuffy that doors had to be opened to let fresh air in" (Carey & Aalund, 2007). By the time JetBlue decided to cancel flights, it did not have enough gates for its aircraft. At JFK, airport buses were used to get passengers from their aircraft back to the terminal.

Severe operational problems continued for a full week with JetBlue canceling about 25% of its flights each day as it attempted to restore scheduled operations. Flight crews exceeded regulatory duty times and could not fly until receiving regulatory rest intervals. Both planes and crewmembers were out of position to operate needed flights. The airline's 20 crew schedulers were overwhelmed, unable to put together a feasible recovery plan and often unable to contact crewmembers needed for rescheduling. JetBlue had neither sufficient specialized personnel nor adequate crew scheduling and flight control software to plan and execute a successful recovery plan.

Figure 5.8 Irregular Operations.
Photo source: Wikimedia Commons.

The problems and extensive negative publicity caused JetBlue to publish a Passengers' Bill of Rights. Further, most of the existing operational management and the airline's founder, David Neeleman, were subsequently replaced.

This example notwithstanding, there are several factors which favor lengthy delays awaiting takeoff rather than a flight cancelation. Both pilots and passengers frequently prefer to wait for departure when flights are delayed after taxi-out. Returning to the gate usually means sacrificing a place in line for takeoff.

Finally, with high load factors, few seats are available for rebooking, a fact many passengers realize.

Major disruptions aren't confined to newer and smaller airlines. Chaos sometimes strikes at even the largest and most experienced airlines as British Airways learned with its ill-fated move to its new Terminal 5 at London Heathrow (Figure 5.8, Panel B). Within hours of opening on March 27, 2008, the $8.5 billion complex where British Airways is the sole occupant quickly became a nightmare. The terminal's high-tech baggage system crashed, resulting in thousands of bags being misplaced, more than 400 flights were canceled or delayed and hundreds of irate passengers left stranded in its first 10 days of operation. The opening was a major public relations disaster. British Airways had touted the modern terminal as a major step in ending the so-called "Heathrow hassle" of long lines, overcrowded conditions and lost bags that has long plagued Europe's busiest airport.

5.5.5 Dynamic Scheduling

Specific aircraft assignment to the flight schedule can be completed some weeks in advance of the actual operation, but frequent changes to the specific aircraft assignments are common to accommodate various disruptions to the flight schedule. With the introduction of several aircraft models of the same type, especially the Airbus 320 and the Boeing 737 series, a new opportunity to increase revenues and profits arose by swapping aircraft models of different capacity to accommodate changing demand. Alaska Airlines, for example, operates Boeing 737–700, –800, and –900 series aircraft with seating capacity ranging from 124 to 172 (Alaska Airlines, n.d.). As the date of departure approaches, the airline can estimate passenger demand for each route with ever greater precision. This presents an opportunity to swap aircraft of different capacity to meet projected demand and thereby increase revenue. A flight initially scheduled for the smallest Boeing 737–700 model but experiencing higher than projected passenger bookings might be rescheduled with the larger 800 or 900 models. The consequence, of course, is that another flight would now be flown with a smaller series aircraft.

While this process of *dynamic scheduling* may increase revenues, it also presents several problems. First, the aircraft maintenance requirements must be respected. Each aircraft that is swapped to a new flight may not be returned to its original schedule until at least two and probably several more flights have been completed. Demand on these subsequent flights may not be well matched to the aircraft's capacity; thus, the decision to swap aircraft must consider the demand on a sequence of several flights which will likely dilute the potential revenue gain. In Alaska's case, aircraft models also differ in first class seating capacity. If a smaller model than originally scheduled is swapped to a flight, some reserved first class passengers may be denied first class accommodations. Because these passengers are among the airline's most valued, the negative consequences probably outweigh any potential for increased revenue. Finally, pilots are usually qualified to fly all models of the aircraft type, so swapping models generally don't affect the assignment pilots; however, the larger models may require one or more additional flight attendants introducing another complication.

Although the potential revenue enhancement from dynamic scheduling has been recognized for some years (Clark, 2000), the operational complications have limited the practice.

5.6 Continuous Improvement

The JetBlue meltdown illustrates that airlines, like all other businesses, must strive for continual improvement or competitors will eventually gain their customers. Customers want a cheap price, but they also expect and demand quality. One classic example of the use of quality as a competitive weapon is the Japanese assault on the U.S. domestic auto industry in the second half of the twentieth century. Higher quality Japanese automobiles gradually won market share. Despite impressive gains in recent years, the perception of poor manufacturing quality continues to haunt U.S. producers today.

Quality must be defined by the customer, not the producer. Thus, research is necessary to determine what customers value and will pay for. This, of course, is part of the marketing concept discussed in Chapter 4.

Quality function deployment is a concept of designing quality into a product rather than something obtained after production by inspection and correction of defects. The basis for this concept is the conviction that high-quality products are ultimately cheaper to produce and sell. Consider the cost to JetBlue of its operational nightmare that other airlines could avoid.

Another critical component of both the *total quality management* and quality function deployment movements is employee involvement. Employees often know where to seek improvement and can offer solutions.

5.6.1 Goals

The heart of continuous improvement is an intuitively appealing, four-step process diagrammed in Figure 5.9. In the first step, specific performance goals are set that can be objectively measured. While this may be an obvious management task, many companies do not set clear objectives and/or develop measures to determine if objectives have been met. This can lead to reactive management—putting out fires. In one study, less than half of companies knew the profitability of each product. One-third had no regular review. Half failed to compare their prices with competitors, analyze warehousing and distribution costs, analyze causes for returned merchandise, or conduct formal evaluations of advertising effectiveness or review sales force call reports (Baker, 2001).

Establishing effective goals requires careful consideration captured in the acronym SMART. Goals should be specific, measurable, attainable, relevant

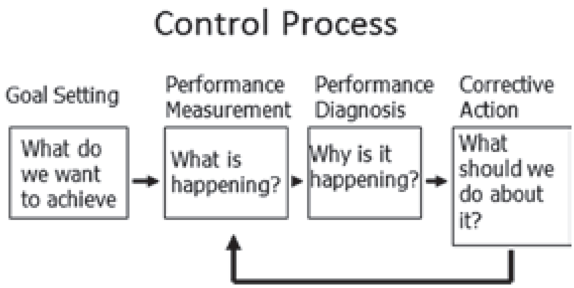


Figure 5.9 Control Process.

and time-bound. An airline, for example, might establish a goal that 90% of flights will arrive within 15 minutes of the flight schedule, considered on-time within the industry. This goal is specific, measurable, and relevant. Whether it is attainable, or even desirable, depends on the airline's unique circumstances. Harkening back again to the marketing concept, objectives should be developed from the passengers' perspective and attainment should add passenger value. An on-time objective that is appropriate for one airline may not be so for another. Passenger wants, competition and cost must be balanced in setting objectives.

5.6.2 Measurement

The second step in continuous improvement measures actual performance. Airlines track hundreds of performance statistics; Figure 5.10 shows two examples. These and several other metrics are published monthly by the U.S. Department of Transport in the Air Travel Consumer Report to allow passengers to evaluate airlines based on measurable performance. Panel A shows arrivals within 15 minutes of schedule for the largest U.S. airlines for the 12 months ended March 2016. Hawaiian Airlines leads the pack followed by Alaska and Delta. The worst performing airlines are post-deregulation entrants with ultra-low-cost-carrier Spirit significantly underperforming the other airlines. Panel B shows the number of passenger complaints filed with the Department of Transportation, Bureau of Transportation Statistics for the 1st quarter 2016. Comparing the two graphs, the two so-called ultra-low-cost-carriers, Spirit and Frontier Airlines, have the highest number of passenger complaints and poor on-time performance. Frontier has substantially improved on-time performance in 2015 whereas Spirit has only recently focused on improving its performance record. High aircraft utilization is an essential element of the LCC business model, but it reduces slack in the flight schedule resulting in poor on-time performance which is one-factor generating passenger complaints. Some passengers were certainly disappointed to experience the lower quality product characteristic of the ULCC. Among the network

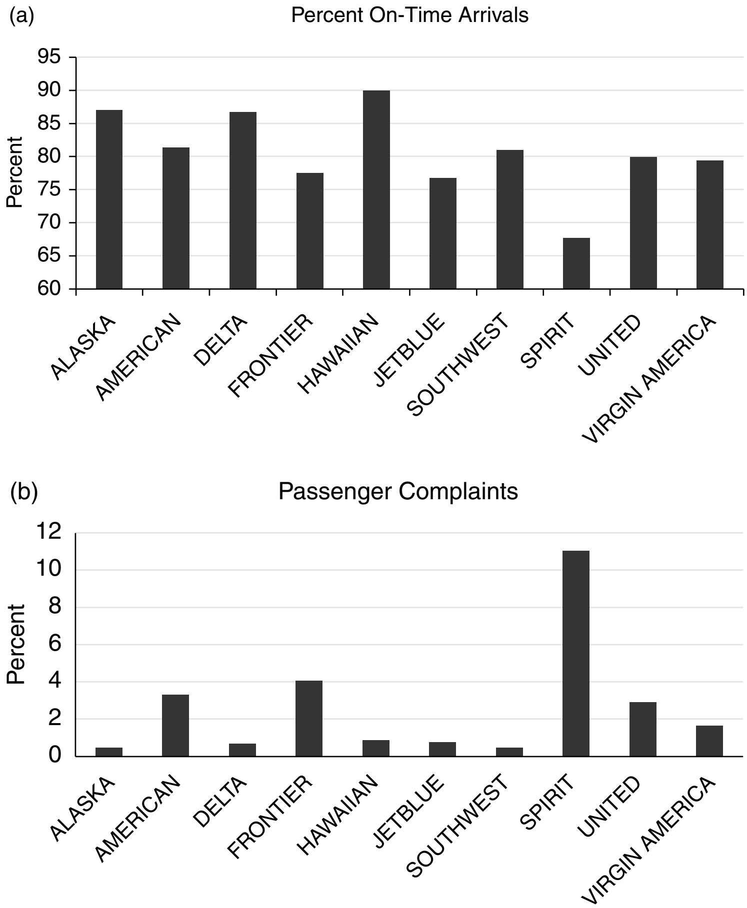


Figure 5.10 Operational Metrics. Panel A—Percentage of flights arriving on time for the 12 months ended March 2016. Panel B—Passenger complaints per 100,000 enplanements for the 3 months ended March 2016.

Data Source: U.S. Department of Transportation, Air Travel Consumer Reports.

carriers, American Airlines is in the bottom half in on-time arrivals and the top half in passenger complaints. This result is, in part, due to its continuing work at integrating the American and US Airways operations following the merger in 2013. While executives should continually analyze many different measures to determine whether their performance is satisfactory, these two metrics suggest that poor on-time performance leads to customer dissatisfaction.

These statistics also allow airlines to compare their performance to competitors, a process known as benchmarking. In 2015, United Airlines continued struggling to integrate its operations with those of Continental Airlines, the result of their 2010 merger (Carey and Nicas, 2015). Similarly, American was in the process of merging with US Airways in 2014. Merging large airlines with different operational procedures and decision process is always difficult and often degrades performance for months or years. Although American and United may not wish to match Hawaiian's 90% on-time arrivals, both would want to improve performance in order to avoid passenger defections, especially to their main rival, Delta Air Lines.

Poor on-time arrival performance is just one of the most visible cases where actual performance doesn't meet established objectives. All departments should have clearly established performance goals. A goal of the reservations department, for example, might be to answer calls within 15 seconds. Customer complaints, although often unpleasant for managers, are another valuable source of information about corporate performance from the customer's perspective.

5.6.3 Performance Diagnosis

While American's and United's poor on-time arrival performance may be, in part, due to merger problems, Southwest Airlines, long at or near the best in on-time performance, is a more informative example. In early 2013, Southwest looked to benefit from strong passenger demand. It could retain its existing flight schedule and raise fares or squeeze more flights from a fixed number of airplanes. It chose the latter. By reducing block and turn times, a new flight schedule added the equivalent of 16 additional aircraft worth of flying without increasing the number of aircraft. Southwest had successfully operated aggressive schedules in the past and felt it could do so again. But, several things had changed. First, an additional row of seats was being added to its 737–300 and –700 series aircraft models increasing the seat density from 137 to 143. It was also placing the larger 737–800 model configured to 175 seats in service. Higher demand also drove load factors. Of course, more passengers to be deplaned and enplaned at each stop require greater turn times. And, as discussed in Chapter 3, Southwest had created more connecting possibilities in cities like Chicago and Denver. The baggage for connecting passengers must be transferred from inbound to outbound flights, a process that often takes longer than for the passenger to make connections. Add to these factors, much less favorable weather in 2014 and the results were predictable even if Southwest didn't fully appreciate the challenges the new schedule presented. Figure 5.11 shows the marked deterioration of Southwest's on-time performance compared to the industry average beginning in January, 2013.

Southwest soon recognized the problem; flights would start out on time each morning but each flight would overfly its scheduled block time by three to five minutes. The shortened turn times didn't provide any opportunity to make up lost time, so the delays lengthened throughout the day. By the end of the day,

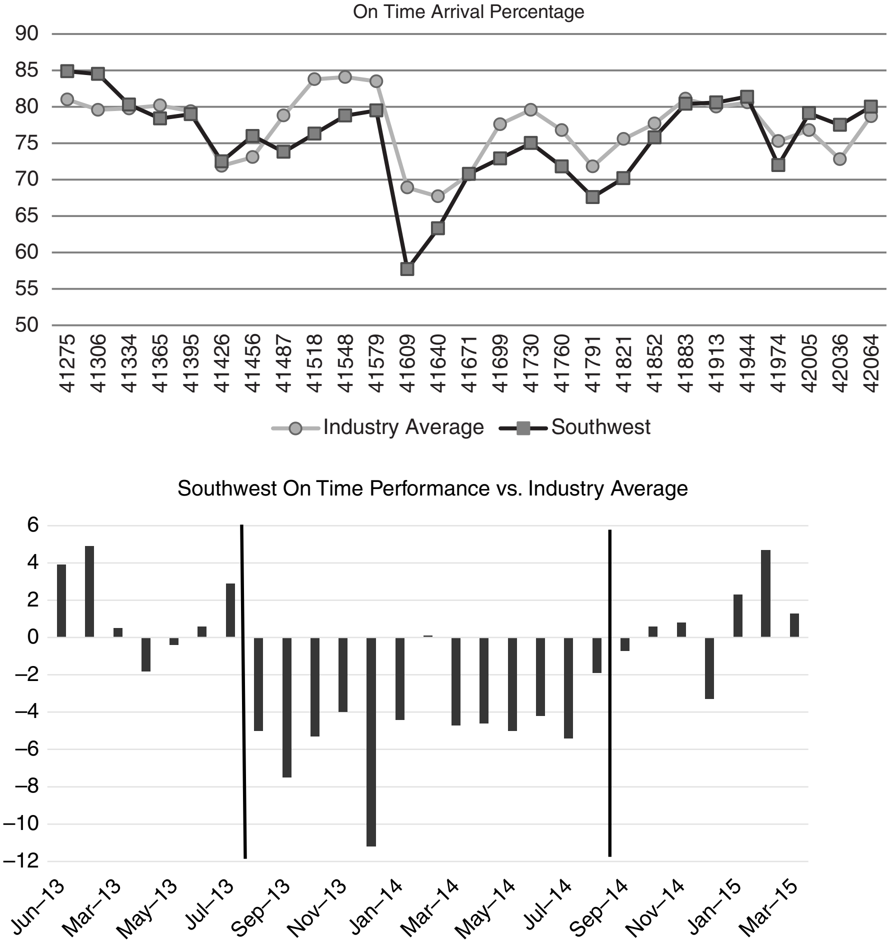


Figure 5.11 Southwest Airlines Operational Performance.

Source: U.S. Department of Transportation, Air Travel Consumer Reports.

flights were running 45 minutes late. And even if some flights were on-time, these often had to be held for connecting passengers and their baggage. The solution was clear, more time needed to be added back into the schedule, but Southwest had an additional problem, an antiquated reservations system that couldn't be updated quickly. So the schedule was maintained for a year ("How Southwest Tanked," 2014). On-time performance improved dramatically when a revised schedule was implemented in the fall of 2014 as Figure 5.11 shows, but the on-time percentage has yet to return to the stellar performance Southwest had long enjoyed.

OPERATIONAL PERFORMANCE SUMMARY							
	Daily Statistics				Month To Date		
	Day	Forecast	Deviation		MTD		
OPERATIONS	Actual %	Goal %			Actual %	Goal %	Deviation %
Kickoff flights on time	89.5	85	4.5		71.1	85	–13.9
Kickoff flights <16	100	90	10		83.5	90	–6.5
Departures/delay <16	77.1	80	–2.9		71	80	–9
Arrival/delay <16	70.8	85	–14.2		64.6	85	–20.4
Arrival/delay <60	91.7	95	–3.3		84.7	95	–10.3
Arrival/delay <2hr	94.8	99	–4.2		92.1	99	–6.9
Departures completed							
Actual	96				1981		
Scheduled	96				1984		
Cancellations	0				3		
DELAY PERCENTAGE	Over 5 Min						
Stations	45.2	14			22	167	
Mx	22.6	7			24.4	185	
Crew	3.2	1			13.9	106	
ATC/WX	19.4	6			30.5	232	
Gate	9.6	3			4.1	31	
Operations	0	0			4.7	36	
AC Damage	0	0			0.4	3	
FAA Ramp	0	0			0	0	
Unknown/Unresolved	0	0			0	0	
Total	100	31			100	760	

Figure 5.12 Operational Performance Summary.

Southwest was able to quickly identify the cause of its poor on time performance, but the root causes of poor performance are often not obvious. Every airline department should maintain detailed statistics in order to track and diagnose performance problems. Figure 5.12 is an example from a flight operation department that lists performance goals, actual performance, and deviations from objectives. The month to date statistics reveals serious deficiencies as only one goal, departure percentage, was met. Diagnosis might begin by recognizing that morning originating flights (kickoff flights in Figure 5.12) are not departing on time so that subsequent flights are delayed throughout the day. Of the many potential causes, analysts would consider whether aircraft undergoing overnight maintenance are not being positioned in the morning at the gates as soon as needed. Perhaps security lines are especially long in the morning delaying passengers. Poor labor relations can slow operations system-wide or may be isolated to one or a few stations. There is a myriad of possibilities. More than one cause is likely. In addition to data analysis, front line personnel should be asked for their observations and diagnosis.

5.6.4 Corrective Action

Implementing corrective action is the final step in the control process. The appropriate corrective action, of course, depends on the diagnosis. If the morning originating flights are on time but delays increase throughout the day, then slack resources may be added to the flight schedule. Alternatively, delays may occur at hubs due to passenger and baggage transfer. More personnel or equipment might alleviate the problem. If the cause of flight delays are primarily incurred at one airport, potential corrective actions could range from adding staff to more training, additional equipment, or addressing poor labor relations.

The control process is continuous and iterative. Once corrective action is implemented, then data must be analyzed to determine if the correction is effective and the process begins anew. A consistent failure to meet a goal may be the result of an unattainable or inappropriate goal rather than performance.

5.7 Summary

Developing a flight schedule, or Schedule of Services, is an extremely complex task subject to many constraints such as aircraft availability and capability, airport and gate limitations, maintenance requirements, and many others. Tradeoffs must be made between revenue and cost in an attempt to maximize potential profits. Many software applications assist with the task, but none can replace the airline planners. In daily operation, the flight schedule is subject to disruptions, weather being chief among the causes of irregular operations. Most airlines now place various tactical operations managers in an Airline Operations Control Center. Specialists in dispatch, crew scheduling, aircraft maintenance, and passenger service coordinate their decisions through an overall operations manager. In the case of severe disruption, the operations manager has several tools available to restore the schedule including aircraft and crew swaps, slack resources, combining and/or canceling flights. Collection and analysis of operational data are essential to continuous improvement of the airline's flight operation.

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Review Questions

1 The Schedule of Services represents the foundation or basis of the airline product (product attributes such as cabin configuration are also important). What is the economic objective of the schedule? Why does schedule construction consist of a "thousand compromises"? Give an example of one such compromise between revenue maximization and cost minimization.
2 Explain why a mixed fleet, particularly airplanes of different seating capacity, can increase revenue potential and, therefore, profitability? If so, why do Southwest and Ryanair only operate Boeing 737s?
3 How are unit costs (cost per available seat mile, CASM) lowered with higher asset utilization (for example, how is the CASM of an aircraft lowered by flying more hours per day)?
4 How can slack resources (such as a spare aircraft) improve schedule reliability? (Note that this is true for any production process.) If schedule reliability increases revenue through improved passenger satisfaction and repeat

business, why don't airlines build more slack resources into their Schedule of Services?

5 How might a constraint such as available gates at an airport reduce the Schedule of Services revenue potential?
6 What are the typical causes of irregular operations? Which is most common?
7 Why is a hub-and-spoke route structure more vulnerable to large scale weather disruption than a point-to-point or linear system?
8 Why has the AOCC evolved?
9 What functions are typically located within AOCC? Describe the responsibility of each.
10 Why is continuous improvement critical to the success of any business operating in a competitive environment?
11 Describe the Control Process. How can it lead to Continuous Improvement?
12 What are some of the metrics (measures) that an airline tracks to control and improve its operations?

Chapter 6

Economics and Finance

Airlines are notorious for their lack of profitability. This chapter begins with a review of historical world airline profits and then turns to examining the main sources of airline revenue and discussing the interaction between revenue-generating activities. After considering revenue generation, the discussion then turns to airline costs. The many cost factors associated with running an airline can overwhelm managers as they attempt to maintain a competitive cost structure. Understanding these cost factors and their relationships is especially important to legacy carriers as they face ever increasing competition from established and new entrant low-cost carriers. Finally, the chapter examines the fleet selection process and discusses how managers weigh aircraft alternatives in order to make smart choices for fleet expansion or aircraft replacement.

6.1 Profit History

6.1.1 Cyclical World Airline Profits

Since the end of World War II, airline profits have been mostly anemic and increasingly volatile. Figure 6.1 shows the profits for the world's airlines measured in real (inflation-adjusted) U.S. dollars. From 1948 until the mid-1960s, a period in which airlines were highly regulated and many were state-owned, the industry incurred small but stable losses. Then as airline economic deregulation spread across much of the developed world, profits and losses increased dramatically in a series of cyclical swings.

Profits and losses closely track the business cycle, fluctuations in economic activity over irregular periods of time. During periods of expansion, the economy grows in real terms (adjusted for inflation) with increases in jobs, industrial production, sales, and personal income. In a recession, the economy contracts, unemployment increases, production and sales fall. The effects of world recessions in the early 1990s, 2001, and 2008 are evident in large airline industry losses. Recessions cause businesses to hunker down reducing employee travel, thus airline revenue plummets as the highest price tickets go wanting. Leisure travel is less affected, but passengers look for bargains which airlines accommodate to fill

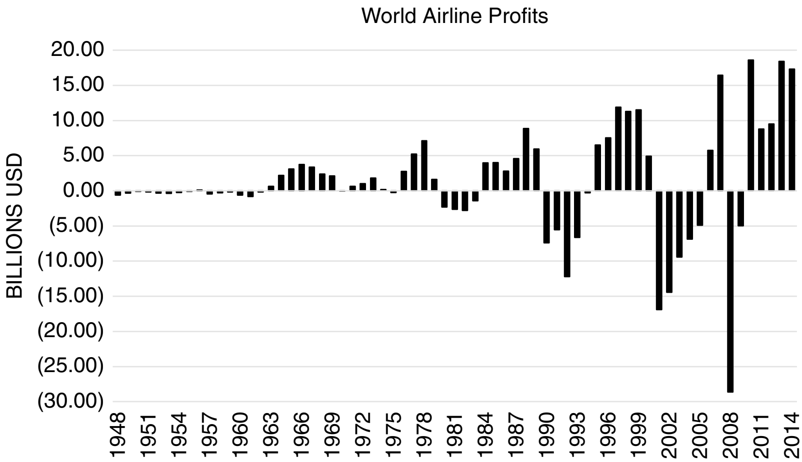

Figure 6.1 World Airline Net Profits. Profits are adjusted for inflation and measured in 2014 dollars.

Data sources: Airlines for America and St. Louis Federal Reserve Bank (2015).

otherwise empty seats. In response to declining demand, airlines reduce flights and cut costs wherever possible, but many costs cannot be cut in the short-term. Among the several fixed costs, aircraft ownership expenses remain. On its leased fleet, for example, an airline must still make the same monthly payments even if aircraft utilization is substantially reduced.

Airlines are also often victims of their own earlier success when profits were high. As economist Paul Clark and others have observed, this profit oscillation is caused by the time lag in adding capacity in response to high demand. In good economic times with rising corporate profits, business activity is vigorous with high-paying business travelers filling airline seats. Airlines, enjoying healthy profits, decide to increase capacity by ordering more aircraft. However, aircraft delivery lead times, which can run four years or more, result in the delivery of the aircraft just in time for the next economic downturn in the business cycle. The airlines are then forced to take delivery of aircraft they do not want or need so that there are too many aircraft and too much capacity for the reduced demand. Large losses ensue (Clark, 2010).

6.1.2 Net Profit Margin

By several measures, the airline industry has historically been a low-margin, low-profit business. Two common metrics for measuring profitability are *net profit margin* and *return on invested capital.*

Net profit margin is calculated by dividing after-tax net income (profit) by total revenue; it is a percentage of total revenue that remains after paying all expenses. In measuring net income as a percentage of total revenue, net profit margin is useful for comparing earnings of firms of varying sizes. Although 2014 was a relatively good year for U.S. airlines with $7.5 billion in net income, this equates to just 4.4¢ profit for each dollar of revenue. An Airlines for America (A4A) analysis shows U.S. airlines' net profit margins lagged behind many U.S. corporations as Figure 6.2 shows.

As Standard and Poor's analyst Phillip Baggaley once noted, airlines "have made progress on what they can control. However, the industry is inherently risky and will be low margin for the foreseeable future" (quoted in Anselmo, 2012, p. 1). Not only have airlines lagged behind firms in other industries but an earlier study by Doganis (2010) put airline profitability at the bottom of firms in other sectors of the aviation industry. Over the period of the study, airlines earned less than 5 cents on each dollar of sales whereas global distribution systems (GDSs) earned nearly 25 cents. See Figure 6.3.

6.1.3 *Profits by World Region*

Profitability varies by world region. In recent years, the North American airline industry has surpassed airlines in the Asia-Pacific region. As shown in Figure 6.4, North American airlines have outperformed other world regions in profit margins with profits measured before deducting interest, taxes (EBIT) and excluding bankruptcy-related expenses.

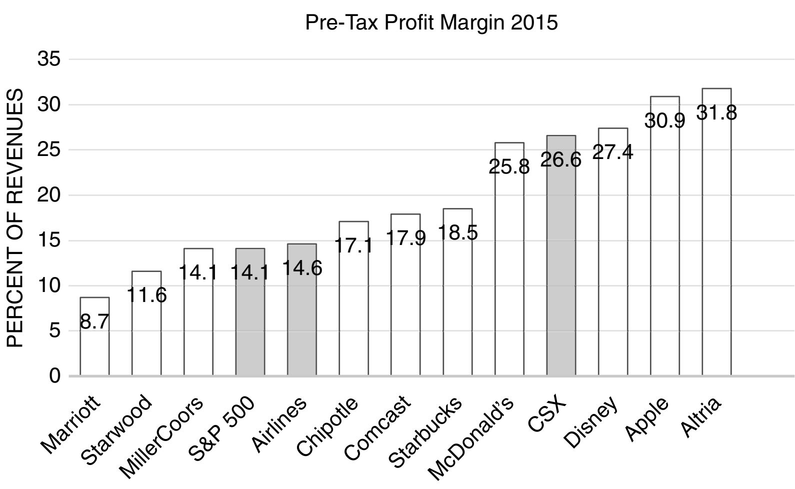

Figure 6.2 2015 Pre-Tax Profit Margins Comparison for U.S. Airlines.

Data source: Airlines for America, 2015.

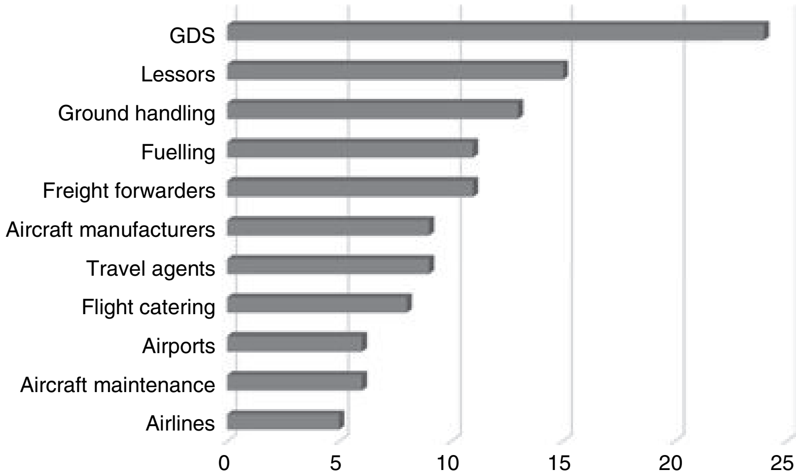

Figure 6.3 Airline Earnings Vs. Other Aviation Sectors 1996 through 2004.

Adapted from Doganis, 2010.

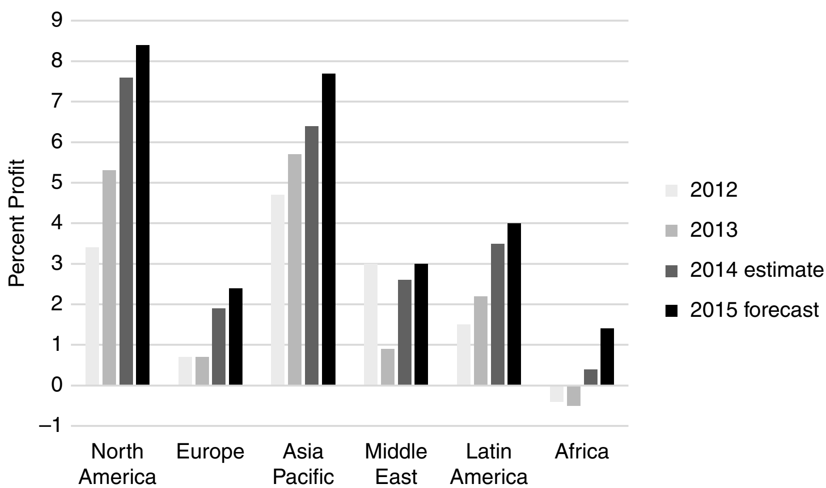

Figure 6.4 Earnings Before Interest and Tax for 2012, 2013, 2014 and 2015 (forecast). Data exclude bankruptcy reorganization and other large non-cash expenses that substantially impacted US airline results.

Adapted from IATA Forecast June 2015.

6.1.4 Return on Invested Capital

Another common measure of profitability is *return on invested capital* or ROIC. ROIC compares profit to all invested capital, equity as well as debt-financed capital, providing a measure of management's efficiency at putting its capital to work in profitable investments. Although it seems easy to compute, airlines use several methods to determine ROIC. The obvious and most frequently used method is to simply divide net profit by total assets. For example, if an airline's net profit is $200M and their total assets are $2.0B, the ROIC is 10%. The thorny part is that airlines do not always compute their profit in the same manner, for example, some use pre-tax figures and other use post-tax figures. Additionally, it is difficult to estimate the assets of an airline because of varied depreciation methods, varied proportions of leased equipment and various government subsidies (Doganis, 2010). Like all financial measures, ROIC is not perfect but does provide another important measure of airline profitability.

Publicly-owned firms must earn a return for their shareholders' investment or the shareholders will move their money to other firms, thereby eliminating one source of funds that firms use to expand. ROIC can be compared with the opportunity cost to investors, in other words, what return would their money earn if it were invested elsewhere at similar risk. This opportunity cost is called the Weighted Average Cost of Capital (WACC). Figure 6.5 compares WACC with airline ROIC from 2000 through mid-2015. For most of this period, airlines underperformed, giving investors a good reason to withdraw their investments. However, in 2015, airline ROIC has, for the first time in decades, outperformed the WACC. This was a combined result of lower fuel prices, controlled capacity growth, and record load factors.

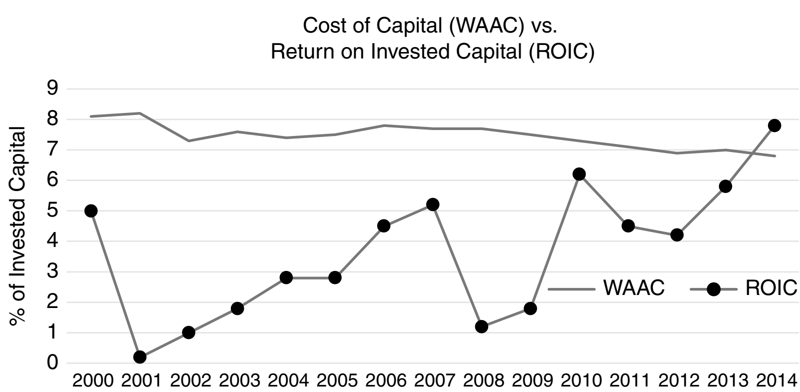

Figure 6.5 Return on Capital 2000 through 2014.

Data source: IATA, 2015.

6.2 Earning Profits

Despite historically low profits compared with other industries, most airlines survive, some since the birth of the industry, so it may be worth asking why profits are important. If airlines are viewed as a public service and state-owned or subsidized as was true for much of airline history, then profitability is not necessary for survival. Indeed, many state-owned airlines are not efficient or profitable, a topic addressed in Chapter 9. However, if airlines cannot rely on government support, then financing must be obtained in capital markets through a combination of stockholder supplied funds and private loans. Investors shun firms which do not promise future profits, so airlines that are perennially plagued by poor profits are unable to obtain funding by selling new stock. A common perception of investors is of a small, elite group of the very rich, but pension funds, insurance companies, and other institutions are the major source of corporate equity financing. Airlines also borrow from commercial banks or by the direct issuance of debt. Like investors, lenders will not make loans to firms with poor prospects for repayment which again depends on future profits. Many airlines have survived surprisingly long periods while making losses but eventually find themselves unable to raise money to continue operations. Those airlines that do not successfully restructure go out of business.

An airline earns profits when total revenues exceed total cost, or *profit = total revenue − total cost*. Revenues for large airlines are many billions of dollars per year. American Airlines, the world's largest carrier, reported total revenue of $42.7 billion for 2014. But billions in revenues are often accompanied by equally high costs resulting scant profits or, as the previous section showed, large losses. The fundamental responsibility of airline executives, beginning from the chief executive officer down through middle managers, is earning profits for the airline's shareholders, so managers must ensure that revenues consistently exceed costs. This is a constant struggle in the airline industry which is competitive and subject to many volatile outside forces. To better appreciate the decisions that managers face, it is helpful to introduce a few more measures of airline finance.

- The *available seat mile or kilometer* (ASM or ASK) is the basic unit of airline production, defined as one airline seat flown one mile (kilometer), whether the seat is occupied or not. Just as an automobile company measures its production by the number of cars produced in a given time period, an airline measures production by the number available seat miles produced in a given period. For example, a 100-seat aircraft flown 1,000 miles contributes 100,000 ASMs to the airline's total production. With hundreds of aircraft flying ten or more hours every day, a large airline's production in ASMs is a huge number ranging in billions per month. Using American Airlines again as an example, it reported producing 24.3 billion ASMs in August of 2014. Two other metrics follow directly from the ASM, the revenue and cost per available seat mile.

- *Revenue per available seat mile* (RASM) is the money an airline earns from a unit of production. RASM (pronounced ras-um) is computed by dividing total revenue by ASMs per period of time, usually either a month, quarter, or year. Because RASM measures the revenue for the airline's unit of product, it is also known as *unit revenue*. If a small airline has revenues of $100 million in a month in which it produced one billion ASMs, RASM is 10 cents. In recent years, the term *passenger revenue per available seat mile* (PRASM) has been added to the airline financial lexicon to distinguish it from total RASM which includes revenues from cargo and other sources in addition to passenger revenue. PRASM is measured in U.S. cents or similar unit in other currencies. PRASM for the U.S. airlines for 2014 was a little under 14 cents.
- *Cost per available seat mile* or *kilometer* (CASM or CASK) is similar to RASM, but measures the cost, rather than revenue, of producing an ASM. It is computed by dividing the airline's total cost per a period of time by the ASMs. CASM (pronounced cas-um) is also known as *unit cost*. Because fuel prices are volatile, airlines often also measure CASM without including fuel cost or CASM ex-fuel. Fuel prices are mostly beyond management's control, so CASM ex-fuel provides a better comparison over time of management's success in controlling costs. When RASM exceeds CASM, an airline is profitable.
- *Revenue passenger mile* or *kilometer* (RPM or RPK) is the basic measure of airline passenger traffic. It reflects how many of an airline's available seat miles were actually sold. For example, on a flight of 1,000 miles with 100 passengers are aboard, the airline generated 100,000 RPMs (regardless of the aircraft seating capacity).
- *Load factor* (LF) is the portion of an airline's production that is sold. For any given flight, load factor is the percentage of seats occupied or the number of passengers divided by the number of seats. For all flights, LF is computed by dividing RPMs by ASMs.
- *Yield* is the price a passenger pays for per mile flown, so it's a direct measure of the airline's average price. To compute yield, divide total passenger revenue by RPMs. Typically measured in cents per mile, yield is useful in assessing changes in fares over time. Yield is easily confused with RASM. Yield does not incorporate or vary directly with load factor as RASM does, so an airline might have a relatively high yield but a low load factor. In this case, yield would be much higher than RASM.

With these metrics in hand, we can define a more sophisticated profit equation that provides valuable insights into the options a manager has available to earn profits.

$$\text{Total revenue} = \text{Yield} \times \text{RPM},\ \text{RPM} = \text{ASM} \times \text{LF, and}$$
$$\text{Total Cost} = \text{ASM} \times \text{CASM}$$

Substituting these identities into the basic profit equation: *Profit = (Yield × LF × ASM) − (ASM × CASM)*. By considering how each factor in this equation can be managed, we will see that the interaction or dependency among the factors sometimes thwarts the manager's effort to increase profits.

Faced with losses or low profit, raising the ticket price is often the first option for the manager to consider. But raising the price, which directly increases yield, will reduce load factor. The fundamental microeconomic law of demand holds that people will purchase less of a product the higher the price, all else remaining unchanged (ceteris paribus). Passengers traveling for leisure are especially price sensitive. Many will choose an airline based primarily on price, so raising the price by as little as $10 will drive some potential passengers to a competitor. Then load factor will fall. Whether the price increase results in more or less revenue depends on the number of passengers who choose another airline, or the price elasticity of demand in economic terminology. In other words, raising price may be self-defeating. Airline pricing, which is surprisingly complex, is the subject of Chapter 7.

Next, the manager might consider increasing load factor and filling seats that would otherwise go empty. The problem here is the inverse of raising the price. The most direct means of filling more seats is to lower the price thereby attracting the most price-sensitive passengers. It may be possible to make discount fares available only to those passengers without lowering the fare of other passengers. But if all fares are reduced, yield may fall substantially so total revenue also falls.

The final factor in the equation that could increase revenue is ASM. By flying aircraft more hours per day and increasing ASMs, revenue will increase. Unfortunately, as with the two previous examples, this tactic may or may not be successful. If aircraft are operated more hours per day, then some flights must be flown at periods of lower demand. Adding flights in the late night and early morning hours, so-called red-eyes, will substantially increase aircraft utilization and ASMs, but flights that depart during these hours are not popular with most travelers. In order to encourage passengers to choose a red-eye flight, prices must be very attractive. Yield falls and revenue may or may not increase. Alternatively, an airline might consider reducing ASM in order to boost yield. But if other airlines don't also reduce or, at least, restrain their capacity growth, the benefits for a single carrier are likely limited. In fact, some of the recent profits of U.S. carriers is attributed to "capacity discipline"; that is, reduced ASM growth. In the fall of 2015, the U.S. Department of Justice launched an investigation of the big 4 airlines for illegally colluding to restrain capacity growth, an allegation that most analysts and industry observers feel is baseless (Karp and Walker, 2015).

The cost side of the equation includes just two factors, CASM and ASM. There are many avenues for lowering CASM which are considered later in this chapter, so only ASM is addressed here. ASMs are increased by flying more hours per day. This spreads the fixed cost, such as monthly lease costs, across more ASMs. While CASM will decrease with more flight hours, total cost also increases. As noted above, some flights offered at times of lower passenger demand will likely decrease yield offsetting some or all of the benefit of lower cost. Another way to increase ASMs is to put more seats in the aircraft. This is typically done by decreasing the legroom in economy class. The trade-off here is between passenger comfort and price. Less comfort means the airline may have to lower prices. As we've seen in Chapter 4, LCCs employ high aircraft utilization and high seat density to lower CASM.

6.3 Revenue Generation

With this general overview of the factors that drive airline profits, we turn now to a more detailed examination of airline revenues. Although there are a couple of other sources we'll discuss later, an airline's revenue comes primarily from passenger ticket sales. Passenger revenue can be best understood by examining its components. In general terms, revenue is the product of the price times the quantity sold. In the airline profit equation, revenue is the product of yield and RPM.

6.3.1 Yield History

Figure 6.6 shows yield in both real and nominal values. Nominal yield does not account for inflation while real yield is adjusted for inflation so that prices can be compared over time. In this figure, real yield is shown in 2014 dollars. With just a few exceptions, real yield has declined steadily over the entire period. In other words, the price of the airlines' product declines over time. Over the long term, prices closely follow costs. During the period of economic regulation, the decline in costs was primarily the result of rapidly improving technology, especially more productive and efficient aircraft, but also from automation of other airline functions. Because regulated prices were set at cost plus a profit margin, declining cost

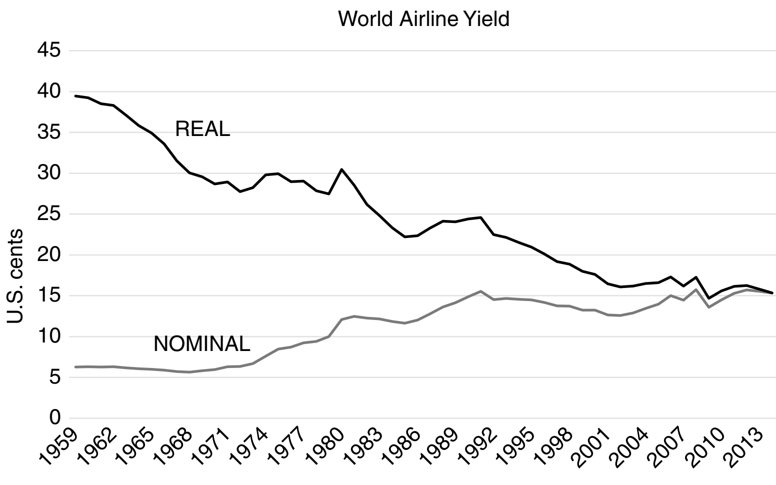

Figure 6.6 World Airline Nominal and Real Yield, 1959–2014.

Data source: Airline Monitor, 2015; Bureau of Labor Statistics, 2015.

led to lower prices. Prices are still set this way on many international routes subject to government control, but with the spread of economic deregulation, competition has driven down fares. Aircraft technology has continued to improve, especially with increased fuel efficiency of newer high-bypass jet engines. Automation in all areas of airline operations has decreased costs. Referring to Figure 6.6 again, note that the nominal yield has stayed in the 10¢ to 15¢ range throughout the period. This means that the average nominal price of an airline ticket was about the same in 2014 as it was almost 35 years earlier even though consumer prices have increased 2.5-fold over the same period.

6.3.2 Fare History

Airlines periodically attempt to raise prices, but if other airlines don't match the proposed increase, the airline faces the loss of the most price sensitive passengers. Because of the effects of competitors' reactions, the airline might "test the water" with a unilateral fare hike, hoping that their competitors will join in. If competitors follow, the fare hike succeeds and the airlines benefit. If competitors do not follow, the instigator really has no choice but to rescind the increase, or risk losing market share to the lower-priced competitors. Table 6.1 shows attempted fare increases for U.S. airlines in 2013. Only three of the 12 attempts succeeded. The failures are typically caused by low-cost airlines refusing to go along with the increase. The point is illustrated by a famous, perhaps infamous, phone conversation between the CEOs of Braniff and American Airlines. In 1981 Braniff Airlines, under the leadership of Howard Putnam, began slashing fares in order to undercut American at Dallas-Fort Worth. In the conversation between American CEO Bob Crandall and Putnam, Crandall appears to try to get Putnam to agree to a bilateral 20% price increase. "You will make more money and I will too," said Crandall (Petzinger, 1995, p. 167; Flottau, 2015). Although this seems a clear case of price collusion, which is a violation of antitrust laws, Crandall was only mildly reprimanded for the suggestion because it was never carried out.

An article from the San Antonio Express-News further illustrates the issue. This article describes an attempted fare hike in 2004 started by Continental. American and Delta both joined in, but all three were forced to retreat after Northwest and Southwest refused to go along.

> Major air carriers including Texas-based Continental Airlines and American Airlines have pulled back from a $10 fare increase on round trips after unwillingness by Northwest Airlines to ramp up prices. Other airlines, including Delta Air Lines, also retreated Monday. Houston-based Continental, the nation's fifth-largest carrier, announced Friday it was increasing round-trip fares by $10. Some other major competitors quickly matched Continental, which had said higher fuel cost made the increase necessary. Dallas-based Southwest Airlines wasn't about to match the increase.
>
> ("Airlines Rescind," 2004)

Table 6.1 2013 Attempted Fare Increases

Attempt	*Date*	*Initiating Carrier*	*Status*	*Roundtrip Increase*
1	Jan 4	United	Failed	$4–$10
2	Jan 16	United	Failed	$4–$10
3	Feb 12	Delta	Failed	$4–$10
4	Feb 20	Delta	Success	$4–$10
5	Feb 28	Delta	Failed	$4–$10
6	Apr 11	Delta	Success	$4
7	Apr 22	Delta	Failed	$6–$10
8	Jul 11	United	Failed	Up to $10
9	Aug 13	Delta	Failed	$20
10	Aug 30	Delta	Failed	$4–$10
11	Sep 10	United/Air Canada	Success	Up to $10
12	Dec 10	Delta	Failed	$4–$10

Source: Seaney, 2013.

Table 6.1 shows 2013 attempts by various U.S. airlines to instigate fare increases. Of the 12 attempts, only three succeeded.

6.3.3 Revenue Passenger Miles

The other component of airline revenue is the quantity of travel purchased, or revenue passenger miles. The RPM, in turn, is the product of the quantity produced (available seat miles) times the percent purchased (load factor). Each of these components is examined next.

Available seat miles

Airline capacity as measured in ASM has grown steadily over many decades. Figure 6.7 shows world airline capacity growth since 1969. The upward trend is occasionally interpreted by capacity reductions in response to severe economic shocks with the effects of the recessions of 2001 and 2008 especially prominent in the data.

Load factor

The load factor, the number of seats actually purchased divided by the number produced, is as important as the average ticket price. Airlines have been successfully increasing load factors over the years, filling more and more of their seats even as capacity has increased. Higher load factors increase airline efficiency as fewer available seats go unfilled or spoil. This increased efficiency is the result of many changes including intense competition, more efficient scheduling, the rise in non-refundable fares, and the increasing sophistication of revenue management systems.

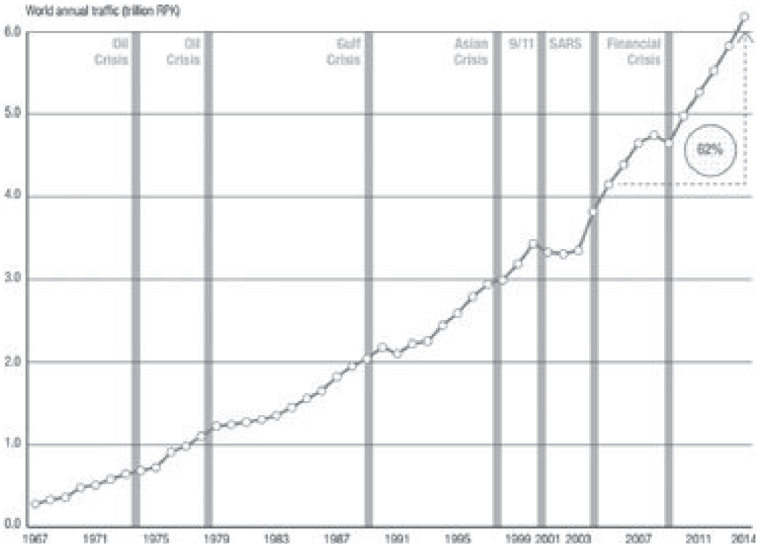

Figure 6.7 World Airline Capacity 1969 to 2014. Courtesy of Airbus, 2015a.

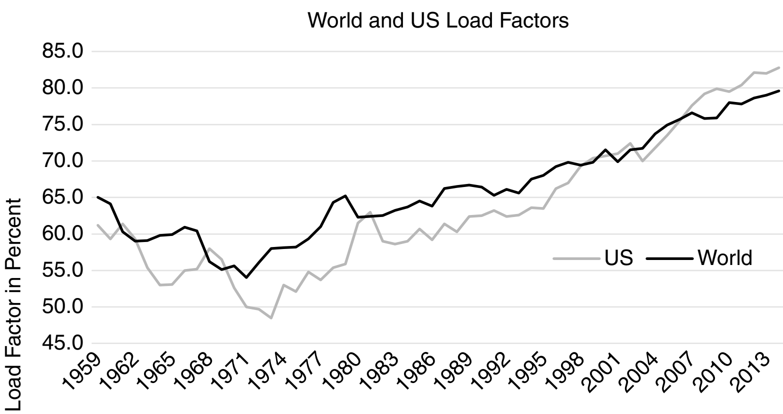

Figure 6.8 World and U.S. Airline Load Factor from 1960 through 2014.

Data Sources: Airline Monitor, 2015; Airlines for America, 2015.

Figure 6.8 displays both world and U.S. airline load factors revealing an interesting reversal of positions beginning with the twenty-first century. U.S. load factors lagged those of the world until a rapid increase following the 2001 recession but now exceed world load factors by about 5%. This reversal probably results from major airline restructuring, mostly through the bankruptcy of the U.S. legacy carriers. Many of the world's oldest and largest airlines are currently restructuring as well but at different rates and degrees of success.

These data may seem to contradict the often-heard complaints from travelers that flights are always full (100% load factor). Many popular flights are usually full, but the demand for travel is highly variable. For example, travel to popular events is directional; before the event, passengers travel to the location, and after the event, passengers travel back home. Most passengers experience only the full flights; they don't see the mostly empty aircraft that leave after dropping them off or come in to pick them up. Some of these repositioning flights operate with very low load factors. Flights during off-peak hours, like overnight red-eye flights and very early departures or very late arrivals are generally not full. As mentioned earlier, to have an aircraft available for a high demand flight, it may have to reposition to the departure airport almost empty. When the load factor is averaged out over the airline's entire network, taking into consideration not only the full flights but also the less full off-peak and nearly empty repositioning flights, the practical limit is about 85%. As Figure 6.9 indicates, many airlines are approaching this limit. A notable exception to this limit is Allegiant Air. Allegiant flies a somewhat unusual schedule, sometimes flying to a particular airport only once a week. They go so far as to completely ground their aircraft two days a week. Using this scheduling technique, they are able to avoid off-peak and repositioning flights and post some of the highest load factors in the industry—sometimes over 90%.

Breakeven load factor

Breakeven Load Factor (BLF) is the average percent of seats that must be filled on an average flight at average fares for the airline's passenger revenue to equal the total cost. BLF is determined using a simple equation:

$$\text{BLF} = \text{CASM} \div \text{yield}$$

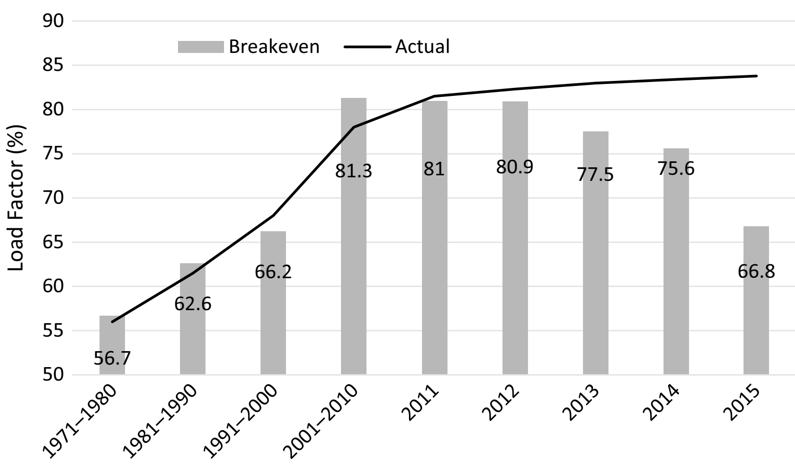

Figure 6.9 Breakeven Load Factors for U.S. Airlines from 1971 to 2015.

Source: Airlines for America, 2016.

If CASM is unchanged and yield goes down, the breakeven load factor goes up. Intuitively, if costs stay the same and fares go down, the breakeven load factor would have to go up. Alternatively, with a constant yield, if costs increase the breakeven load factor increases.

During recessions, ticket prices fall as airlines attempt to keep seats filled, but the drop in yield raises the breakeven load factor. If the airline drops yield at the same time as an unavoidable increase in costs, like a spike in fuel costs, the airline becomes the victim to the "double-whammy" leading to a sharp increase in the breakeven load factor. This is what happened beginning in the summer of 2008 when skyrocketing fuel prices dramatically raised CASM while, at the same time, yields declined. Average load factors fell below breakeven load factors and airlines lost money. Figure 6.9 shows the significant difference between average actual and breakeven load factors for 1978 through 2014.

Understandably, many casual observers of the industry fall victim to the fallacy of concluding that an airline must be profitable because flights are nearly always full. If ticket prices (yield) are low and costs are high, an airline can lose money even with every seat full. During recessions, some carriers have reported CASM and yield combinations that result in breakeven load factors over 100%. Note from Figure 6.9 that for several years, the breakeven load factor was above 80%, nearing the practical limit of about 85%.

Southwest Airlines' historical low breakeven load factor is another illustration of the fact that none of the factors affecting total revenue can be viewed in isolation. Until recently Southwest Airlines has operated with lower load factors than its competitors, yet it is more profitable. Despite its reputation for low fares, Southwest actually enjoys fairly high yields. The combination of low costs (CASM) and high yield result in a relatively low breakeven load factor. Southwest was profitable with low average load factors because the breakeven load factor is even lower. Conversely, during the 2008 global recession, airlines maintained high load factors, but seats were filled with low-yield leisure passengers as business travel dropped significantly. Breakeven load factors went up and even relatively high average load factors were not high enough to make a profit. Revenues fell by 20% or more and most airlines suffered losses.

6.3.4 Ancillary Revenue

In addition to passenger ticket revenue, airlines also make significant revenue from ancillary sources. *Ancillary revenue*, or revenue separate from the base airfare, first arose in 2007, when Spirit Airlines began charging for checked luggage. The idea spread like wildfire and between 2007 and 2014, ancillary revenue has grown more than 1,400% worldwide—from \$2.45B in 2007 to \$38.1B in 2014 (Figure 6.10) ("The Unfriendly Skies," 2015; "Airline Ancillary Revenue," 2015). The 2014 income represents an increase of \$6.6B in just one year, a nearly 21% increase. Ancillary revenue sources vary airline-to-airline, but examples include luggage fees (both checked and carry-on), reservation change

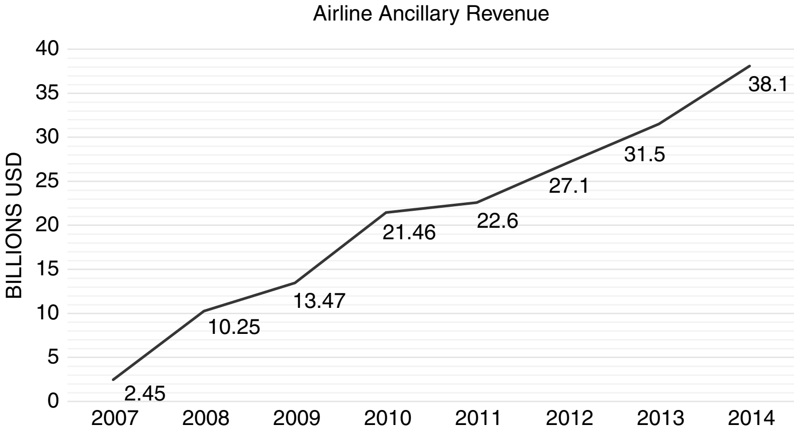

Figure 6.10 Worldwide Ancillary Revenue Growth from 2007 through 2014.
Data source: "2014 Airline Ancillary," 2015.

fees, boarding priority fees, Wi-Fi fees, and preferred seating fees—to mention just a few.

There are several major areas to categorize ancillary revenue. Figure 6.11 shows ancillary revenue sorted into four major areas: frequent flier miles, baggage fees, a la cart services and retail travel services.

Frequent flier miles

Airlines can earn ancillary revenue by selling their frequent flier miles (FFM) to various companies who give them away as customer incentives. For example, a credit card company might offer airline FFMs for credit card purchases. Assuming these FFMs are eventually redeemed for travel, the airline absorbs a cost. To cover those redemptions, the credit card company pays the airline a fee for the FFMs the credit card issues to customers. Figure 6.11 shows the fees collected by airlines for FFMs amounted to about 55% and accounted for the largest portion of an airline's ancillary revenue in 2013.

Baggage fees

Airline fares in the pre- and early post-deregulation years included many complementary services in the basic fare. One of those complementary services was the ability to check at least a couple pieces of luggage. Before 2007, airlines charged only for overweight bags (over 50 pounds) or additional bags above their one- or two-bag limit. Mounting airline costs and poor revenue in 2007, however, forced the airlines to look for ways to increase revenue. Spirit Airlines and American Airlines

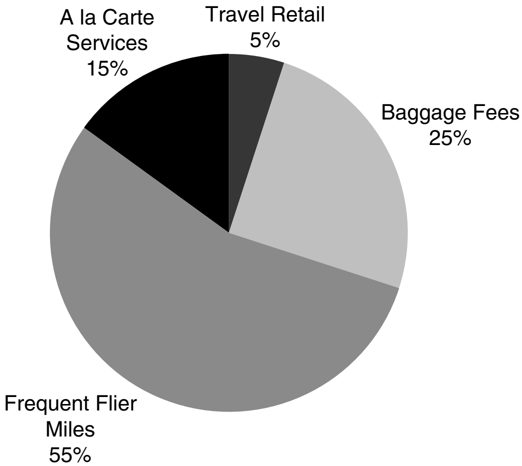

Figure 6.11 Key Ancillary Revenue Components of U.S. Airlines in 2013.

Source: "Airline Ancillary Revenue," 2015.

broke the trend when they began to charge for the first checked bag. By 2010, most other airlines had joined in; the only two holdouts were Southwest (two free bags), and Jetblue (one free bag) (McDermott, 2010). In 2015 JetBlue succumbed to the pressure and started charging for even the first bag, leaving Southwest the only U.S. airline that doesn't charge for luggage (Dastin, 2015). Southwest CEO Gary Kelly says they have no plans to add baggage fees (Martin, 2015). Figure 6.11 shows that baggage fees attributed to 25% of total airline ancillary revenues in 2013.

A la carte services

Before 2008, airline basic fares also included other complementary services including reservation changes, in-flight meals and beverages, tickets, seat selection, and cabin overhead storage. As soon as baggage fees were "unbundled" from the basic fare, it opened the floodgates and soon airlines were charging for other former complimentary services. This led to what is now call *menu pricing,* where the basic fare does not include many amenities but is supplemented by many additional, usually optional, fees. A la carte services accounted for about 15% of the total ancillary revenue in 2013 (Figure 6.11).

Travel retail

This category of ancillary revenue includes revenue airlines collect for travel-related retail sales from their websites. These could include commissions from hotels and car rental companies for bookings made on the airline's website, or fees collected by the airline for advertising they might sell. An example might include hotel advertising

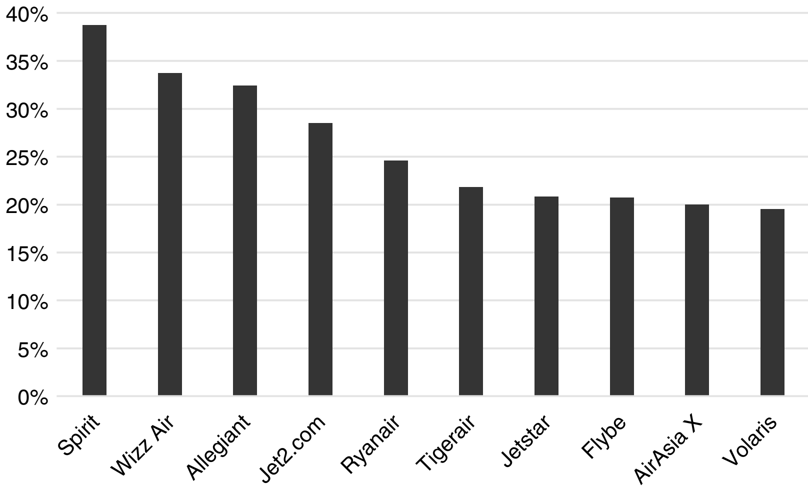

Figure 6.12 Ancillary Revenue as a Percent of Total Revenue.

Data source: Airline Ancillary, 2015.

on an airline's cocktail napkins, or on their website. Another travel retail revenue might be an airline's sales of travel insurance. Travel retail income was the lowest ancillary revenue source at only about 5% in 2013 (Figure 6.11).

Figure 6.12 shows several world airlines and the percent of their total revenue that is attributable to ancillary revenue in 2014.

The menu pricing fees that can be added to the basic fares can be significant and not always transparent to the customer. For example, JetBlue charges as much a $100 to change a reservation, and Spirit might charge as much as $100 to store a bag in the cabin overhead compartment (Figure 6.13).

In the first quarter of 2015, U.S. airlines raised a whopping $864 million from checked baggage fees (Martin, 2015). The tremendous growth of this income area, coupled with the travelers' feeling that not all fees are transparent to customers, led the European Commission to enact regulations requiring fare transparency back in 2008 (European Commission, 2013). Ryanair was singled out as an offender. Apparently not having entirely mended its ways, Ryanair was fined $521,000 by Italian regulators for failing "to simplify online ticket sales, and that consumers are not given a crystal-clear picture of overall ticket prices at the beginning of the booking procedure" (Osborne, 2013). Similar concerns resulted in an investigation by the U.S. Senate Committee on Commerce, Science, and Transportation of U.S. airline practices ("The Unfriendly Skies," 2015). The Committee made seven recommendations:

- Ancillary fees should be standardized and disclosed early in the booking process.

Figure 6.13 Spirit Airlines Carry-On Bag Rules.
Photo by B. Billig.

- Checked and carry-on baggage fees should have a clear connection to the costs incurred by the airline.
- Airlines should promptly refund fees for any checked bags that are delayed more than six hours on a domestic flight.
- Airline change fees should be limited to a reasonable amount tied to lead time prior to departure and maximum percentage of the original fare paid.
- Airlines should provide clear disclosures that "preferred seat" charges are optional.
- Airline and travel websites should have a clear and conspicuous link to the Department of Transportation's Aviation Consumer Protection Website.
- The Department of Transportation should update its aviation consumer protection website to improve the consumer experience. ("Unfriendly Skies," 2015)

Airlines for America President Nicholas Calio responded to the Committee's report, saying that optional services are a positive development for both consumers and airlines and that airlines have an incentive to transparently market their optional services (Calio, 2015).

6.4 Cost Structure

Next we look at airline costs. Federal laws require that U.S. airlines submit cost data to the Department of Transportation on a monthly, quarterly and annual basis, so we have more extensive data on U.S. carriers than for airlines in many other regions. Airline costs as a percentage of total operating expenses, categorized by administrative areas, are shown in Figure 6.14 for the first quarter of 2015. Labor and fuel are the two largest expenses for airlines comprising nearly 50% of total cost. The third highest cost category is called *transport related*, not a very helpful label. This category includes several smaller expenses, but the major expense is the purchase of capacity from regional airlines or what the comprehensive network carriers pay to their regional partners to provide service on some routes. Rents and ownership represent the capital cost of all of the airlines' assets including aircraft which are more than half of this category. A surprisingly large cost is for professional services. Included are attorney fees and other legal services, engineering, and consultants fees. Legal and consultant fees are substantially increased in bankruptcy. All other expenses ranging from catering to advertising and insurance make up the remaining 18.2%.

Because fuel and labor are the two largest expense categories, airlines must attempt to control both in order to remain competitive and profitable. The next section explains what airlines can, and cannot, control.

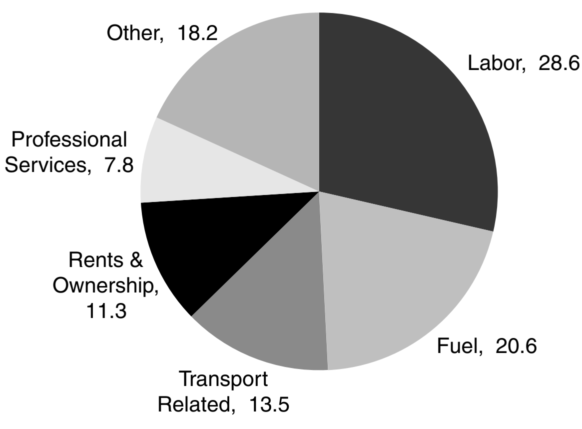

Figure 6.14 U.S. Airline Administrative Cost Percentages for the 1st Quarter of 2015.

Source: Airlines for America, 2015.

6.4.1 Labor

Labor has traditionally been the highest cost category but has, at times, been overtaken by volatile fuel prices. A huge spike in oil prices in 2008 prior to the Great Recession drove fuel costs to nearly twice that of labor. For much of airline history, management regarded labor costs as uncontrollable. Airlines in the developed economies were highly unionized and labor fiercely opposed attempts to increase productivity or reduce wages. While some concessionary contracts were negotiated during recessions, wages and work rules were usually restored, with enhancements during the next economic boom. The recession of 2001 altered the dynamics of labor/management relations, especially in the United States. Legacy carriers in Europe and elsewhere remain under pressure to obtain more labor productivity, a topic we take up later, but results are uneven. We begin by considering the actions of U.S. airlines to reduce labor cost and improve productivity in the wake of the 2001 recession.

The first response to large losses was to cut flights and furlough employees. U.S. airlines initially furloughed some 100,000 employees including 10,000 pilots and flight attendants. Those that remained on the job were required to work harder and become more efficient. As Figure 6.15 shows, employment peaked at 674 thousand in 2000 falling to a low of 514 thousand 10 years later before beginning a modest increase. Airline production as measured in ASM, on the other hand, dropped for a few years but then began increasing even as employment was reduced. The result is a dramatic increase in employee productivity, output divided by input. Figure 6.16 illustrates the increase in productivity by dividing ASMs by the number of full-time equivalent employees.

Productivity increases were achieved by many means. Automation, such as passenger check-in kiosks, replaced some employees. Other work was outsourced to

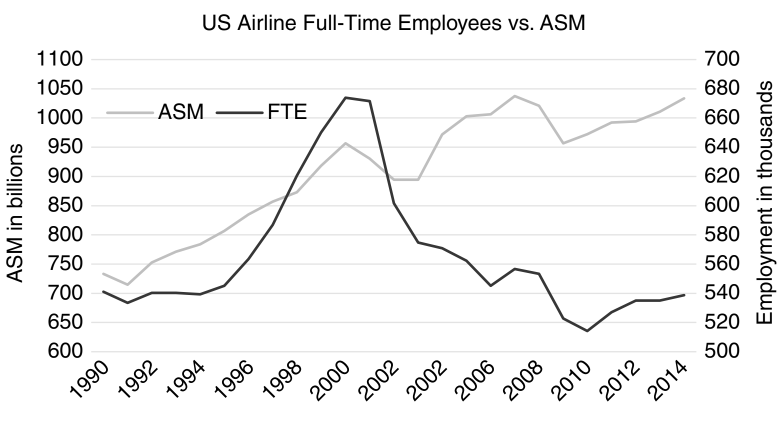

Figure 6.15 U.S. Airline ASM Versus Full-Time Equivalent Employees.

Data sources: Airlines for America, 2015; Bureau of Transportation Statistics, 2015.

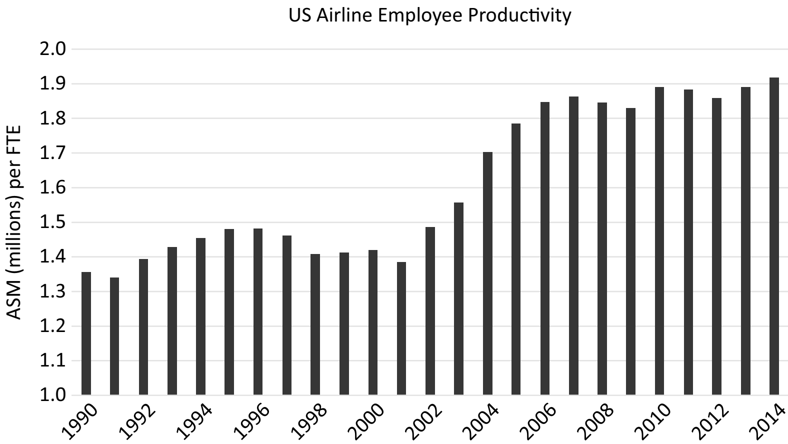

Figure 6.16 Labor Productivity in the U.S. as Measured by ASM Per Full Time Equivalent (FTE) Employee.

Data source: Bureau of Transportation Statistics, 2015.

third parties. Work rules were revised to increase the hours worked while reducing vacations and other time off work. The number of employees per task was reduced wherever possible. For example, flight attendant staffing per flight that often had been above the minimum regulatory requirements was reduced.

Reducing labor costs

Increasing productivity lowers an airline's cost of production, but airline employee wages were also reduced. All legacy carriers renegotiated union contracts with the pilots usually being the first to experience some of the biggest pay cuts. While American and Continental were able to reach agreements with their labor groups outside of bankruptcy, US Airways, United, Delta and Northwest all filed bankruptcy, in part, to force labor groups to accept lower compensation which airlines believed was essential to their survival. With U.S. airlines' return to profitability, recent labor contracts have restored many of the pay cuts.

Labor outsourcing

As the U.S. comprehensive network airlines reduced domestic capacity, many routes were turned over to their regional airline partners. Regional airlines offer significantly lower wages than their major airline partner for comparable positions with the major airline partner, so average compensation is reduced and the network carrier saves money. This is especially true for pilots, which are one of the highest paid labor groups. Moving flying from the highly paid network pilots to lower paid regional pilots can result in furloughed network pilots and more work for regional pilots. Between 2000 and 2009 network carriers grounded almost 800 narrow-body aircraft, taking with them over 14,000 pilot jobs. During the same period, regional airlines' capacity went up 178% tripling their share of the domestic market (Swelbar, 2010). Network pilot contracts attempt to limit this activity by including *scope clauses* in their contracts. A scope clause seeks to limit the network carrier from transferring their capacity to the regional affiliate. Scope clauses usually include a limit on the size of the regional jet based on seats or gross weight; the smaller the limit the better for the network pilots. For years scope clauses restricted network carriers from transferring flying hours to regional carriers with aircraft larger than 50 seats. This allowed major carriers to use small regional jets in some markets, but restricted the use of larger regional jets which could be used in many more markets. Under restructuring, scope clause limitations have been relaxed (Compart, 2013).

Airlines also expanded outsourcing of other tasks. Outsourcing of heavy aircraft maintenance to third parties, often offshore, was greatly expanded. Other back office functions, including accounting, and reservations, can be moved to low labor cost countries. This step is not limited to legacy carriers; in 2007, low-cost carrier Spirit Airlines closed its domestic reservation centers and outsourced all reservations to the Philippines and the Dominican Republic. Southwest contracts much of its heavy maintenance to El Salvador.

Pensions

Employee unions and airlines negotiate retirement benefits based on salary and other variables. Typically, airlines opt for two different types of retirement plans—*defined benefit plans* which are much like pensions; and *defined contribution plans* which are savings plans, such as the U.S. 401K programs, where employee contributions are matched to a predetermined level with company contributions. Some airlines use one plan or the other—some a combination of both. Older airlines tended to offer defined benefit plans with younger companies opting for defined contribution plans.

Defined benefit plans

Many airlines with defined benefit plans found that pension plan payments became a significant component of labor cost and a huge liability. With defined benefit plans, airlines invest funds in the financial markets to pay future benefits for employees. The ability to pay the promised benefits depends on the amount invested and estimated market returns. If market returns are less than estimated, the retirement plan becomes under-funded and more money must be invested to fund the plan. On several occasions, airlines entering bankruptcy asked the bankruptcy courts for approval to drop the underfunded plans. Delta, United, and US Airways terminated their significantly underfunded pensions in bankruptcy.

American sought to do so as well, but the bankruptcy court did not approve. For terminated pension plans, the Pension Benefit Guarantee Corporation (PBGC), a U.S. government agency that provides pension insurance, became trustee of the plans, assumes the obligations to retirees, but because of Congressional limitations on PBGC payouts, many retirees saw their pension payments cut to pennies on the dollar (Pension Benefit Guarantee Corporation [PBGC], 2013). As of 2005, other airlines also had significant underfunding. Delta topped the list with a deficit of $5.3 billion when it declared bankruptcy in 2005. In 2006, the bankruptcy court gave Delta approval to terminate its plan, and transfer retirement pension responsibility to the PBGC (PBGC, 2013). More recently, Air Canada was able to gain the approval of all employee unions to defer pension contributions as it attempts to return to profitability. Worldwide, many long-established carriers struggle to fund employee pension plans.

Defined contribution plans

Defined contribution plans, such as U.S. 401K plans, are common for newer airlines and LCCs. Employees and the company make tax-deferred investments into stock market funds. With some limitations, these investment funds are controlled and maintained by the employee. Unlike older defined benefit plans, the invested funds are owned by the employees, usually after some vestment period. Although the employee bears the risk of the investment's return and subsequent overall value, the employee owns the plan and economic failure of the company cannot result in the elimination of the fund. Funds are withdrawn at retirement; the amount available dependent on the amounts deposited by employees and their companies and the investment return.

6.4.2 Fuel

Prior to the Great Recession of 2008, fuel prices quickly doubled from $2 to $4 per gallon (see Figure 6.17). Then the recession reduced the demand for oil worldwide and the price plummeted. In 2015, airlines were once again enjoying relatively low fuel prices which, in large part, are responsible for much higher profits. The U.S. Energy Information Administration (2015) predicts low and stable prices for the foreseeable future, but oil prices are subject to many global forces that are difficult to anticipate. Nonetheless, the prospect is for labor to remain the highest airline expense category.

Fuel efficiency

Faced with rapidly escalating fuel prices in the first decade of the century, airlines ordered new aircraft with improved fuel efficiency in record numbers. When All Nippon Airways replaced older jets with the Boeing 787, it reporting fuel savings of over 20% on long-range flights (Norris, 2012). Jet engine manufacturers have

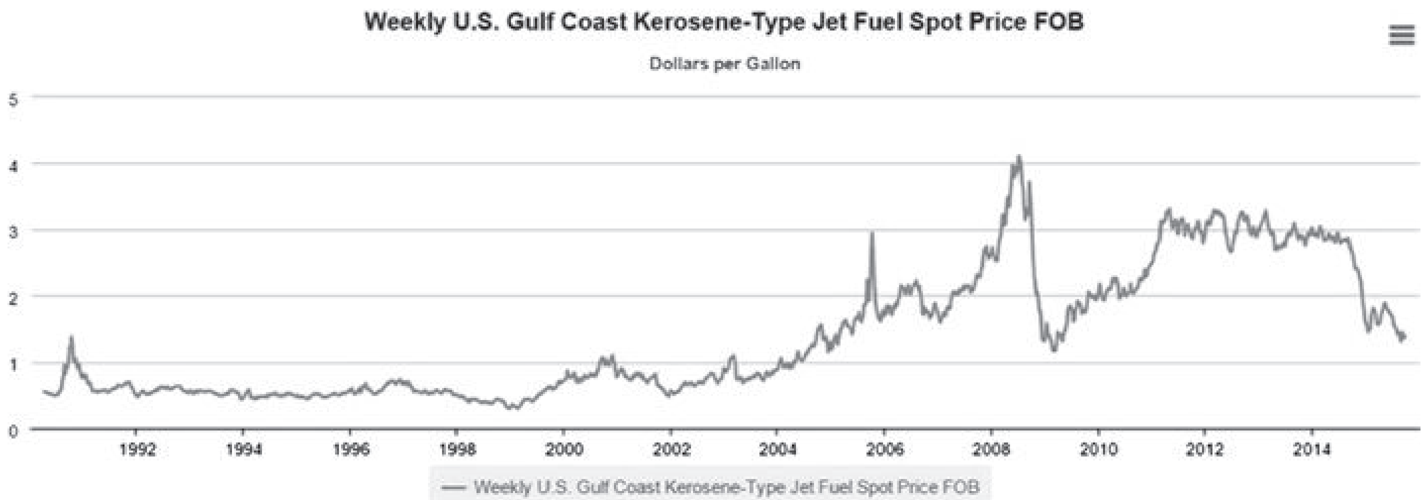

Figure 6.17 Historical Jet Fuel Prices.

Source: U.S. Energy Information Agency.

steadily improved fuel efficiency with new aircraft, such as the B-787, being 70% more fuel efficient than those of 40 years ago including a nearly 20% increase in the first decade of the twenty-first century. The introduction of the latest technology in commercial jet engines combined with aerodynamic improvements, particularly on the popular Airbus 320neo and Boeing 737max that will enter service in 2016, promise an additional 15% improvement.

Recall that ASMs are a measure of airline production, so ASMs per gallon is a measure of how much production airlines are getting for their fuel. This measures the bottom line for airline fuel productivity. Fuel efficiency simply measures the mileage of the aircraft. To use an automobile analogy as an example of these concepts, consider the following: a high power two-seat sports car averages 15 miles per gallon (fuel efficiency). Another vehicle, a 10-passenger van has the same fuel efficiency at 15 miles per gallon, but it carries 10 seats. As you can imagine, the van has a much higher fuel productivity being that 10 people can ride for the same fuel as two in the sports car.

Table 6.2 shows specific productivity examples for Boeing 737–700 and Airbus A321 aircraft operated by both legacy and low-cost carriers during 2010. Note that in all cases, low-cost carriers Air Tran, Southwest and Spirit achieved better productivity than the legacy carriers Continental and Delta flying the same aircraft. This difference in productivity derives from the differences in seating configuration. As seats are added, CASM decreases. For example, US Airways (now merged with American) configures their A321 to seat 187 passengers while Spirit Airlines has 218 seats in its A321s.

Fuel hedging

While the fuel efficiency of new aircraft reduces fuel cost, fuel hedging is a financial means of protecting an airline against the unpredictable volatility of fuel prices. Hedging locks in the price of the airline's future fuel purchases, essentially providing an insurance policy against catastrophic fuel price increases. Southwest Airlines has historically been the most aggressive in fuel hedging of U.S. airlines. In some periods of rising fuel prices, hedging has allowed Southwest to earn a profit from what otherwise would have been a loss. But Southwest states

Table 6.2 Fuel Productivity (ASM per gallon) for Selected Airlines for 2010

Airline	*Type of Airline*	*B737–700 ASM/gallon*	*A321 ASM/gallon*
Continental	Legacy	69.42	N/A
Delta	Legacy	52.75	N/A
US Airways	Legacy	N/A	76.29
Air Tran	Low Cost	71.31	N/A
Southwest	Low Cost	72.43	N/A
Spirit	Low Cost	N/A	80.95

Adapted from BTS Special Report by Firestine & Guarino (2012).

that hedging is intended to provide fuel price stability rather than profits. As Southwest puts it,

> We do not purchase or hold any fuel hedge instruments for trading purposes. In other words, we're not aiming to make money by buying and selling hedges as a separate business pursuit. Remember, we view our fuel hedging program as a form of insurance to manage the fuel expenses and risks involved in operating our airline.
>
> ("Hedging in a Nutshell," 2009, pp. 18–19)

To hedge fuel prices, an airline purchases one or a combination of futures contracts in the financial markets. Whatever investment instrument it uses, the fuel hedge will cost the airline a fee (insurance premium, if you will). If the price of fuel goes up, the fuel hedges will save the airline money. However, if the price of fuel falls, the airline will still pay the higher hedged fuel price, as well as the cost of the instrument itself.

American Airlines takes a different view on hedging. Although American recognized a net gain of $333M between 2011 and 2013 from its fuel hedging program, CEO Doug Parker believes the cost of hedging is too high and not a core airline business. American still has some hedges in place from the pre-merger management but is no longer hedging against future fuel purchases (American Airlines, 2014). With fuel prices now relatively low and forecasted to remain stable, it's likely that hedging popularity will wane.

CASM ex-Fuel

CASM (or CASK) is the most widely used measure of airline costs. Rising CASM is sometimes a cause of alarm for airline financial analysts as it may indicate managers are unable to control costs. However, because fuel costs are mostly outside of management control, other CASM measures are also commonly reported. The CASM without fuel is a better indicator to investors and other interested parties of how well the airline is able to manage costs that are within its control. Transport related costs can skew comparisons across carriers, so CASM is sometimes also presented without transport related costs.

Cost per available seat mile, except for fuel, for network and LCCs from 2007 to 2014 are shown in Figure 6.18. Network carriers and LCCs paid very similar prices for fuel, so excluding fuel from CASM eliminates volatility from the data. The data reveal a stable and continuing gap between the network and LCC airlines. This isn't surprising, of course; the LCC business model is designed to result in a lower cost per passenger.

6.4.3 Ownership and Rental Expenses

Airlines require extensive capital goods, the most obvious being aircraft. Firms acquire expensive capital goods with internally generated funds, by borrowing,

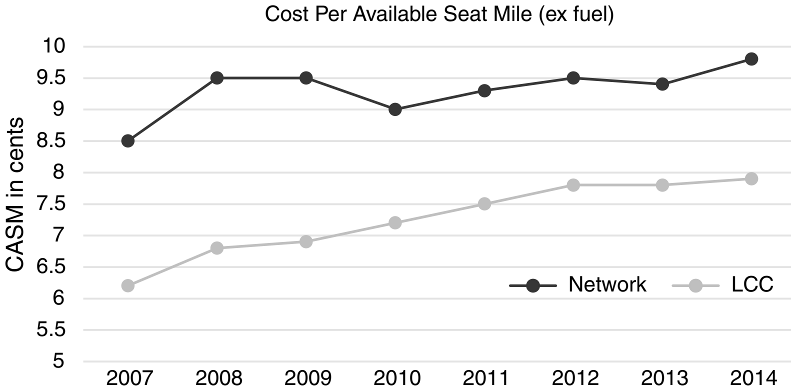

Figure 6.18 Unit Operating Costs from 2007 through 2014.

Data source: Hazel, Stalmaker, Taylor & Usman, 2014.

or from selling equity in the corporation. Capital structure is the proportion of funds used for current operations and growth obtained from debt versus equity. Debt includes loans, some types of equipment leases, and other types of credit that must be repaid in the future with interest. Equity is obtained through selling a partial interest in the firm in corporate stock and increases as the firm makes profits. Equity does not obligate the firm to make payments to shareholders, but profitable firms often pay shareholder dividends.

A company's debt-to-equity (D/E) ratio is long-term debt divided shareholder's equity. Airlines have continued to grow, but, as we now know, most have not been successful in earning steady profits. Without steady profits, the ability to finance growth through equity is limited, so how have airlines financed their growth? The answer is often ever increasing debt. Adding debt increases the D/E ratio. A high debt-to-equity ratio, also known a high financial leverage, increases the volatility of earnings and is one of the reasons for the highly cyclical nature of airline profitability. Transportation companies typically have higher D/E ratios than firms in other industries and airlines have among the highest debt levels. Airlines are able to obtain loans and thus have high D/E ratios than firms in other industries because aircraft can be mortgaged or used as collateral. Although it would be difficult for a creditor to repossess a factory and resell it, highly mobile aircraft can be repossessed and sold or leased to new operators.

In periods of recession, firms with high debt levels may struggle to meet the repayment obligations. If payments cannot be made, the firm may be forced into bankruptcy. As part of the bankruptcy proceedings, lenders are usually forced to accept reduced payment on loans. The inability to make loan payments forced all legacy U.S. airlines into bankruptcy at some time since deregulation. Because of the risk imposed by high D/E ratios, financial analysts look closely at an airline's ability to meet future payment obligation. Since emerging from bankruptcy, the U.S. big three airlines have used their recent profits to pay down loans and reduce the D/E ratios.

6.4.4 Taxes

The airline industry is subject to heavy taxation which adds to airline costs. Of course, some taxes directly support infrastructure and services for commercial aviation, but the airline industry is often looked at as a ready source of revenue to fund non-aviation projects. The International Air Transport Association argues that burdensome aviation taxes are counterproductive because they suppress air commerce which supports a wide range of economic activity (IATA, 2015). Taxes vary by country and world region but fall into several general categories.

- An air passenger duty is leveled on each passenger.
- Environmental taxes are intended to compensate for the damage caused by jet engine emissions.
- Fuel taxes are levied on the sale of jet fuel per gallon or liter.
- Value added taxes are applied in many countries to most purchases including air travel.
- Special purpose taxes are imposed to support causes unrelated to aviation. France and several African countries have imposed taxes to aid in the fight against HIV/AIDS, malaria, and tuberculosis.

U.S. aviation taxes

U.S. taxes are illustrative of the magnitude of airline taxation. As shown in Figure 6.19, since the early 1970s airline ticket taxes have been steadily increasing, with a dramatic jump in 2001. In 2014, taxes totaled 21% of the ticket price and taxes are projected to reach 26% for 2015 (Airlines for America, 2015). U.S. airline ticket taxes can be categorized into three main groups: the Airport & Airway Trust Fund (AATF), Passenger Facility Charges (PFC), and Homeland Security Fees.

Airport & Airway Trust Fund (AATF)

The AATF was started in 1970 to help the government finance aviation programs. Although its primary source of funds is from passenger taxes, it also collects excise taxes from freight and fuel. The AATF provides the majority of the funding for the Federal Aviation Administration (FAA)—92.77% in 2015 (Federal Aviation Administration, n.d.). The excise tax is currently set at 7.5%, but at one time was as high as 10%. In 1997, segment fees ($4.00 per leg) were introduced with a subsequent lowering of the excise tax back to 7.5%.

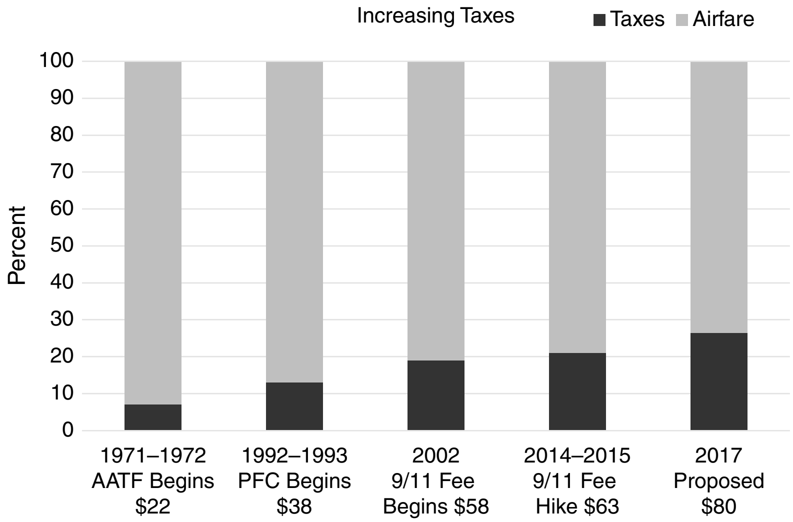

Figure 6.19 Percentage of Ticket Prices Going to Taxes.

Source: Airlines for America, 2015.

Passenger facility charges

In the early 1990s, federally authorized passenger facility charges (PFC) were added. These charges are currently capped at $4.50 and are collected by the airlines and paid to local airport operators to fund federally approved capital improvement projects at the airport ("Passenger Facility Charges," n.d.). Airport coalitions, however, are pushing Congress to raise the PFC cap to $8.50, citing the fact that the PFC has not been adjusted since 2000 and airport construction costs have continued to grow (Laing, 2015). As of August 2015, over half (56%) of PFCs were used for terminal projects, and about 25% were used for runway and taxiway projects. The remaining funds were spent in other areas like noise reduction and access fees (FAA, 2015).

Homeland Security fees

After 9/11, Federal Security Surcharges were added. These fees, called September 11 Security Fees, are incurred for each leg of a flight and are paid directly to the Transportation Security Administration to offset the cost of providing civil aviation security (Borenstein, 2011). These taxes are currently $5.60 per one-way domestic trip, but international flights incur more taxes ($17.70) than domestic flights due to customs and immigration costs.

In 2015, the commercial aviation tax burden hit a record high, totaling $22.6 billion (about $62 million per day). Figure 6.20 shows the sources of that $22.6B.

To illustrate how these taxes can impact a typical domestic flight, consider Table 6.3 which shows the taxes charged for a hypothetical round-trip flight from

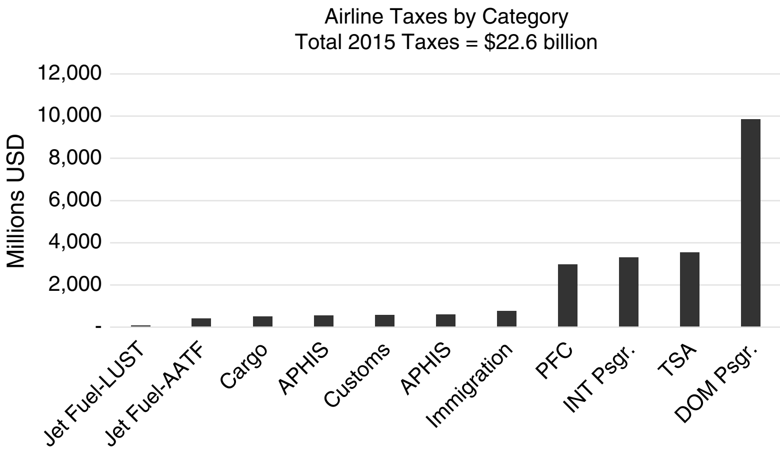

Figure 6.20 FY 2015 Airline Tax Collection.

Source: Airlines for America.

Table 6.3 Taxes and Fees for a Hypothetical Domestic Flight from Peoria, IL, through Chicago O'Hare, to Raleigh-Durham, NC

Base Airline Fare	$237.02
Federal Ticket (Excise) Tax (AATF) (7.5%)	17.78
Passenger Facility Charge at Peoria	4.50
Federal Security Surcharge (Peoria—Raleigh)	5.60
Federal Flight Segment Tax (Peoria—Chicago)	4.00
Passenger Facility Charge (Chicago)	4.50
Federal Flight Segment Tax (Chicago–Raleigh)	4.00
Passenger Facility Charge (Raleigh)	4.50
Federal Security Surcharge (Raleigh–Peoria)	5.60
Federal Flight Segment Tax (Raleigh–Chicago)	4.00
Passenger Facility Charge at Chicago	4.50
Federal Flight Segment Tax (Chicago–Peoria)	4.00
Total Taxes	62.98
Total Ticket (Fare + Taxes)	$300.00
Taxes as a percent of Fare	26.6%

Source: Airlines for America.

Peoria, IL, thru Chicago O'Hare, to Raleigh-Durham, NC. In this example, the taxes added up to over 26% of the fare.

Cost of carbon emissions

The United States does not currently impose a direct tax on jet engine carbon emissions, but the European Union does tax emissions and is pressuring other countries to follow suit increasing worldwide airline concern. In 2012, the European Union began including airlines in their carbon dioxide Emissions Trading System (EU ETS). The EU ETS works on the cap and trade principle, where a limit or "cap" is placed on the amount of carbon dioxide (CO_2) greenhouse gasses that can be emitted. Burning jet fuel results in two main by-products: CO_2 and water vapor. Combined with oxygen, 1 kilogram (kg) of jet fuel results in 3.15 kg of CO_2, 1.24 kg of water vapor[1] and trace amounts of other contaminants like sulfur dioxide and soot. The EU ETS allows a certain level of CO_2 emissions called the "cap." If the airline produces the exact amount of CO_2 they are allowed (the cap), there is no additional cost or benefit. If the airline operates with fewer emissions, they can sell or "trade" the amount they are under the cap to other emitters who are over the cap. If the airline's CO_2 emissions exceed the cap (which they usually do), the airline is required to purchase trades to cover the excess. CO_2 emissions are traded in metric tons, with a ton costing about \$6 to \$9 in 2014 ("EUAs on the rebound," 2014). Lufthansa estimated the additional CO_2 emissions trades they would have to buy would cost the airline \$169 million in 2012 and would result in higher ticket prices for their customers (Sheahan & Hepher, 2012).

The EU Commission's original plan would subject all airlines arriving or departing any EU country to the ETS at the start of 2012, meaning that at the end of 2012, the airlines would have to settle their CO_2 accounts. The interesting spin is that airlines were required to account for their emissions for the aircraft's entire flight, not just the short time flying through EU airspace. For example, an Air China flight departing from Beijing and landing in London would have to pay for the carbon emissions of the entire flight although only a short period of time was spent in EU airspace. International airlines complained that this system was unfair for long-distance international flights. Several airlines from around the world filed lawsuits, but the European Court of Justice found the EU EST compatible with international law. Several countries then passed laws prohibiting their airlines from participating in the EU ETS. Seeing a potential international trade war looming, the EU Commission decided to suspend implementation of the program for airlines flying to and from non-EU countries until the International Civil Aviation Organization could address the emissions issue from a more global perspective. Until then, the EU ETS applies only to EU airlines flying within the EU.

6.5 Legacy Carrier Restructuring

Since deregulation and liberalization of airline markets, legacy carriers have struggled to become more efficient and productive in the face of increased competition, often from new and rapidly growing LCCs. Although LCCs were not exempted, the two severe recessions of the first decade of the twenty-first century were especially cruel to legacy carriers. Table 6.4 reveals that LCCs continue to enjoy substantial cost advantages over their full-service competitors (Comprehensive Network Carriers) across the globe. Some passengers are willing

Table 6.4 LCC Versus Comprehensive Network Carrier Costs. CASM in U.S. Cents.

CNC	*CASM*	*LCC*	*CASM*	*CNC*	*CASM*	*LCC*	*CASM*
North America				Europe			
Air Canada	18.64	WestJet	12.35	Air France	20.1	easyJet	11.88
American	13.42	Frontier	11.76	British Airways	16.78	Norwegian	11.38
Delta	15.05	Southwest	12.45	Iberia	18.35	Ryanair	7.39
United	13.68	Spirit	9.61	KLM	18.99		
				Lufthansa	24.46		
South America				Asia			
LAN	19.06	GOL	13.16	Air China	14.02	AirAsia	5.68
				ANA	22.85		
				JAL	24.31		

Data source: Airline Monitor, 2015.

to pay higher prices for better quality service, but many will sacrifice quality for a lower price, especially on flights of less than two hours. Price competition and the loss of market share has forced CNCs to either lower their cost structure or face going out of business.

The recession of 2001 hit North American carriers particularly hard forcing widespread restructuring culminating in mergers that created the Big 3 U.S. network carriers. The Big 3 and Southwest with its acquisition of Air Tran, left American, United, Delta, and Southwest controlling 80% of U.S. domestic traffic. The 2001 recession was not as harmful to carriers outside North America, but few were spared the devastation of the Great Recession of 2008. European legacy carriers have been forced to seek improved productivity in order to stem losses resulting from the growth of Ryanair, easyJet, and other low-cost carriers within Europe and from increasing competition on world routes from the Big 3 Gulf carriers. International Airlines Group, comprising British Airways, Iberia, Vueling, and Aer Lingus, has been most successful in increasing productivity and lowering costs. Air France/KLM and the Lufthansa group, on the other hand, endured a series of strikes by pilots and other labor groups fiercely opposed to cost savings programs. Each group has responded by growing their low-cost carriers at the expense of the legacy airlines within the group. Faced with continuing losses and having failed to reach a restructuring agreement with its pilots, Air France announced in the fall of 2015 a reduction in international flights, the retirement of 14 aircraft, and the furlough of 2,900 employees. In Asia, state-owned Japan Airlines was successfully restructured through bankruptcy in 2009. It emerged as a smaller airline having slashed one-third of its workforce and retiring much of its older fleet.

The tragic loss of two B-777s in 2014 was the immediate cause of the restructuring of state-owned Malaysian Airlines, although the airline has long suffered from poor financial performance. The turnaround effort is typical and instructive. A new management team led by Christoph Mueller, previously credited with reforming Aer Lingus, was installed by the state investment fund that controls the airline. Mueller described the airline technically bankrupt following years of mismanagement and loss of market share to Air Asia. The restructuring includes more than 100 projects that will "reset the operating business model" (quoted in Chong, 2015). Several unprofitable routes including service to Frankfurt, Istanbul, and Kocki were dropped with further route rationalization under consideration. Reductions in the 97 aircraft fleet, including the disposal of two of its six Airbus A-380s, are planned. The staff was reduced by about one-third with 6,000 employees shed from the 20,000 member workforce. Four thousand of the remaining 13,000 were placed on short-term contracts. The airline is reviewing its supply contracts with the intent of renegotiating some and terminating others. Other projects include improving revenue, optimizing costs and revamping the organizational structure. Even with these efforts, the airline faces a long road to sustained profitability (Chong, 2015).

Of course, restructuring is not new; every struggling airline attempts to revise its business model in an effort to stave off liquidation and return to profitability. It is the worldwide scope of the recent legacy carrier restructuring attempts that is remarkable. The steps in airline restructuring are well-known and similar to those undertaken by loss-making firms in other industries. Each airline restructuring program is different but includes some or all the following:

- Dropping unprofitable routes and simplifying the network;
- Reducing the number of fleet types and retiring older aircraft;
- Increasing utilization of the remaining aircraft sometimes with "depeaking" of hubs;
- Outsourcing non-core tasks, particularly of aircraft maintenance, and transferring thinner domestic routes to regional partners;
- Reducing staffing through employee buyouts, attrition, and involuntary furlough;
- Renegotiating or imposing concessionary work agreements with lower wage rates and improved productivity;
- Renegotiating aircraft lease agreements to obtain lower lease rates;
- Reduction in debt through renegotiation often facilitated by bankruptcy; and
- Merger, acquisition, or partnership.

6.6 Fleet Selection

We now turn from the sometimes dismal look at struggling airlines to exploring how successful airlines manage their biggest assets, the aircraft fleet. As an airline grows, its existing fleet ages and the route structure and markets served evolve. As a result, the airline's fleet must be expanded and upgraded. Commercial aircraft differ substantially in passenger and cargo capacity, range and payload capability, capital, and operating costs. Airbus and Boeing dominate the production of larger commercial aircraft with seating capacities above 150 passengers, but several other manufacturers, notably Embraer and Bombardier, produce a range of smaller commercial jets. In addition to the choices of new aircraft, the airline may also choose from a large pool of used aircraft for either all or a part of its fleet. In this section, we explore how an airline chooses the aircraft it operates to meet the demands of its route structure and passengers.

6.6.1 Range and Payload

As we've seen in Chapter 3, airline route structures vary in geography. Some airlines serve a limited area such as the continental United States or Europe whereas the route structure of large network carriers extends across much of the globe. Routes vary in length from less than a hundred miles and under an hour of flight time, to more than 8,000 miles and 16 hours flight time. Similarly, aircraft range capability varies greatly. For example, the Boeing 717 is a short-haul mainline jet with an economic range of approximately 1,000 nautical miles and not capable of non-stop trans-continental U.S. service. In contrast, the Airbus 340, 350, and 380 and Boeing's 747, 777, and 787 have range capability in excess of 8,000 nautical miles.

An airline must operate aircraft with capabilities suited to its route structure. For the network carrier, this often requires several aircraft types from regional jets to wide-body, long-range aircraft. As new medium-sized planes with long-range capabilities, such as the Boeing 787 Dreamliner, have entered the market, airlines have been able to expand their route structure with non-stop international flights in thinner markets that would not previously have been profitable.

Payload, the weight of passengers and cargo, varies directly with aircraft size. Larger aircraft can carry more passengers and cargo, but there may be a trade-off between the weight of fuel carried, and thus range, and passenger and cargo weight. If an aircraft is fueled to its maximum capacity, its payload will be restricted. Conversely, if an airline chooses high density, single class seating in its fleet, then payload will restrict fuel what can be carried so that range is limited. The Airbus A-321, for example, is capable of U.S. transcontinental range except when configured at high-density seating. Ambient temperature, takeoff runway length, and en route winds also limit aircraft range. On most days, the A-321 might be capable of coast-to-coast service but would be forced to make a stop for fuel on some occasions.

In addition to range, an airline must consider limitations of the airports it serves. Many airports are not capable of handling the largest commercial aircraft because of limited terminal and taxi-way space and inadequate runway length and weight bearing capability. The Airbus 380, in particular, requires wider taxiways and tailored terminal facilities. Some airports such as New York LaGuardia and Chicago Midway are severely space and runway constrained. The high elevation of some cities such as Denver and Bogotá impose performance restrictions which severely limit the range of some aircraft operating from these airports. Similarly, high ambient temperatures also limit aircraft performance. Boeing's latest upgrade of the 777, currently dubbed the 777X, is designed to meet the high temperatures encountered in the Middle East without sacrificing range or payload. This capability garnered large orders announced at the 2013 Dubai airshow from Emirates Airline, Qatar Airways, and Etihad Airways with initial deliveries scheduled by the end of the decade.

6.6.2 Aircraft Operating Costs

Just as aircraft performance capability varies greatly by aircraft type, so does operating cost. Aircraft operations and maintenance comprise about half of total airline costs, so understanding and managing these costs are critical to airline success. Aircraft operating costs can be computed and categorized in several ways. The appropriate metrics depend on the information needed for specific decisions. One method is to divide costs into direct and fixed. Direct operating costs (DOC) are those incurred only when the aircraft is flown. Major direct costs are fuel, maintenance and a portion of crew wages. Fixed costs such as depreciation or lease fees and insurance, on the other hand, are incurred each month regardless of how many hours the aircraft is flown. Suppose an airline is considering implementing a reduced mid-week schedule, then it would want to know what costs would be avoided. For this decision, division into direct and fixed costs is useful. For other purposes, however, costs are computed by block (or flight) hour or by cost per available seat mile.

Aircraft size versus CASM

Block hour cost increases with aircraft size. A large aircraft burns more fuel per flight hour than a smaller aircraft. For example, Boeing's smallest aircraft, the B-737–700 burns about 680 gallons per block hour whereas the B-747-400 consumes 3,300 gallons per hour (The Airline Monitor, 2015). Maintenance costs per block hour are similarly higher for the B-747.

While DOC per block hour is appropriate for some airline decisions, CASM is more important for most decisions as it represents the cost of providing air transportation for a single passenger. Large aircraft cost more to operate per hour, but CASM decreases as aircraft size increases because maximum seating capacity increases faster than aircraft operating costs. Thus, the higher DOC of larger aircraft is spread over an even greater number of seats. An aircraft with 150 seat capacity has about a 17% lower CASM than one with a 100 seat capacity (Swan, 2002).

Airbus' very large aircraft, the A-380, has the lowest CASM because of its high seat capacity, long segment lengths, excellent fuel efficiency, and relatively low maintenance costs. It is, however, very expensive to operate per hour. In contrast, the regional jet has lower cost per flight hour than larger mainline jets, but substantially higher CASM. Therefore, yield for regional jet flights must be higher on average than for larger mainline jets. In fact, the CASM disadvantage for the smallest regional jets is leading to their rapid removal from service in favor of the new generation of larger regional jets.

Larger aircraft have higher seat capacity, but the number of seats installed on an aircraft is the choice of the airline. The number of cabins and seating density depends on the passenger segments targeted, markets served, and competition. This is a purchase option on new aircraft, but can also be changed during the aircraft's service life. For example, when Delta established its low-cost Song subsidiary, it reconfigured the Boeing 757 aircraft to single-class, moderate seating density. Spirit Airlines and Ryanair configure their aircraft with high density, single-class cabins whereas other airlines choose more legroom and two or more separate cabins. Using the Airbus A-320 in service with U.S. airlines as an example, seating density varies from United Airlines' 142 seats to Spirit's 178. ASMs increase directly with the number of seats per aircraft, so CASM is lower for higher seating density. Spirit's CASM would be 20% lower than United's just due to seat density. The Airline Monitor (2015) computes United's A-320 operating CASM at 8.71¢ versus Spirit's 6.23¢. Spirit enjoys other cost savings as well, but seat density accounts for more than half of the difference.

Segment length

Cost per available seat mile (CASM) decreases with longer segment length (also called stage length) for several reasons. First, longer segment lengths result in more time spent at efficient cruise altitudes and speeds, equating to fuel savings per average hour of flight. Second, takeoffs and landings require additional departure and arrival time for sequencing with other traffic. This additional time not only cuts into aircraft utilization but also increases the fuel burn. There are also maintenance costs that are attributable to the number of takeoffs and landings, called aircraft cycles. Fewer cycles equate to lower maintenance costs. Finally, airport and passenger handling costs are spread over more mileage. Figure 6.21 shows the general inverse relationship of CASM and stage segment length. Notice, however, the substantial dispersion around the regression line illustrating that other aspects of an airline's operation have more effect on CASM than stage length.

Yield

Yield is more than 50% higher in low density, short-haul markets compared with high-density markets. If you are flying to or from a small city, expect to pay much higher fares. In competitive markets, including most U.S. domestic city-pairs, average fares follow operating costs.

New versus older aircraft

Just as consumers purchase cars, airlines can choose new or used aircraft for fleet expansion. Used aircraft are available for nearly all airline requirements in both capacity and performance. The exception is the mid-size, long-range aircraft

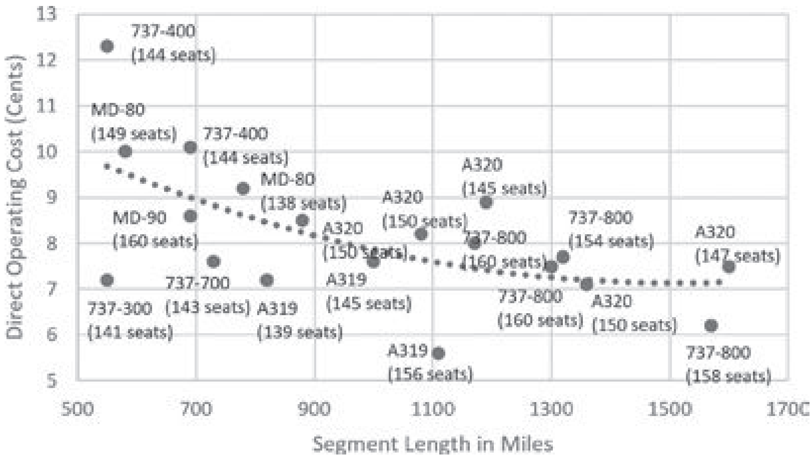

Figure 6.21 CASM Versus Segment Length.

Source: Adapted from Hazel, Stalnaker, Taylor & Usman, 2014.

where the choice is between the new Boeing 787 Dreamliner and the Airbus 350. While most airlines have elected to upgrade their fleets with large orders for the latest generation aircraft, there are exceptions. Delta Air Lines has chosen to acquire some used aircraft along with its orders for new planes. Delta is the largest operator of the MD-90 aircraft for which it was the launch customer in 1989. More recently, it has acquired 88 B-717s from Southwest Airlines. Southwest inherited these planes from its merger with Air Tran. The U.S. LCC Allegiant, which been consistently profitable, acquires mostly used aircraft.

New aircraft have lower DOC arising from lower maintenance expenses and more fuel efficient engines. Maintenance costs are reduced through longer design life of new components, improved reliability, and automated diagnostic tools. New aircraft components do not require overhaul or replacement for several years. State-of-the-art engines burn significantly less fuel than those of older technology. At Alaska Airlines, for example, the newer Boeing 737–700 burns 14% less fuel per hour than the older but similar sized B-737-400 (The Airline Monitor, 2015). Boeing promises an additional 14% improvement in fuel burn with the next generation B-737 MAX over the most efficient current generation aircraft (Boeing, n.d.). Airbus will achieve similar efficiencies with its next generation A-320neo series. Figure 6.22 shows the impressive gains in fuel efficiency over the last 55 years.

The lower acquisition price of used aircraft, however, may offset the lower DOC of new aircraft. The Airline Monitor (2015) reports a 15-year-old model of today's most popular narrow-bodied aircraft can be had for 40% of the price of a new aircraft. (This is the purchase price, not the list price. Like automobiles,

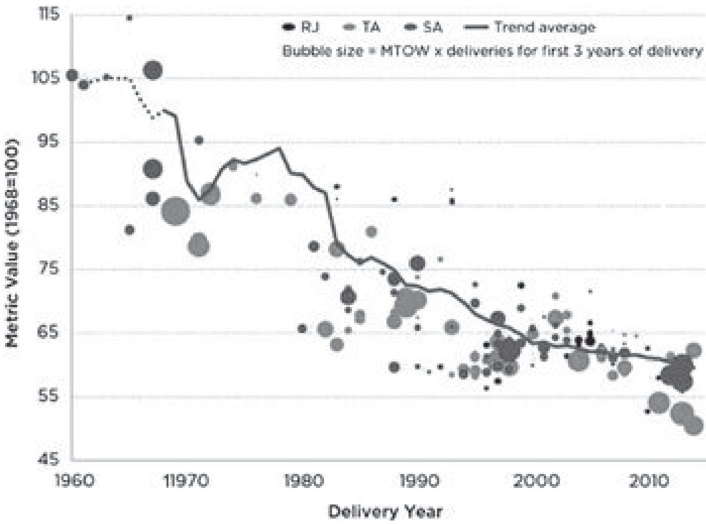

Figure 6.22 Aircraft Fuel Efficiency Improvements.

Source: Kharnia and Rutherford, 2015. Image courtesy of The International Council on Clean Transportation.
Notes: RJ = regional jet, SA = single aisle, TA = twin aisle

the manufacturer's list price is usually negotiable, especially for good customers.) Allegiant acquired many of its older MD-80 aircraft for as little as $4 million each. Another benefit is that used aircraft are often available with little lead-time whereas airlines may have to wait years for the delivery of a new aircraft.

Older aircraft will incur higher maintenance expenses. Time limited parts must be replaced or overhauled. Likewise, the airframe requires periodic major overhaul. This extra maintenance limits availability for revenue service. Older aircraft also suffer a higher rate of mechanical failure which can adversely impact customer service. In turn, a higher level of spare parts is needed to maintain required service levels.

Determining whether a new or used aircraft is better suited to an airline's needs requires careful financial analysis. Aircraft utilization may be the deciding factor. Because of differing business models, Spirit Airlines obtains about twice the daily utilization of Allegiant. This fact alone likely explains Spirit's choice of new aircraft versus Allegiant's used plane fleet.

Commonality

Substantial cost savings result from operating a common aircraft type such as an all Airbus A-320 or Boeing 737 fleet as is typical for LCCs. Crew training and qualifications costs are reduced. The airline has to develop and maintain only a single training program. Similarly, mechanics must learn and qualify on a single aircraft. Both groups gain more experience and benefit from learning curve efficiencies. Spare parts inventory is also reduced with a single fleet type.

Airbus and Boeing both produce families for aircraft with high commonality. The Airbus A-320 series ranges from the A-318 typically configured to 120 seats to the A-321 which Spirit Airlines configures to 218 seats. Boeing's 737 family consists of the 737–700 (typically configured to 128-148 seats) to the 737–900 which can seat 177–189 (Boeing, 2013). Pilots are usually qualified to fly all models within the family. In contrast to the new families of aircraft, airlines operating used planes will face greater differences within a fleet.

Most aircraft manufacturers offer a choice of engine manufacturers and engine models. Airlines generally prefer to minimize the number of engine types to obtain commonality cost advantages.

There are great advantages to commonality, but, as we've seen previously, comprehensive network carrier route systems require more than one aircraft type to fit the market. Regional jets operated in partnership with regional airlines connect smaller cities with the network carrier's hub airport. Long-range, wide-body aircraft are best suited to many international routes. Operating a fleet with a mix of aircraft ages also offers some flexibility. Airlines can choose to operate older aircraft that are nearing the end of their economic lives when the economy is strong or these aircraft can be parked or scrapped at relatively low cost during economic slowdowns.

6.7 Fleet Financing

Whether acquiring new or used aircraft, an airline must decide on how to pay for the acquisition. There are several alternatives, most of which are similar to financing available for automobiles. A profitable incumbent airline could choose from all options whereas a new or financially struggling airline would have fewer choices. But, unlike automobiles, new aircraft are priced in the millions of dollars. The list prices for Airbus's products range from $74 million for its smallest aircraft, the A-318, to $428 million for the A-380 (Airbus, 2015b). In 2013, Dubai-based Emirates announced the largest ever aircraft order for Airbus and Boeing aircraft valued at nearly $100 billion at list prices (Emirates, 2013). Of course, Emirates will not pay list price; actual purchase prices are proprietary but fall somewhere between two-thirds to half of the list price.

6.7.1 Internal Financing

Despite a history of uncompetitive profit margins, airlines generate lots of cash that can be used to purchase aircraft. For example, in 2014, Delta Air Lines generated $4.9 billion in cash from operating activities. Over the longer-term, cash from operations follows net profits. In the short run, however, non-cash expenses, primarily depreciation and goodwill, will cause cash flow and profits to differ. For example, after 2001, airlines wrote down the value of their owned aircraft reflecting lower market prices. These write-downs lowered profits but did not affect short-term cash flow. As an aside, cash flow statements are critical to evaluating company health. Profits can be misleading but cash flow often reveals the true health of operations.

Airlines may also choose to issue new shares of stock to finance expansion including aircraft acquisition. In order to successfully sell new shares, a company must show a promise of continued profitability. If an airline is issuing stock for the first time, it becomes publicly-owned with its stock traded on an exchange. This first issuance of stock is known as an initial public offering or IPO. Mexico's ultra-low-cost-carrier Volaris sold its first stock in 2013 as did Spirit Airlines in 2011. Japan Airlines stock offering in 2012 was one of the most impressive. Japan Airlines entered bankruptcy and had its stock delisted in 2010, but the new stock offering after existing bankruptcy raised $8.5 billion signifying a dramatic turn-around.

6.7.2 Debt Financing

Airlines will often finance a portion of a fleet expansion with internal funds, but debt or borrowing is also common. Commercial bank loans, akin to a home or car loan but with the aircraft as collateral, were once a primary source of aircraft financing. Loans were flexible with banks willing to negotiate tailored terms; typically a 15% cash down payment with the remainder of the purchase price borrowed. With the collapse of aircraft values in the 2001 recession, many banks shied away from aircraft financing, though some, led by Chinese banks, have become more active recently.

Larger airlines are able to bypass commercial banks by selling bonds directly to investors. These bonds, known as Enhanced Equipment Trust Certificates, offer deep capacity, attractive rates, long maturities, and diversified investor base. Enhanced Equipment Trust Certificates generally include 20 or more aircraft with 20% financed by a lead investor who takes ownership with the remaining 80% financed in three tranches of progressively subordinated public debt.

Most commercial aircraft manufacturers are reluctant to finance aircraft but will often provide financing assistance to get a sale. Support varies from leasing to guaranteeing the aircraft's value at the end of a lease or loan. Airbus and Boeing have also taken trade-ins from an airline's fleet to obtain a new sale.

U.S. and European governments support exports of aircraft, mostly to boost employment in well-paying aircraft manufacturing jobs, by guaranteeing loans for foreign airline buyers. The Air Finance Journal ("How Airlines Finance Aircraft," n.d.) cites the example of Kazakhstan Airlines wishing to purchase new Boeing aircraft but finding few banks willing to provide a loan given the lack of profits and country risk. To facilitate the sale, the U.S. Export-Import (EXIM) Bank will guarantee the loan. The EU offers similar support for Airbus. During the Great Recession of 2008/2009, government guaranteed loans for exported aircraft took a prominent role in new aircraft sales. This development, however, led to a backlash from U.S. airlines and the airline pilots union who argued that the U.S. taxpayers were unfairly subsidizing foreign competition. In FY 2014, EXIM Bank financing supported $27.5 billion worth of U.S. exports, 29% of which (just under $8 billion) were for aircraft and avionics purchases ("Facts About EXIM Bank," n.d.). In the summer of 2015, however, the U.S. Congress failed to reauthorize EXIM forcing it to suspend new loans, at least temporarily.

6.7.3 Leasing

Leasing, again similar to the automobile industry, is the most common form of aircraft finance (Cameron, 2013). Several specialized aircraft leasing companies, dominated by GE Capital Aviation Service (GECAS) and International Lease Finance Corporation (ILFC), provide leased aircraft to airlines worldwide. Table 6.5 lists the 10 largest aircraft leasing companies. As with airlines, there has been a flurry of mergers and consolidation within the leasing business in recent years. In early 2014, ILFC and AerCap agreed to merge to create a strong second to U.S.-based GECAS.

Though we tend to think of airlines as being Airbus's and Boeing's most important customers, leasing companies usually place large, early orders for new aircraft commanding large discounts. Leasing provides airlines with an alternative or supplement to ordering new aircraft directly from the manufacturers. There are two types of leases—operating and capital.

Operating lease

An operating lease is similar to a car lease; the title remains with the lessor and the aircraft is returned at the end of the lease. As a result, the lessor bears the risk of changes in the aircraft's value. Operating leases vary in length from just a few

Table 6.5 Commercial Aircraft Leasing Companies

Company	*Aircraft*	*Value (billions USD)*
GEGAS	1,560	30.0
ILFC	971	23.7
BBAM	400	10.2
SMBC Aviation Capital	323	8.3
AerCap	294	7.5
BOC Aviation	202	7.5
CIT Aerospace	261	6.7
AWAS	244	6.3
Aviation Capital Group	237	5.5
Boeing	194	1.5

Source: Cameron, 2013.

months to several years; 5 years is typical. The leasing company might place an aircraft at several different airlines over the aircraft's economic life.

With an operating lease of 5 to 7 years, the airline would pay the leasing company 9% to 12% of the aircraft's value annually. One percent of the original price per month is a common industry rule of thumb. The aircraft is depreciated rapidly yielding tax benefits to the leasing company and its investors. In good times, at the end of the lease, the used aircraft can be sold for 85% of original price, but there is a market risk. The price of older aircraft collapsed in the recession of 2001. But, if everything goes well, a $100 million aircraft brings in $84 million over the 7-year lease and then is sold used for $75 million—a pretty good business proposition.

Capital lease

Capital lease, on the other hand, is just an alternative form of long-term purchase financing. Through the capital lease, the tax benefits from aircraft depreciation can be transferred to individuals or companies with higher tax liabilities than the airline, thus making the lease attractive to both the airline and investors. Capital leases range from 15 to 25 years in length with the title transferring to lessee at the end of the lease.

A leasing company's inventory of aircraft may be obtained directly from the manufacturer, but another variant of leasing is sale and lease-back. An airline places an order for new aircraft directly with the manufacturer with the first delivery several years into the future. At the time of placing the order, the airline has not arranged for long-term financing. As the delivery date approaches, the airline sells its new aircraft to a leasing company with the agreement to then lease-back the aircraft from the new owners. Table 6.6 summarizes the various aircraft financing options.

The last variation on financing is an agreement with the manufacturer or large third-party maintenance provider whereby the airline pays a set amount of every hour of operation, so-called *power-by-the-hour*. Power-by-the-hour agreements

Table 6.6 Aircraft Financing Options

	Operating Lease	*Capital Lease*	*Purchase*
Term	Few months to 7 years	12–18 years	Aircraft life
Capital usage	Low	Medium	High
Repayment	Rental	Principal & interest	Balance
Asset exposure	None	Some/all	full
Fleet flexibility	High	Low	Low
Entry cost to latest technology	Low	Medium	High
Lead Time	Short	Short to long	Long
Balance sheet	Off	Off or on	On
Deposit	3 month's rent	10%	25% or more

most often cover engine operation. The airline pays a negotiated fee and the counterparty provides all maintenance and overhaul. The airline can accurately forecast a major operating cost and avoids having to inventory engine parts and accessories. The maintenance provider benefits from economies of scale and assumes the risk of repair in exchange for a long-term guarantee of future work.

6.7.4 Financing Portfolio

Just as an airline may benefit from having a range of aircraft ages in its fleet, so too can it benefit from financing its fleet with various financial vehicles. Operating leases are more expensive than capital leases, but the airline may choose to return an aircraft to the lessor at the end of the lease. This option provides flexibility to change the fleet composition or easily downsize in the face of a recession. The optimal mix of financing is a complex decision; however, a large airline might structure its financing so that 40% to 50% of the fleet is purchased with internal funds or directly issued debt, 30% to 40% is acquired with capital leases, and the remaining 20% to 25% of the fleet is on operating leases.

6.8 Economics of Scale, Scope, and Density

We conclude this chapter with an introduction to three economic concepts that provide a different perspective on airline economics: economies of scale, scope, and density.

6.8.1 Scale

Scale refers to the size of the business. For airlines scale means capacity or available seat miles. Economies of scale exist when larger firms, those with more assets and greater production capacity, can produce at lower cost than smaller rivals. If no small producers for a product exist, that is strong evidence for economies of scale. Commercial aircraft manufacturers are one example. Only Airbus and Boeing produce large commercial aircraft. There were once several other manufacturers, but these either quit the business as did Lockheed-Martin or were absorbed as was McDonnell Douglas by Boeing. In the airline industry, however, there is little evidence that larger size leads to lower costs with airlines. Some costs do decrease, for example, larger airlines can obtain better pricing from suppliers, but these seem to be offset by higher costs of running a very large operation. Most LCCs are smaller than comprehensive network carriers but exhibit lower CASM. Although economies of scale in a narrow economic sense may not pertain to air transportation, size may be important in two other ways. First, larger airlines usually have larger reserves and easier access to financing that can help them survive downturns in the travel market. Second, scale can be of political importance; it gives greater lobby weight and the ability to affect policy. As an example, in 1993, American Airlines' pilots threatened a strike. The large scale of American

Airlines and the resultant impact on the U.S. economy was so large that President Clinton used his authority in accordance with the Railway Labor Act to end the pilot strike after only 20 minutes (Ifill, 1993). Certainly, U.S. air service bilateral negotiations have, in the past, been influenced by the voice of major carriers.

6.8.2 Density

Density refers to the demand per market or city-pair. Unlike economies of scale, airlines benefit from route density. With high route density, airlines can utilize larger aircraft with lower CASM. As we learned earlier, a hub-and-spoke system creates route density by combining passengers bound for many cities on a single flight, so network carriers benefit from density. However, the density of passengers traveling from one small city to another is usually far smaller than the density between large cities. In the majority of cases, there is not enough origin-destination or local passenger flow to justify a regular service.

6.8.3 Scope

The third economy is that of scope. Economies of scope exist when average cost is reduced by producing more products. This contrasts with economies of scale where unit cost is reduced by producing more of a single product. Airlines also benefit from economies of scope in two distinct ways. First, scope can be viewed as the extent of geographical coverage and the number of destinations an airline serves where each city-pair is a different product. Here, economies are evident. Significant marketing advantages arise from offering many destinations, especially through a hub-and-spoke system. It comes as no surprise that passengers want their airline to have a large network, ideally allowing them to fly from any origination to any destination. Although that goal is obviously not attainable, the closer an airline can get to that goal, the more passengers will be attracted to their brand. Airlines can increase their scope, especially internationally, by joining alliances with other airlines. Second, classes of service are also different products targeted to different passenger segments. With the few exceptions covered in Chapter 4, airlines produce different classes of service on a single flight. By combining demand from several passenger segments on a single flight, the cost of producing each product is reduced. Another jointly produced product is belly cargo accommodated on the same flight potentially reducing the unit cost of cargo.

6.9 Summary

Airline profits as measured by net profit on sales or return on invested capital have historically lagged behind firms in other segments of the aviation industry and in other unrelated industries. Profits have become increasingly cyclical with large swings between profits and losses that generally follow the world economic cycles of boom and recession. The airline manager has several tools available to increase total revenue and thus profits but is usually challenged by intense competition. Raising the average ticket price, for example, will lead some passengers to choose competing airlines offering lower fares. Load factor will fall and total revenue may rise or fall depending on the overall price sensitivity of passengers. Cost is the other variable in the profit equation that must be managed. Labor and fuel are the largest components of airline cost comprising about 50% of the total, so these receive great attention. Faced with two severe recessions in the new millennium, many airlines, beginning with U.S. legacy carriers, have been successful in increasing labor productivity and lowering wages. Airline restructuring of old-line, legacy carriers continues across the world. Fuel prices are determined in world markets and beyond the control of managers, but can be mitigated with new fuel efficient aircraft and stabilized over the short-term by fuel hedging.

Airlines renewing older fleets or expanding the existing fleet have a large choice of aircraft types, but, for aircraft seating more than 150 passengers, are limited to Airbus and Boeing for new aircraft. Used aircraft can also be attractive because of low acquisition costs and are available for most mission requirements. In choosing aircraft for replacement or expansion, the airline must carefully evaluate range and payload capability, capital, and operating costs. Aircraft can be financed in several ways including internally generated cash, debt, or leasing from one of the many aircraft leasing companies.

Note

1 With the right atmospheric conditions, this water vapor is what causes the contrails we see from the ground.

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Review Questions

1. How do historical airline industry profits compare with other industries?
2. What financial metrics are useful in comparing the profitability of different firms?
3. Define ASM, RASM, CASM, LF, and yield. How might a change in one affect another?
4. Do airline prices keep rising?
5. Why is a 100% load factor not achievable across all airline flights? What is a practical limit?
6. What is ancillary revenue? What category of airlines realize the highest percentage of ancillary revenue? Why?
7. What are the two largest airline cost categories?
8. What steps have airlines taken to control labor cost?
9. Can fuel hedging lower fuel cost? Why do some airlines hedge fuel prices?
10. What are the typical steps legacy airlines take in restructuring?
11. How does the EU Emissions Trading System affect airlines?
12. What factors must an airline consider in selecting new aircraft?
13. Why has Delta Air Lines added a mix of new and used aircraft to its fleet?
14. Do airlines benefit from economies of scale, scope, and density?

Chapter 7

Pricing and Revenue Management

Unlike many products and services, the price of an airline ticket can vary greatly on any given route. Two passengers sitting next to each other in economy class may discover that one paid several times more than the other even though both are provided the same service. For other routes, even of about the same distance, price differences are often even greater. As we know from Chapter 2, demand varies by time of day, day of the week, season, and with the business cycle. So to do airline fares. Of course ticket prices differ by class of service whether first, business, premium economy, or economy; but also by the time of purchase and payment; whether the booking was made online or through a travel agency; and with the restrictions on the itinerary such as a minimum length of stay at the destination, a requirement to stay over a Saturday night, or the price to change travel plans (Hanlon, 2007).

This chapter explores this puzzling, seemingly random and senseless variation in airline pricing. We will find that airline pricing is based more on the demand for travel than the cost to the airline and is designed to extract the highest price each passenger, or segments of passengers with similar purchasing behavior, are willing and able to pay. Airlines control pricing with sophisticated software applications developed since U.S. airline deregulation known now as *revenue management systems.*

7.1 Regulated Prices

Prior the spread of airline deregulation, ticket prices were usually set by government agencies; either singly for domestic operations, or jointly on international routes, based on cost plus profit. A mileage-based formula promulgated by the International Air Transport Association, the global airline industry trade association, was widely used to set international fares and remains in use in many markets today. Domestic markets were often dominated by a single state-owned airline which set fares on both economic and political considerations. In the United States, the Civil Aeronautics Board (CAB) set ticket prices for scheduled air carriers based on the length of the flight and the airline's cost to operate the flight.

Passengers paid the same fare on all airlines with different fares allowed only for class of service such as first class and coach (Belobaba, 2009).

The CAB's fares should have allowed airlines to make a profit; however, in the early to mid-70s the CAB had allowed a situation to develop where airlines were losing money. During the same time period, charter airlines, largely left alone by the CAB, were making profits by flying to many vacation and leisure destinations like Las Vegas and Orlando. Charter operators benefited not only by flying less expensive[1] older aircraft (aircraft sold off cheap as scheduled airlines took delivery of newer models), but also by the "unscheduled" nature of their operation which allowed them to fly an aircraft only after it was booked full. As a result, they enjoyed very high load factors and could charge lower fares suited to leisure passengers. The CAB could have added operating restrictions to the charters to help the established airlines fill their planes, but chose not to. As a result, the scheduled airlines lost some of the leisure traveler market (Petzinger, 1995).

In response, the CAB approved a load factor enhancing, across-the-board sale by Texas International Airlines (called "peanuts fares"), but American Airlines had a better idea. Although they were occasionally flying charters in addition to their scheduled service, American wanted to put the two together and offer charter fares for the unsold seats on their scheduled flights. The concept of offering different fares for the same flight wasn't new; the airlines had been charging different fares for different classes of service for years (typically first class and coach), but offering different prices for the same class was revolutionary (Petzinger, 1995).

In response to mounting criticism from scheduled carriers, the CAB approved American's plan for lower fares with discounts as much as 45% below the standard CAB-set coach fares (Wensveen, 2011; Petzinger, 1995). The number of discounted seats was restricted based on a best guess of demand. The new "super saver" fares proved hugely popular, stopping the market share loss to charters while filling seats that would otherwise have been empty ("History of AMR," n.d.; Petzinger, 1995). It was also the beginning of a system originally called yield management, but now known by the more descriptive name of *revenue management*. Today's complex and sophisticated revenue management systems are employed by most airlines worldwide to increase revenue and profitability as well as by a host of other industries with similar product and marketing characteristics (Petzinger, 1995). This chapter explores the puzzling and sometimes counterintuitive process airlines employ to set the several prices for available seats on each of some one hundred thousand daily flights worldwide.

7.2 Objective of Revenue Management

The objective of revenue management is fairly simple: achieve the highest revenue possible through a combination of price discrimination and seat inventory management. Several prices within the same class of service are available but the number of seats available at each price is limited by estimated demand, thereby exploiting the passengers' willingness to pay. Purchase restrictions prevent passengers willing to pay higher prices from purchasing discounted seats.

The sales of most goods and services are not well suited to revenue management—retailers mostly use cost-based prices for the products on their shelves. As inventory sells, they just restock. All buyers pay the same price regardless of how much they may want or need the product or how much they are willing or able to pay. For example, two shoppers go to a department store looking for a sweater and they both find a nice one for $50. The first shopper bought the sweater for $50 and walks out thinking she got a steal—in fact, she liked the sweater so much she would have paid $100 if she had needed to. The second shopper, who also liked the sweater, had a limited budget and couldn't afford the $50 price tag, so she left with nothing. If the sweater cost the department store $25, the store made only $25 on the sale of just one sweater.

Using price and inventory management, a seller sets multiple prices for the same product or service and allocates a specific amount of inventory for each price. The retailer in the example above could have made more revenue by pricing the sweater for $100, then offering limited deep discounts to $35 with restrictions on the sale, like a special coupon. In that situation, the retailer might have sold one sweater for $100 and one for $35, for a total revenue of $135 and cost of $50. In the airline business, the use of even the most basic revenue management can typically see revenue gains of 2–5% over airlines that do not use revenue management (Belobaba & Wilson, 1997).

The process of setting the prices, inventory limits, and sale restrictions based on demand forecasts, requires complex data manipulation and computation. Airline computer reservation systems developed in the later part of the twentieth century (and covered in detail in the next chapter), not only provided airlines with a faster and more efficient reservations process, but also captured information and trends about how passengers fly. This database allowed analysts to mine historical ticket sales to accurately forecast future demand. With accurate passenger demand forecasts, revenue managers improved their bottom lines.

In practice, this allows the airline to capitalize on passengers' willingness to pay. "In its 1987 annual report, American Airlines broadly described the function of yield management as 'selling the right seats to the right customers at the right prices'" (Smith, Leimkuhler & Darrow, 1992. p. 8).

7.3 Revenue Management Components

The characteristics of the airline product allow the use of several revenue management techniques. In this chapter, each of the following is discussed in detail:

- *Overbooking.* The practice of accepting more reservations than the aircraft has seats.
- *Seat allocation.* Offering the same seat for several different prices by controlling the seat inventory and restrictions to purchase.

- *Fare nesting.* Making sure seat allocation restrictions do not deny the sale of a higher priced fare as long as a lower priced seat remains available.
- *Network inventory allocation.* Making sure that seat inventory is considered for not just a single flight, but for an entire flight from the passenger's origination to their destination.

7.3.1 Overbooking

Overbooking has gotten a bad reputation over the years. We have all heard horror stories about people getting kicked off aircraft and having to spend the night on the floor at the airport. In reality, according to the Department of Transportation, in 2014, less than one person (0.92) out of 10,000 passengers was involuntarily denied boarding, or "bumped" off their flight (U.S. Department of Transportation, 2015). In this section, you'll learn why airlines overbook, and why it's actually good for most passengers.

Overbooking was started in the late 1960s, even while airline regulation was still in progress (Hellerman, 2006). Most airlines at that time had fairly liberal no-show and late cancellation policies. Generally, if you didn't make your scheduled flight, your airline either moved you to the next flight or refunded your ticket. (In comparison, have you ever missed a concert or football game and tried to get a refund on your ticket? Good luck!) The downside of these liberal policies, however, is that they lead to no-shows or late cancellations, often so close to departure that the airline has no opportunity to sell the empty seat.

In the 1980s and 1990s no-show rates averaged 10–15% with peaks in some cases as high as 20% (Toh & Raven, 2003; Belobaba, 2009). American Airlines estimated their no-show/late cancelation rate at about 15% (Smith et al., 1992). In more recent years, however, no-show rates have declined to 7–10% with improvements in the reservations systems that have eliminated duplicate reservations (Lawrence, Hong, & Cherrier, 2003; Bailey, 2007). Not surprisingly, leisure customers, who normally book their reservations far in advance, are less apt to cancel or no-show because of penalties they might incur canceling hotel, cruise, or other vacation plans. Business travelers, on the other hand, usually have higher no-show and cancellation rates (Walczak, Boyd, & Cramer, 2012).

Struggling to make a profit, most airlines can simply not afford to lose 7–10% of their potential revenue because of no-shows. To offset no-shows or late cancelations, airlines *overbook*, which means they sell more reservations on a flight than they have seats. For example, if through historical data, an airline forecasts a specific flight will have a 3% no-show rate, they might allow 3% overbooking to fill the seats left unoccupied by the no-shows. Without overbooking, a no-show or late cancellation on a fully booked flight would result in empty seats and a resultant opportunity cost for the airline.

As discussed earlier, the airline product is very perishable. Petzinger (1995) compares an airline seat to a grapefruit, but an airline seat is more perishable than any fresh fruit—it spoils as soon as it is produced. An unsold grapefruit might be kept on the shelf for a few days whereas an empty seat on a departing aircraft is lost immediately and can never be recovered.

Generally during the booking period, the most discounted tickets sell first, typically to leisure passengers planning trips way ahead of time. The late booking passengers, generally business people who find a need to travel with a relatively short lead time, pay the highest fares. If reservations are curtailed when an aircraft is booked to capacity, the late booking, high-paying business travelers will be denied a reservation and might instead go to a competing airline. The industry term for a passenger denied a reservation is called *spill.* Airline managers hate to turn down these prime customers, especially when historical data show that a certain percentage of people holding reservations will no-show or cancel their reservation just before departure—too late to re-book. This is a double whammy for the manager—they turned down their highest paying passengers because the aircraft was booked full, but then the aircraft ended up departing with empty seats due to no-shows. As a result, airlines judiciously overbook reservations based on the no-show rates of similar historical flights. The overbooking rate will vary for each flight and is usually derived from complex mathematical algorithms that weigh the costs incurred due to overbooking against the opportunity cost of empty seats (Belobaba, 2009).

If the overbooking algorithm works out perfectly, the overbooked passengers will exactly offset the no-shows. That's a win-win-win situation. The late booking, high-paying passengers, who would have been turned down if it were not for overbooking, get their needed seat on the aircraft (wins for both the passenger and the airline), and the passenger who missed their flight due to traffic on the freeway wins by benefitting from the airline's liberal refund policy or by getting a seat on the next flight.

In some cases, however, seats still go out empty because either the actual no-shows exceed the forecast or the overbooking levels are too low. In this case, empty seats go out on flights that were booked full. The industry term for this is *spoil.* Spoiled or empty seats not only have no value but also represent an opportunity cost for the airline (Smith et al., 1992).

7.3.2 Overselling

With overbooking comes the risk of *overselling.* Overselling occurs when more passengers show up than expected and the airline doesn't have enough seats for all of them. There is a cost to the airline for an oversale and it can come in two different ways.

First, if it looks like a flight will oversell, agents are required to solicit volunteers who will give up their seat willingly and take a later flight instead ("FAA Oversale Policy," 2013; "European Commission (EC) Regulation 261/2004," 2004). The airline will offer incentives for volunteers that might include ticket reimbursement for that leg, vouchers that can be put toward future travel, hotel or restaurant vouchers/discounts or a combination of those (Belobaba, 2009).

Figure 7.1 is an example of such an offer from United Airlines. This screen appears on the check-in kiosk if there is a chance of an oversale on your flight. The goal is to get enough volunteers so that the airline can avoid involuntarily bumping passengers off the flight. The compensation given to volunteers reduces the net revenue the airline makes from overbooking, so optimal overbooking rates incorporate the estimated cost of compensation. Oversale costs are not consistent as the more volunteers needed, the higher the compensation needed. The specific market must also be considered. Here's an example: passengers headed to Venice might not volunteer to give up their seat even for a huge voucher because they are en route to catch a cruise ship that they can't risk missing. Fans going to a sporting event or concert might also exhibit the same tendency. Leisure travelers who are not on a specific schedule and are looking for a good deal are the best candidates for oversale volunteers. About 90% of the time, oversale situations are resolved by passengers voluntarily giving up their seats (Belobaba, 2009).

The second possible cost from overselling comes as a result of a passenger who was involuntary denied boarding or "bumped" from the flight. If the agent cannot find enough volunteers to give up their seats, he or she will have no choice but to involuntarily deny boarding to some passengers. Boarding priority rules differ by airline, but many times the last passengers arriving at the gate will be the ones involuntarily bumped.[2] An involuntarily bumped passenger in the United States has specific legal rights in accordance with 14 C.F.R. § 250 ("FAA Oversale Policy," 2013) and can cost the airline cash (not vouchers). Similar rights protect European passengers through European Commission (EC) Regulation 261/2004 (2004), although financial compensation in the EU depends also on the distance of the flight. (The EU regulation also requires compensation for certain late flights.) In both jurisdictions, the passenger being bumped has the option of cash compensation or voucher compensation. In 2010, Southwest Airlines was fined $200,000 by the Department of Transportation for failure to properly inform bumped passengers of their rights concerning denied boarding cash compensation (Martin, 2010).

Figure 7.1 Check-In Kiosk Screenshot. Photo by B. Billig.

Oversales can also be costly to the airline in terms of reputation (Lindenmeir & Tscheulin, 2008). Word-of-mouth reputation can suffer from the bumped passenger telling all their friends and vowing to never fly on the airline again. Additionally, the airline's statistical reputation can suffer because the Department of Transportation tracks and reports numbers of passengers denied boarding. These statistics are used for reports like the annual Airline Quality Rating (Bowen & Headley, 2015). There have also been instances of lawsuits resulting in airlines reimbursing passengers nonrefundable prepaid vacation expenses that were incurred due to the bumping (Maull, 2005).

Figure 7.2 illustrates the overbooking process. Note how potential revenue climbs as seats are booked during the reservation period (sometimes up to a year's time from the opening of the flight for reservations until departure). If the reservations were stopped when capacity was reached, and everyone showed up, revenue would be shown at R. But with refunds to no-shows and late cancellations, the revenue drops to R_1.

Figure 7.3 shows the same example, but this time bookings continue past the aircraft's capacity to a predetermined overbooking percentage. If more passengers show up than the capacity of the aircraft, the airline will begin to incur an associated cost beginning with the first passenger above capacity. This cost is shown by the short curve on the bottom of the graph. Notice this cost is not linear; the airline may be able to persuade the first or second volunteer for little incentive, but as more volunteers are needed, the "bribe" will have to increase. The total revenue line is reduced by this cost. The highest point on this net revenue curve represents the maximum revenue possible at R_x and the optimum overbooking level at x%. If the flight is overbooked too much (to y%), the cost of the oversale will outweigh the added revenue and net revenue will drop to R_y. The overbooking rate is the total number of passengers booked divided by the capacity of the aircraft. If too many people show up and an oversale occurs, the important thing

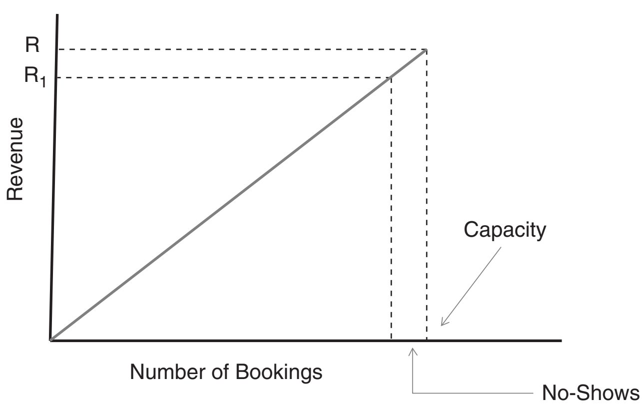

Figure 7.2 No Overbooking Revenue.

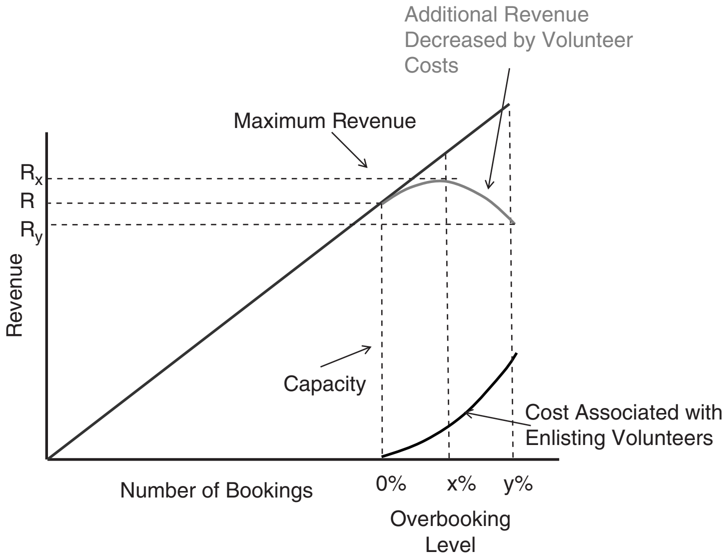

Figure 7.3 Revenue with Overbooking.

for the airline is to keep the oversell costs (either volunteer bribes and/or denied boarding fees) less than the lost potential revenue (Belobaba, 2009). That is hard to accomplish if passengers are involuntarily denied boarding due to regulatory imposed compensation payable to the passenger. Note that these curves are exaggerated in order to better illustrate the concept.

It's interesting to note that the expected revenue at the optimum overbooking level (R_x in Fig. 7.3) is higher than the zero overbooking expected revenue (R in Fig 7.3). This is because the last passengers to make reservations usually pay the highest fare whereas the volunteers often paid a highly discounted fare.

The value of overbooking is demonstrated in Figure 7.4 for three notional flights. In the first column, the flight was insufficiently overbooked. Although the historic no-show rate was 3%, the actual no-show rate for that flight was 9%. The result was seven empty seats that would have otherwise been filled equating to an opportunity cost of $3,367. The other two columns both had flights with lower no-show rates than projected and resultant oversell costs that the airline paid in vouchers good for future travel.[3]

7.4 Pricing

Before deregulation, the CAB used cost-based pricing to set airline fares. Pricing was based on the average cost to produce a unit of output—the airline seat. In industry terms, this was the cost per available seat mile (CASM) times the length

Flight Origination—Destination	SAT-BWI	SFO-LAX	DEN-PDX
Aircraft Capacity	143	137	175
Average No-Show	3%	10%	7%
Overbooking rate (authorized bookings)	2% (146)	8% (148)	5% (184)
Total seats booked	146	148	182
Passengers that showed	135 7 empty seats	142 5 denied boarding	181 6 denied boarding
Result	Opportunity cost of spoiled product	5 volunteers moved to other flights	4 volunteers moved to other flights, 2 sent to hotels
Cost	Empty seats worth $481 each. Total lost $3,367	$1,200 in flight vouchers to volunteers	$1,500 total for flight vouchers, hotels and meals

Figure 7.4 Overbooking Examples.

of the leg, plus a small profit. Although this type of pricing is generally functional and used regularly in retail sales, it does not consider any variance in the market from one place to another.

Demand-based pricing, on the other hand, sets a price based on what the customer is willing to pay, taking full advantage of the market demand. In order to take advantage of a customer's willingness to pay, the seller must set different prices for the product through price discrimination and/or product differentiation (Belobaba, 2009). Both price discrimination and product differentiation will be thoroughly discussed in the following sections.

7.5 Revenue Management Product Characteristics

Revenue management was originally developed within the airline industry, but it has since been applied in many other industries including railroads, shipping, bus lines, rental cars, hotel rooms and others. Each of these industries has special product characteristics in common that are necessary in order to use revenue management (Hellerman, 2006):

- *Perishable inventory.* The airline product is not storable and inventory cannot be stockpiled for sale at a future date. An empty seat on a departing airliner spoils as soon as the door is closed and the revenue potential of that product is lost. Hotel rooms are similar.
- *Fixed short-term capacity.* The number of airline seats for a flight is fixed once the schedule is in place, which may be as long as 6 to 12 months prior to the day of the flight. Although airlines have some limited flexibility to swap aircraft assignments to adjust capacity, an airline cannot vary the number of seats in the short-term to fit variances in demand. Only in the long-term can significant capacity can be added or reduced to match demand.

- *High fixed costs.* The cost associated with moving even an empty aircraft from one point to another is high. Once the airline schedules a flight, it is committed to that fixed cost of operation. Adding payload, passengers and cargo, to the aircraft increases the weight and adds a relatively small increase in the cost of operation. By analogy, consider the cost of driving your car from Texas to California. Once you decide to take the drive, adding another person or suitcase to the car adds some small additional cost, mostly in extra fuel.
- *Very low marginal costs.* The cost of carrying one additional passenger (marginal cost) is very low relative to fixed cost. The marginal cost varies with the length of the flight, but adding one additional passenger to a 500 mile flight probably costs the airline less than $10 (the cost of a couple gallons of fuel, a soda and a bag of peanuts). The combination of high fixed costs and low marginal costs results in a situation where it is better to sell the product for a substantial discount rather than let it spoil (Weatherford & Bodily, 1992; Belobaba, 2009).
- *Uncertain demand.* Average demand may be forecast to some degree of certainty, but exact demand cannot. With demand certainty, a company can adjust capacity and prices to maximize revenue. With uncertain demand or fluctuating demand across time, excess capacity exists at some points.
- *Segmentable market.* Tracking passenger purchasing patterns allows the airline to gauge passengers' willingness and ability to pay for air travel and to segment the passengers into groups of similar demand.
- *Advance sales/bookings.* Tracking advance ticket sales allows the airline to fine-tune seat allocation and overbooking rates as the day of departure approaches. An advance booking requirement is generally a market segmenting device itself.
- *Historic sales data.* Historic data is needed to determine forecast demand.

7.5.1 Seat Allocation

We begin this section with the basic economic theory behind airline revenue management. The demand curve shown in Figure 7.5 indicates individual customer's willingness and ability to buy a product or service at different prices. Not surprisingly, the lower the price, the more product or service consumers are willing to buy; each customer values the product differently and thus is willing to pay a different price. In Figure 7.5, at price P1, only one unit would be sold; in other words, there is only one consumer willing and able to buy the product at that price. At price P4, however (see Figure 7.6), four units would be sold, presumably to four different consumers.

In competitive markets such as the United States and Europe, most products sell for a single, cost-based price. This is because prices are easily obtained and compared, several convenient sellers are available to the consumer and there is generally no lack of supply. If one seller raises the price above the others, consumers move to the lower priced sellers. Over time, consumer choice tends to even prices.

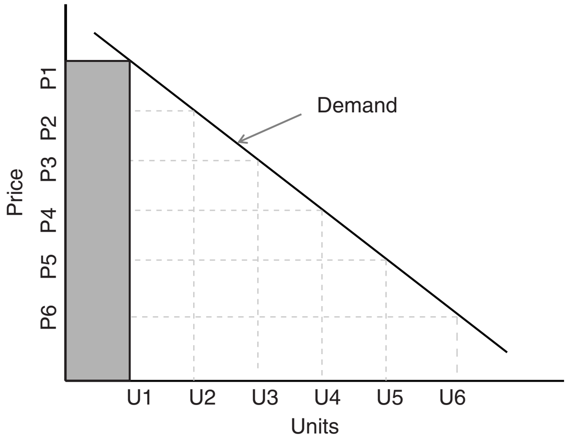

Figure 7.5 Demand Curve Indicating One Unit Sold at Price P1. Total Revenue is P1 × U1, Equal to the Shaded Area.

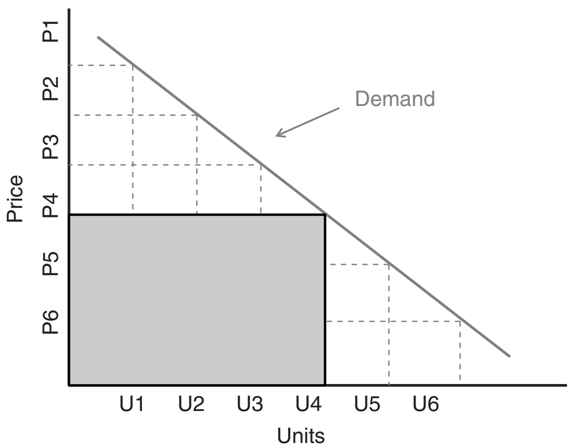

Figure 7.6 Demand Curve Indicating Four Units Sold at Price P4. The Total Revenue for Selling Four Units Is P4 × U4 and Equal to the Shaded Area.

With just one price, total revenue is simply the price times the quantity sold and is indicated by the shaded areas in both Figures 7.5 and 7.6.

Looking again at Figure 7.5, reducing the price from P1 to P2 adds one more buyer as the demand moves from U1 to U2. This additional buyer was not willing to pay P1, but will pay P2. Obviously the buyer who was willing to pay P1 is also willing to pay P2, so the U2 demand is made up of P1 and P2 buyers. If the price is decreased another notch to P3, another buyer comes forward. This buyer is willing to pay P3 and is joined in the group by buyers at P1 and P2, who would be very happy to get the item for P3. Finally in Figure 7.6, the price is reduced one more time and another buyer appears. Of the four buyers at price P4, three are actually willing to pay more.

Total revenue for the sales can be significantly increased if the price is demand-based, where each consumer can be charged the maximum price he or she is willing and able to pay. In Figure 7.7, note that for every price decrease, one additional unit is sold; one unit would be sold at price P1, the second unit at P2 and so on. The total of the shaded areas representing total revenue is much larger than the area when the four units are sold at a single price (Figure 7.6). The airline revenue manager's challenge is to devise a system that will require, or at least encourage, each passenger to pay the maximum price he or she is willing and able to pay.

One of the most important airline product characteristics mentioned earlier was that of very low marginal costs. Marginal cost is the cost incurred by selling each additional unit; for airlines, adding one more passenger to an aircraft. In Figure 7.8, the seller is willing to sell the fifth unit at a price as low as P5 but will not sell the sixth unit at price P6 because the price is lower than the marginal cost of producing this last unit. The seller would lose money selling at price point P6. To illustrate this point and provide an example of low airline marginal costs, in 2010, JetBlue offered a promotion selling seats to a variety of U.S. destinations for only $10. The fare applied only to seats unsold just before departure that would have presumably spoiled if not for the promotion ("JetBlue offers," 2010).

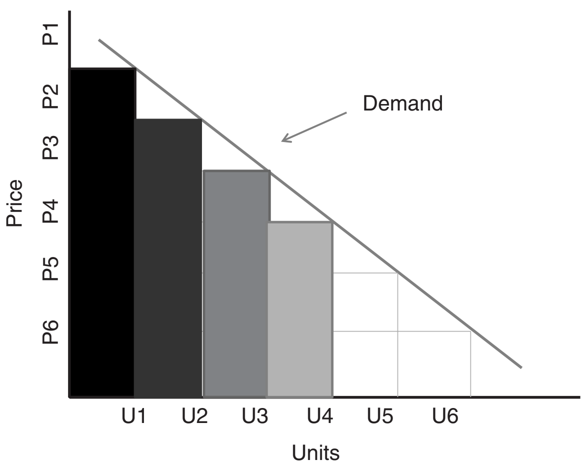

Figure 7.7 Demand Curve Showing Four Units Sold, One Unit at Each Price P1, P2, P3 and P4. The Total Revenue is Indicated by the Total of the Four Shaded Areas.

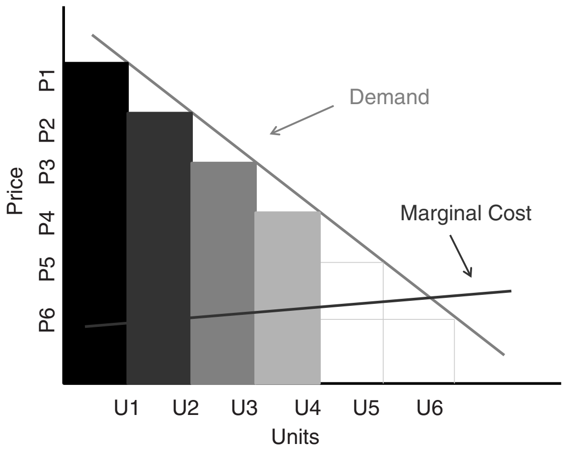

Figure 7.8 Marginal Cost.

7.5.2 Price Discrimination

Selling the same product at different prices to different customers is called *price discrimination*, and is based solely on a customer's willingness to pay. Airlines use price discrimination to accomplish revenue management. Dunleavy and Phillips (2009) describe six conditions that must be met for price discrimination to benefit airline revenue management:

- A market that can be segmented by varying degrees of willingness and ability to pay (in economics, different price elasticity of demand).
- Independent demand between segments.
- Barriers must prevent customers from buying down (buying a discounted seat when they are willing to pay for a more expensive seat).
- Arbitrage, the practice of purchasing products or tickets for resale to others, can be prevented.
- Customers' access or knowledge of other fare levels is limited.
- Marginal demand exceeds marginal supply.

Price discrimination is practiced when the same good or service is sold for different prices. One could argue that airline seats with varying purchase and/or travel restrictions are really different products. For example, two passengers sitting next to each other in the same row might appear as if they each bought exactly the same product, when in reality, one bought an "advanced purchase seat" and the other bought a "non-refundable seat"—two different products. Most economists believe, however, that setting restrictions on seat sales does not rise to the level of creating a separate product and, therefore, is still considered price discrimination.

7.5.3 Market Segmentation

As noted above, airlines must segment their market in order to price discriminate. They do this by attaching various restrictions called *segmentation devices* to an aircraft's seat inventory. As an example, let's go back to Figure 7.7. The airline revenue manager wants to segment the seats into four booking classes sold at four different prices. The highest price ticket, P1, will probably have no sales restrictions, while the P2, P3 and P4 will have increasing levels of restriction. If the segmentation devices work as designed, the four buyers in the example would each pay the highest price they are willing to pay and the resultant revenue would be represented by the total shaded area shown in Figure 7.7. If the segmentation devices do not work and there was no control of the sales in the booking classes, all four buyers would each pay the lowest price (price P4 as shown in Figure 7.6) and the resulting revenue shaded area would be much smaller. This latter case is an example of what is called *price diversion* or the moving of a product from its intended market to an unintended or unauthorized market.

Airline revenue managers have the challenge of determining which customers are more willing to pay the higher prices and somehow devising appropriate restrictions on the discount prices.

Historically, business people are willing and able to pay more for travel than leisure travelers. In terms of elasticity of demand, business travelers' demand is inelastic—less responsive to price changes. Although many businesses might have limited travel budgets, most business travelers are normally not paying for the ticket out of their own pocket and the cost of the travel to the company is probably a small fraction of the ensuing business deal. Further, business travelers are generally tied to more restrictive schedules, make air travel arraignments to fit their meeting schedule, do not want to be gone from home over a weekend, and usually prefer refundable tickets. With these travel needs, business travelers are generally more time-sensitive than price-sensitive (Donovan, 2005).

Leisure travelers, on the other hand, exhibit elastic demand—they are very sensitive to price changes. Leisure travelers are usually paying for the tickets out of their own pockets and often travel as a family. Their travel costs are possibly the biggest expense of their trip and as a result, they are generally very price-sensitive when making travel plans. In fact, sometimes, leisure passengers take advantage of their flexible schedules and plan their trip to accommodate the cheapest airfare. The revenue manager looks for these types of characteristics that differentiate these two consumer groups and then sets up segmentation devices (Donovan, 2005).

Segmentation devices

Segmentation devices are designed for the specific market. For example, movie theaters sometimes use a customer's age as a segmentation device to price discriminate. They might sell tickets for a movie for three different prices: student, adult and senior although the products they are selling are the same—a seat in the theater (Boyd, 2007).

Most airline segmentation devices are designed to separate business and leisure passengers with the overall goal of "fencing the population into different segments based on their willingness to pay" (Boyd, 2007, p. 13). With perfect segmentation devices, customers who are willing and able to purchase a certain fare are dissuaded from purchasing a lower fare by restrictions attached to discounted fares (Botimer & Belobaba, 1999). Business passengers, being less price-sensitive and more time-sensitive, are willing to pay more for last-minute airline reservations that meet their business needs. Company policy might also require they purchase refundable tickets. Leisure passengers, on the other hand, are usually more willing to adjust their schedules to save money. They also usually have longer lead times for their travel plans (Boyd, 2007). Look at this list of restrictions attached to discounted fares and consider how they might segment the business and leisure passengers.

- *Advanced booking.* Flight must be booked in advance, typically 7, 14, and 21 days out from the day of departure.
- *Advanced purchase.* Pay for a ticket a specified number of days in advance of flight or a minimum number of days after the reservation is made.
- *Minimum stay.* Time between outbound and return flights must be at least certain number of days (usually seven).
- *Round trip.* Ticket must be round trip without intermediate stops.
- *Saturday night stay-over.* There must be a Saturday night between outbound and return flights.
- *Refund penalty or no refund.* If the booking is canceled before the flight, the passenger forfeits all or part of the ticket price.
- *Rebooking fee or no rebooking privilege.* Fees apply to any change of itinerary.
- *Limited or no stopover privileges.* No time may be spent at connecting or stopover points.
- *Limited or reduced service.* Reduced in-flight meal and beverage service.
- *Limited time of day.* Price not available at popular times.
- *No interline privilege.* Ticket cannot be accepted by another airline.
- *Finally, tickets not transferable.* This prevents an entrepreneur from buying discounted tickets and reselling the tickets later at a profit but for less than the airline's business fares.

The cheapest tickets have the most restrictions while the most expensive tickets have few or none. Based on a single-class seating arrangement, the highest price ticket probably allows full refundability with no advance purchase or stay-over requirement. The deepest discounted ticket, on the other hand, is probably not refundable, must be booked and paid in advance, requires a Saturday overnight, must be booked on the airline's website, and is limited to certain times of the day and days of the week.

Each fare level is given a single letter designation. Airlines have different own code systems but a "Y" class ticket is usually the full-fare coach ticket and a "Q" class ticket is the most discounted coach ticket. Between the two, there will be many different classes, each with another letter designator. A good example might be an airline offering four fare levels (from highest to lowest): Y, B, M and Q fares. Airlines even go so far as to name their fare classes to entice their intended market. Southwest Airlines' highest fare is called "Business Select" for example.

7.5.4 Estimating Demand

If the airline knew exactly how many late-booking business passengers wished to travel on each flight, revenue management would be relatively easy. Seats would be held in inventory for these business travelers who will buy them in the last few days before the flight at relatively high prices. The remainder of the seats would be offered for earlier sale at discount prices with one or more segmentation restrictions attached to prevent the business traveler from taking advantage of the discounted tickets (prevent price diversion). Although not every passenger would pay the maximum price he or she is willing to pay, this pricing method does significantly increase revenue over a single price for all seats—sometimes as much as 9% or more (Boyd, 2007).

At the largest airlines, even a small increase in revenue per flight can add up to hundreds of millions of dollars per year in additional revenue. For example, in 2014 Southwest Airlines averaged over 3,400 flights a day throughout the continental United States and the Caribbean. Up-selling just one passenger per flight from a discounted seat to a full-fare seat (perhaps just $100) could increase the company's annual revenue by over $124 million (Southwest Airlines Co., 2015).

Revenue management, of course, is not that simple because the number of late-booking business passengers and price insensitive passengers cannot be known with certainty; the number can only be estimated. As we know from the earlier chapters, air travel demand varies with time of day, day of the week, season and other seemingly random reasons that cannot be clearly identified in advance. Because of this fluctuating demand, the number of seats to be held in inventory for late sale can only be estimated.

A good start for estimating the demand for any fare class on a given flight is from historical reservation data. Figure 7.9 shows an example of ticket purchases for a flight with a B fare of $600. Note that over the period data were collected, the number of tickets sold for the flight varied over a large range: a few times less than 30 seats sold but occasionally more than 48 seats sold. The average number of seats sold was 40.

Studies show that the demand can be modeled with a normal probability density function (bell curve). The mean and standard deviation, which define the curve, can be calculated by analyzing the raw data (Belobaba, 1989). In the example shown in Figure 7.9, the mean is 40 and the standard deviation is 5.0.

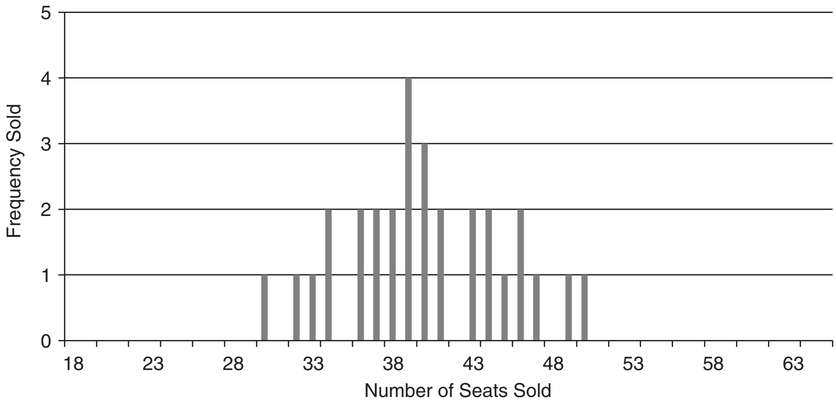

Figure 7.9 Historical Reservation Data from a Specific Flight for the $600 B Fare.

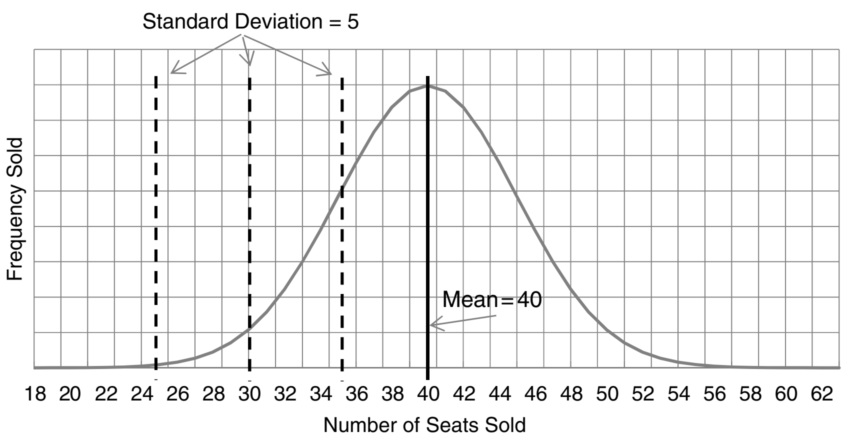

Figure 7.10 Probability Density Function for $600 B Fare.

After finding these two statistics, the normal distribution function can be plotted (Figure 7.10). Notice how the plot resembles the raw data. For those who have not studied statistics (or who have forgotten everything you once learned), not to worry, just follow the general logic.

To determine the probability of selling a given number of seats, we use the mean and standard deviation to compute the cumulative distribution function (CDF), the integral of the normal distribution (the area under the bell curve). The complement of the CDF is called the survivor function. The survivor function is used to find the exact probability of selling any specific seat. The survivor function for the $600 B fare is shown at Figure 7.11.

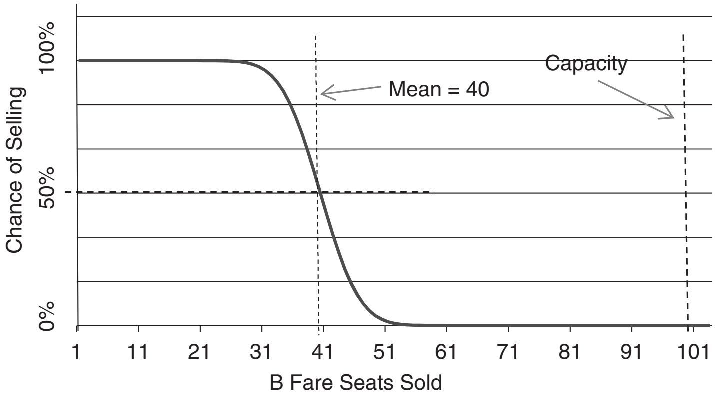

Figure 7.11 Survivor Function for $600 B Fare.

Looking at Figure 7.11, the mean, or the average number of seats sold at the B fare, is 40. What's the probability of selling the 40th seat? Well, half the time fewer seats are sold, and half the time more are sold, so the answer is 50%. It follows that the chance of selling the 41st seat is just a little lower, the 42nd seat a little lower still. On the other side of the mean, the chance of selling the 39th seat is just slightly higher than 50% and the 38th seat a little higher still. Taken to the extremes, the chance of selling the first couple of seats is 100% while the chance of filling up the aircraft is zero. In practice, computations of probabilities are handled by software applications.

Expected marginal seat revenue

The *expected marginal seat revenue* (EMSR) is the single most important concept in airline revenue management. EMSR is defined as the revenue the airline can expect to receive for the next (marginal) seat sold at a given fare—in other words, it's the fare times the probability of selling the seat. Once the analyst knows the probability of selling the next seat (from the survivor function), he or she multiplies the probably by the fare to determine the expected, or average, revenue from that seat at the B fare. Going back to our earlier example, at the B fare, the 40th seat has a 50% probability of selling. If the B fare is $600, on the average the airline makes $300 from the 40th seat ($600 x .50 = $300). If the seats sell, the revenue is $600, but because the 40th seat sells only half of the time at that price, over the long run the airline makes only $300. The plot of the EMSR looks a lot like the survivor function, except the vertical axis now is labeled in dollars (Figure 7.12).

We called the $600 fare in Figure 7.12 a B fare. Now let's try another fare—an M fare at $500. The sales of $500 seats would produce a similar looking EMSR

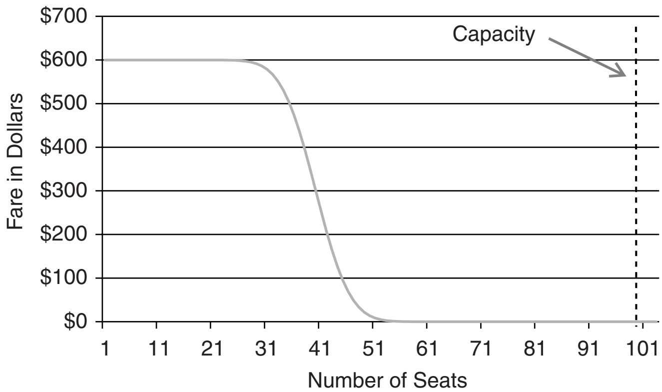

Figure 7.12 Expected Marginal Seat Revenue Plot for the $600 B Fare.

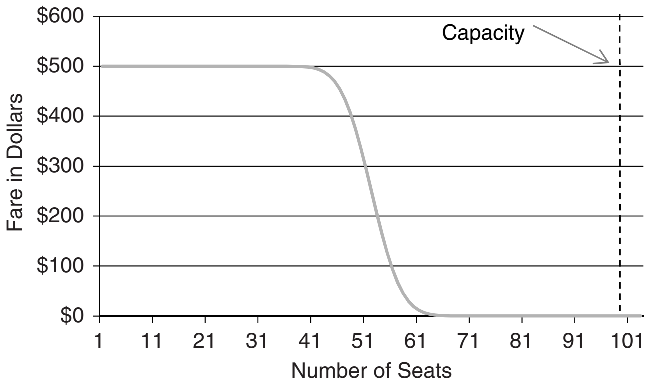

Figure 7.13 Expected Marginal Seat Revenue Plot for the $500 M Fare.

plot, with different values, maybe something like Figure 7.13. Notice it has a shape similar to the $600 EMSR, but the curve starts at $500. It also has a slightly higher mean at about 52, which makes sense—chances are that more people will want to purchase the $500 seats than the $600 seats. Also, note from the plot that even at this lower fare, the 100-seat aircraft will never sell out.

Now let's add in two more fare levels, our lowest and most restrictive, we'll call a Q fare for $300, and an unrestricted fare called a Y fare at $800 (the highest). The two EMSR plots are shown at Figures 7.14 and 7.15. As the plots show, the Q fare is very popular, and if it is offered without limits, it would occasionally sell out the aircraft to capacity. On the other hand, the Y fare is not very popular, rarely selling the 30th seat.

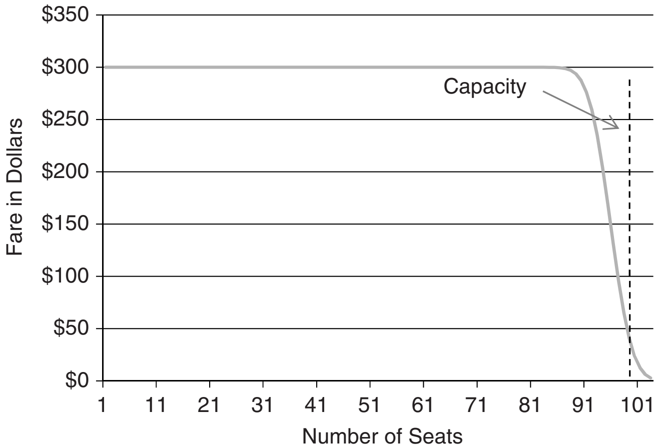

Figure 7.14 Expected Marginal Seat Revenue Plot for the $300 Q Fare.

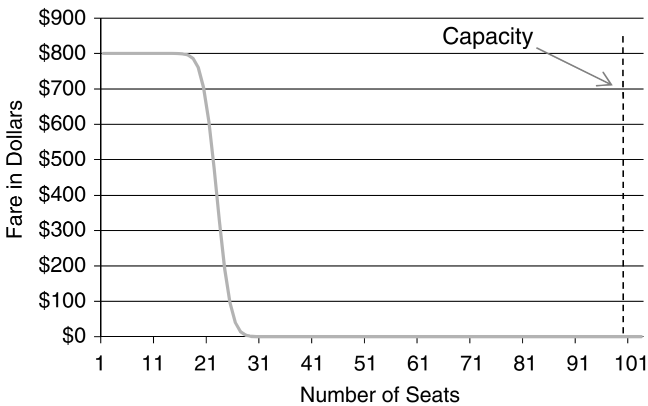

Figure 7.15 Expected Marginal Seat Revenue Plot for the $800 Y Fare.

By analyzing these EMSR plots, airline revenue managers can determine "how many seats *not to sell* in the lowest fare classes and to retain for *possible* sale in higher fare classes closer to the departure day" (Belobaba, 1989, p. 186). They do this by superimposing the plots on top of each other. Figure 7.16 shows the four EMSR plots from Figures 7.12–7.15 together. From the graph, notice that the airline can expect to sell a few Y fare ($800) seats, but the EMSR of the 21st seat (Point 1) sold at $800 is only $600. In other words, the average revenue from selling the 21st seat is the same whether it's sold at the Y fare or the B fare. If the airline tried to sell the 22nd seat at $800, its EMSR would be only about

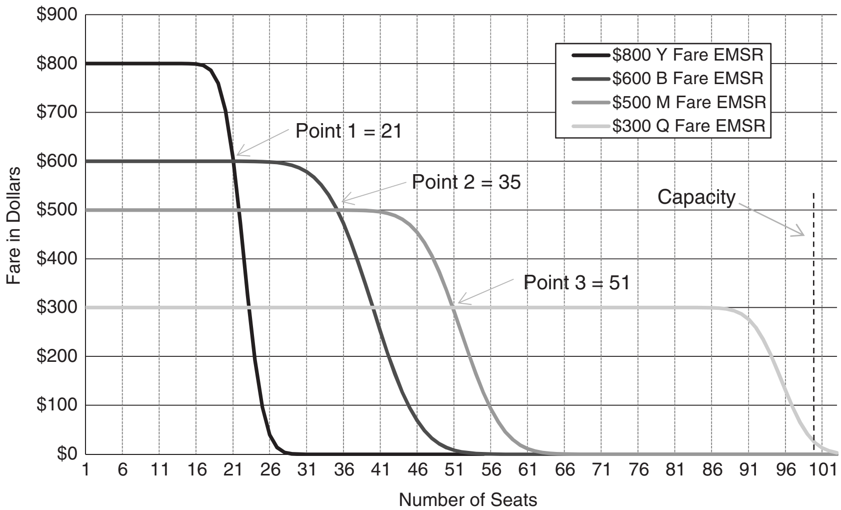

Figure 7.16 EMSR plots for Four Fares in a 100-Seat Aircraft.

$530. However, the EMSR of the $600 tickets for the 22nd seat is still $600. As the plot shows, between Point 1 and Point 2, the EMSR of the $600 seats is the highest. At the 35th seat sold (Point 2), the $600 B fare EMSR drops to about $500. Seats sold between Point 2 and Point 3 (the 51st seat) get the highest revenue from the $500 M fare tickets. Beyond Point 3, the plot shows the most discounted $300 seats are really all that are selling. This booking limit process is known as "Littlewood's Rule" after Kenneth Littlewood who, while working for British Overseas Airways Company (BOAC), first described the process in 1972 (Littlewood, 2005; Phillips, 2005).

Based on this example, the airline would allocate 21 seats for $800 buyers, 14 seats (seats 22–35) for $600 buyers, 16 seats (seats 36–51) for the $500 buyers and allow the 49 remaining seats (seats 52–100) to be sold to $300 buyers. The total expected revenue using this method can be calculated as the area under each respective EMSR curve between the respective limits (a calculus exercise if you are so inclined). This is similar to the area calculated in Figure 7.7.

7.5.5 Fare Buckets and Fare Nesting

The calculations shown above allow managers to determine how many seats to allot to each fare category. If forecast demand were perfect, they could allocate those number seats to each fare category and everything would work out great. With imperfect demand forecasting, however, the airline does not want to get into a situation where a higher fare has sold out, but discount tickets are still available. Can you imagine telling a Y fare customer they can't have a reservation because you have already sold 21 seats at that fare, but still accept B, M or Q fare reservations? If the passenger is willing to pay the $800 Y fare, the revenue manager wants any available seat regardless of its original allocation. To do this, they allot seats into "buckets" for reservations agents to sell. Using the example shown in Figure 7.16, the airline would assign all 100 seats into the highest Y fare bucket—they are willing to sell as many Y fare tickets as there are buyers. The Y fare will always be available as long as the aircraft is not sold out. On the other hand, the B fare bucket will contain only 79 seats because the airline is willing to sell all of the seats at the B fare except the 21 they are saving for the Y fare buyers. The manager wants to sell as many B fare seats as possible and will dip into the M and Q fare allocation if necessary as long as he saves 21 seats for the Y fare passengers, who may buy later in the reservation period. Similarly, the M fare bucket will contain 65 seats (the aircraft capacity minus those saved for the B fare and Y fare buyers). Finally, using the same process, the Q fare bucket will contain only 49 seats. This process is called *fare nesting* and is designed to make sure that higher priced seats never sell out before lower priced seats. Figure 7.17 illustrates this fare nesting. In this example, if an agent sold an M fare reservation, a seat would come out of the M fare, the B fare and Y fare buckets because the M fare is available to M, B and Y fare classes, but not the Q fare class. It follows that a Q fare seat sold would reduce each of the buckets, by one, and a Y fare would decrease only the Y bucket. Another way to think of this is if a marble represented each seat, and the fare buckets were actual buckets. The Y bucket would have 100 marbles, the B bucket 79, the M bucket 65, and the Q bucket 49. Each time a seat is sold, one marble is removed from the appropriate bucket, as well as the higher buckets. Selling a B seat would reduce the available marbles to 78 in B and 99 in Y; selling a Q seat would reduce Q to 48 M to 64, B to 78 and Y to 99.

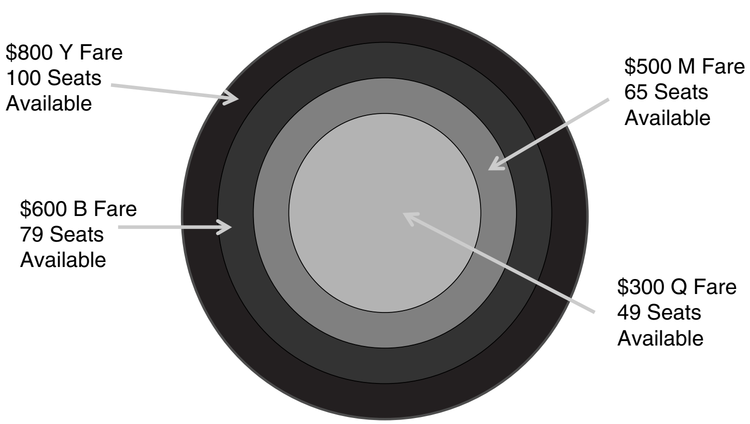

Figure 7.17 Fare Nesting

Departure Time	*Arrival Time*	*Flt #*		*Travel Time*	*$800 Y-Fare*	*$600 B-Fare*	*$500 M-Fare*	*$300 Q-Fare*
5:00 am	**7:05 am**	**3255**	**Nonstop**	**2+05**	○	○	○	**Not Available**
6:35 am	**8:35 am**	**2387**	**Nonstop**	**2+00**	**Not Available**	**Not Available**	**Not Available**	**Not Available**
8:15 am	**11:15 am**	**23**	**1 Stop**	**3+00**	○	**Not Available**	**Not Available**	**Not Available**
10:30 am	**12:35 pm**	**543**	**Nonstop**	**2+05**	○	○	○	**Not Available**
12:45 pm	**2:45 pm**	**980**	**Nonstop**	**2+00**	○	○	○	**Not Available**
3:50 pm	**7:00 pm**	**784**	**1 Stop**	**3+10**	○	○	○	○
4:55 pm	**6:55 pm**	**555**	**Nonstop**	**2+00**	○	○	**Not Available**	**Not Available**
6:30 pm	**8:35 pm**	**2990**	**Nonstop**	**2+05**	○	**Not Available**	**Not Available**	**Not Available**
8:00 pm	**11:30 pm**	**3125**	**1 Shop**	**3+30**	○	○	**Not Available**	**Not Available**

Figure 7.18 Typical Airline Online Reservations Web Page.

Fare nesting can be illustrated on airline reservation websites. Figure 7.18 is an example website offering our four example fare categories, increasing in cost from right to left. Notice how in the example, the cheaper seats ALWAYS sell out first. Because the fare buckets are nested, a higher priced bucket will never sell out if there are still seats in a lower bucket. Sometimes you might notice an anomaly to fare nesting, but this is probably due to physical limitations of the aircraft. For example, a flight might sell out the first-class seats, and still have coach available because there are a fixed number of seats in that section.

7.5.6 Expected Booking Updating

Revenue management as described to this point allocates specific numbers of seats to each fare bucket based on historical information, but demand for the various fare buckets continues to evolve as the departure date approaches. It's unlikely that any forecasting model will be 100% accurate, a host of circumstances will impact the forecast, both positively and negatively. For example, if the economy is in recession, business demand would be negatively impacted as would business ticket sales. Holidays, promotions, or other special events, on the other hand, can increase bookings. As bookings are taken over time, the originally computed demand forecast can be refined and adjusted so that as the day of flight approaches, the forecast demand becomes increasingly accurate.

The expected booking curve, shown in Figure 7.19, as the solid upward sloping line, is generated from sales history and shows how a market segment

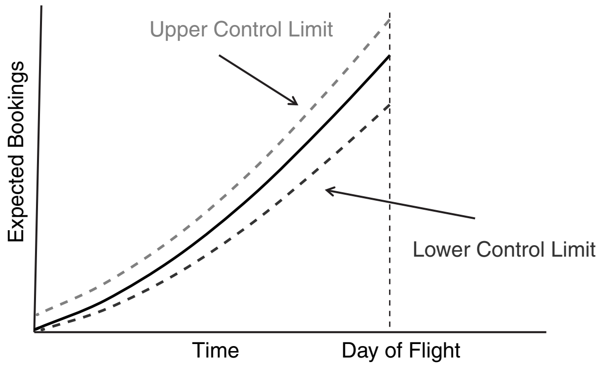

Figure 7.19 Expected Booking Curve.

is expected to book over time, starting the day the flight is opened and ending the day of departure. This period can be four months to a year in advance of the flight departure date.

Actual bookings are continuously compared with the expected booking curve allowing demand estimates to be refined and seat allocations adjusted. A brisk sales pace exceeding the expected booking curve for a certain fare may indicate demand is underestimated for that fare level. In that case, the number of seats allocated to lower fare categories would be reduced and those seats reallocated to the higher fare. Let's go back to our example where there were 21 seats in the Y fare category and 14 seats in the B fare category. On a given day, maybe 10 days before departure, you expect to have sold 15 Y fares, 10 M fares, 8 M fares and 45 Q fare seats. If the Y fare has sold 19 seats (5 higher than projected for that day), the manager would want to reduce the lower fare seat allotments, anticipating increased Y fare sales.

On the other hand, if a higher fare category isn't selling as fast as it should, seats might be reallocated to lower fare categories—in some case re-opening previously sold out discount fares. Because tens of thousands of flights must be tracked, deviations from expectations are automatically tracked and adjusted by the revenue management system. Upper and lower control limits are established and deviations beyond these limits generate an exception report which is reviewed by a revenue management analyst who can then adjust the allocations as needed.

Seat allocation among the fare categories may be adjusted frequently, more often as the day of the flight nears. Thus, a discount fare that had previously sold out its allocation may be reopened later if bookings in higher fares are slow. If you have a reservation, it pays to check frequently for a lower fare. The airline, however, wants to avoid price diversion and may or may not refund the difference if a lower fare becomes available. Policies differ among airlines and are subject to change.

7.5.7 Selling-Up

Selling-up occurs when a customer who meets all of the restrictions for a discount fare instead purchases a higher fare. In a way, it's the opposite of price diversion. Selling-up can occur because the lower fare category is sold out, or the customer is enticed into a higher fare by marketing or advertising. As an example of selling-up, if the seats are still available, Southwest Airlines offers a walk-up upgrade to their highest class (Business Select) as customers are waiting in the gate area. The target customers have already met the restrictions and purchased the lower category fare, but might be inclined to upgrade at the last minute as an impulse.

7.5.8 Revenue Enhancement with Revenue Management

Table 7.1 shows how revenue management can increase an airline's bottom line with an example using the four fare classes from the examples above.

There are a few interesting points to explain this example.

1 The numbers in the total demand column come right off a demand curve like those shown in Figures 7.5 through 7.7. As the price drops, the demand increases. This is also indicated from the EMSR plots.
2 If there were no booking constraints (segmentation devices or seat allocation), everyone would simply buy the cheapest ticket and price diversion would occur. In this case, everyone buys the Q fare and the aircraft goes out full, but only earns $30,000 in revenue. In this example, as many as 63 out of the 100 buyers might be willing and able to purchase higher priced seats but instead, they buy the discounted seats—just because they can. If the airline wants to maximize load factor, this is the way to do it.
3 The average revenue column shows the revenue from the EMSR curves; mathematically, the area under the sections of the highest curve between the associated limits. Remember, the EMSR considers the fact that the aircraft will not always sell-out (the EMSRs taper off contrasted to the square corners on the plots in Figure 7.7). The average revenue, in this case, is $46,000.

Table 7.1 Revenue Management Example

			Passengers			*Revenue*		
Class	*Fare*	*Total Demand*[1]	*Unconstrained Bookings*[2]	*Average Rev Mgt*[3]	*Updated Rev Mgt*[4]	*Unconstrained Revenue*[2]	*Average Revenue*[3]	*Updated Revenue*[4]
Y	$800	28	0	20	10	0	16,000	8,000
B	$600	52	0	13	16	0	7,800	9,600
M	$500	63	0	15	19	0	7,500	9,500
Q	$300	103	100	49	48	30,000	14,700	14,400
Total			100	97	95	30,000	46,000	41,500

4 The updated column shows a hypothetical situation where the Y fare passengers were not booking as projected, so an analyst reallocated 10 Y fare seats: five to the B fare and five to the M fare. Three additional B fares booked and four additional M fares booked. As a result of this adjustment, even though some Y fares were not booked as projected, the analyst saved seat spoilage and added otherwise lost revenue.

7.6 Network Allocation

Our discussion of revenue management thus far has been limited to maximizing revenue for single leg flight segments. We now move to another refinement in revenue management, that of *network revenue management*.

The passengers' ultimate goal is to travel from their origin to their destination (O&D). Some point-to-point airlines do that with a single flight; however, most airlines use their networks to get their passengers from their origin to their destination, often requiring a connection at the hub or a stop or two along a linear network. In network systems, demand is not based on the individual flight legs, but rather on the O&D market demand.

With high demand, airlines have to be sure they allocate seats appropriately to maximize revenue. This is not an easy process as complications arise even in a simple single fare level, linear system such as the one depicted in Figure 7.20. In this example, the airline operates a single flight that originates at point A, flies to point B, and then continues on to point C. Some passengers boarding at A are traveling just from A→B, but others are traveling from A→C with a short layover at B. These through-flight passengers get a slight break on the price compared to the two single legs combined. Additionally, more passengers will board at B who are traveling only from B→C. The challenge here is to allocate seats to maximize the revenue for the two legs. If the revenue manager lets tickets sell

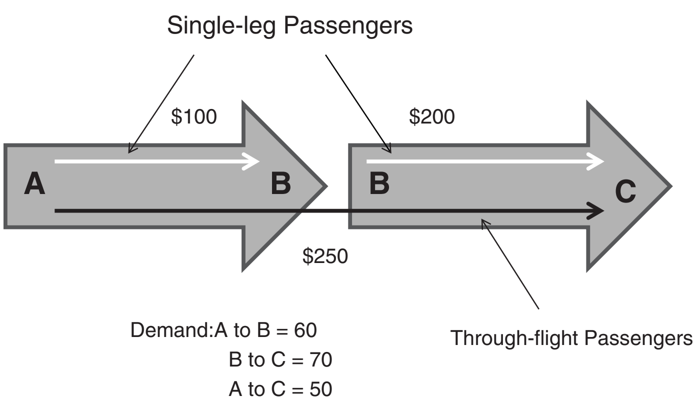

Figure 7.20 Network Allocation Example.

without restrictions, there is a chance A→C tickets ($250) will take up seats that could sell for more to individual leg buyers. With good demand forecasting, the best combination can be determined, although as you may appreciate, even the solution to this very simple problem is not obvious.

In this example, the best combination can be computed by maximizing the passengers on the shorter (higher paying) legs. Sixty seats can be filled for both legs (there will be some spill in the second leg but as you will see, spill is better than spoil). The remaining 40 seats can be sold to the A→C passengers. If the airline allocates 60 seats to A→B passengers (60 x $100 = $6,000), 60 seats from B→C (60 x $200 = 12,000) and 40 through-flight seats from A→C (40 x $250 = 10,000)., the total revenue adds up to $28,000 and the aircraft operates full on both legs.

Alternatively, if the airline accepted all the B→C demand (70) so as to eliminate the spill, only 30 through-flight passengers could be accepted for that leg. That would result in the A→B having only 90 filled seats (60 A→B + 30 A→C) and 10 empty seats. This inefficient example would net only $27,500 revenue. Five hundred dollars might not sound like much, but a large network system that includes thousands of city-pair combinations and several possible daily connecting itineraries for each can add up fast. That $500 can easily snowball into $150 million a year in additional revenue enhancement.

Adding another level of complexity, consider the example in Figure 7.21 which now includes multiple fare levels. Using a segment maximizing allocation system based on leg-by-leg availability (as discussed earlier), as long as each leg has a seat in the fare bucket available, it can be sold. In this example, a passenger wanting the connecting flight from Tucson to London through Dallas (TUS→DFW→LHR) would need the fare level available in both legs' buckets. A Y-fare passenger traveling from TUS→DFW would override a Q fare passenger traveling from TUS→LHR. Assume there is very high demand by business travelers for the TUS→DFW flight, perhaps because of a convention in Dallas. In a segment maximizing, fare nesting system, all the business passengers traveling on the $250 Y fare would be booked. However, the discount Q fare from TUS→LHR at $500 is much higher. If demand for the DFW→LHR segment is light and there will be seats unsold, higher total revenue is obtained by accepting the leisure passenger traveling all the way to London over the business passenger going only to Dallas.

Rather than just maximizing the revenue on each leg, the optimal network revenue solution depends on the probabilities of selling each leg at different fare levels. In this example, to optimize revenue, the manager would accept low yield Q fare connecting passengers (TUS→LHR) over high yield Y fare local passengers (TUS→DFW) if seats are in low demand over the subsequent legs (DFW→LHR) for the low yield, Q fare passenger. However, if high demand exists on both legs, the best option is to accept the higher paying local passengers on both legs over connecting passengers (similarly to the example shown in Figure 7.20).

While this may seem straightforward, the computational complexity in a large system renders the problem very difficult to solve. There are many connections available in DFW besides just London which must be considered to maximize the network revenue. One simplifying technique to solve network revenue management problems is known as *virtual nesting*. Virtual nesting, pioneered by American Airlines, creates virtual buckets (visible only in the revenue management system) that correspond to revenue levels instead of fare levels. These revenue buckets, used similarly to fare buckets, include revenue gained through combinations of itineraries and associated fares available over the O&D network (Walczak, Boyd, & Cramer, 2012; Belobaba, 2009). It's a complex process and beyond the scope of this text.

This last example (Figure 7.22) emphasizes a fact that many students find puzzling: although air fares follow costs, demand is the driving factor. In this example, Emirates Airlines serves New York (JFK) to Dubai (DXB) with non-stop service but also provides through flight service from JFK to Mumbai (BOM) (with a stop in DXB). The fare for the non-stop flight from JFK to DXB is $1,958 whereas the continuing flight from JFK to BOM is only $1,642 (Emirates, n.d.).

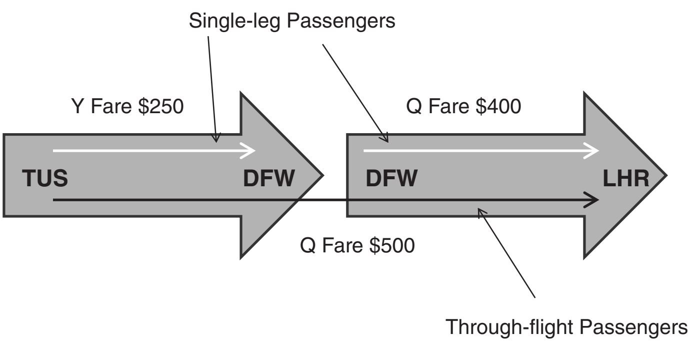

Figure 7.21 Origination/Destination Revenue Management.

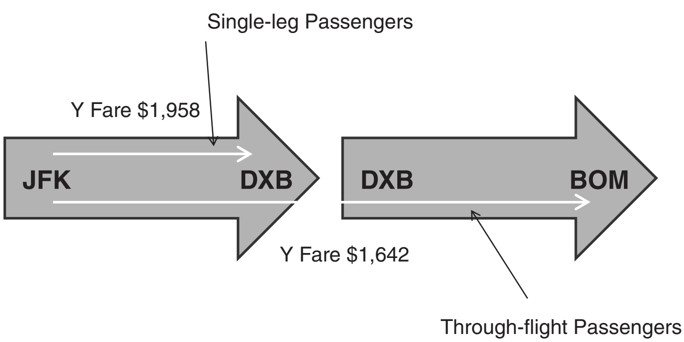

Figure 7.22 Demand-Driven Fares, from Emirates (n.d.).

Origin and destination markets vary greatly by the number of passengers wishing to travel, the purpose of travel (broadly business or leisure), and the competition. Emirates' cost in providing travel from JFK to BOM is considerably higher than from JFK to DXB, yet the fare is less. Emirates faces lower demand in New York to Mumbai, so it must charge a lower fare in order to maximize revenues and profits. Were Emirates to charge a higher fare based on its cost of providing service, many passengers would choose competing airlines. Its total revenues would then be less than with the lower \$1,642 fare. Of course, Emirates offers many fares in each market with various restrictions attached. The \$1,958 and \$1,642 fares are just one example.

A similar odd pricing scheme happened for a while in the San Antonio-Dallas-Washington, D.C., market (SAT→DFW→DCA). American Airlines competed with Southwest in this O&D market (Southwest provides nonstop service from SAT to Baltimore/Washington). As a result, American listed an inexpensive connecting[4] fare (competitive with Southwest's) from SAT→DCA with a stop and aircraft change in DFW. Passengers getting on in DFW for the non-stop leg to DCA who had not started in SAT paid a much higher fare—so much higher in fact, that some DFW→DCA travelers "commuted" to San Antonio so as to begin their trip there and pay the significantly lower fare. They would book an additional flight from DFW→SAT, get off the plane, and re-check in for the SAT→DCA flight. They would then re-board the same aircraft they were just on and fly back to DFW for the connection to DCA. Only in the airline business could this craziness happen!

7.6.1 Hidden City Ticketing

Travelers have discovered that they can circumvent the airlines' revenue management in some rare instances by planning a trip past their actual destination, then bailing out at the intermediate stop. In the above Emirates example, a passenger wanting to travel to Dubai would buy the cheaper ticket to Mumbai but then disembark at Dubai and discard the remaining ticket to Mumbai. This ploy is called *hidden city* or *point beyond ticketing*. While technically legal, this purchasing trick is discouraged by airlines and generally forbidden in their contracts of carriage. American Airlines states, "Passengers who attempt to use hidden city tickets may be denied boarding, have the remainder of their ticket confiscated and may be assessed the difference between the fare paid and the lowest applicable fare" (American Airlines, n.d., p.1). Nonetheless, an online website called "Skiplagged" is designed to find hidden city situations for potential travelers. In 2014, both United Airlines and Orbitz went to court to stop Skiplagged, but so far their attempts have been dismissed due to jurisdiction issues. United claims they will continue the fight (Jansen, 2015). Passengers attempting hidden city ticketing could have problems. Aircraft diverts, reroutes, last-minute checked baggage, customs and return flights could all be problematic for hidden city travelers. Additionally, some airlines are threatening to kick offending passengers out of their frequent flier programs.

7.7 Revenue Management in Air Freight

Today's air freight carriers can be categorized into three groups. First the integrated carriers like FedEx and UPS that provide door-to-door service with fleets of aircraft, sorting hubs and ground delivery vehicles (hence the term "integrated"). Second, the all-cargo carriers operating under contracts with various shippers and cargo forwarders providing airport-to-airport cargo service. And finally, the passenger airlines, virtually all of which carry some cargo in the "belly" compartments of their passenger carriers (Wensveen, 2011).

About half of the world's air freight is carried by all-cargo aircraft, either integrated carriers or all-cargo carriers. These operators enjoy a market share unattainable by passenger carriers—they can transport outsized cargo too large for the cargo compartments on passenger aircraft and hazardous cargo (radioactive, corrosive, flammable, etc.) that is restricted from passenger aircraft.

The other half of air freight capacity is belly-hold capacity on scheduled passenger flights. In contrast to the integrators and all cargo carriers, these airlines have little market power to control pricing. Belly capacity is a "joint product" with passenger service. There is no accepted or theoretically correct method to determine the portion of total flight cost attributable to freight. If airline managers view belly capacity as a by-product of the passenger flight, then any revenue collected from freight that is above the cost of handling the freight is seen as a contribution to profit. This view leads to low freight pricing. Other airlines may account for the cost of belly capacity differently, allocating more of the total cost of the flight to freight. With this view, low freight rates which just cover handling costs result in a loss.

There are several key differences between passenger revenue management and cargo revenue management. First, freight is three-dimensional, with volume, weight and number of containers as variables. While passenger revenue managers deal only with numbers of seats, cargo revenue managers have to manage all three variables. Second, much of the aircraft's cargo space is generally sold under long-term contracts, also called allotments, with the remaining capacity open on a general free-sale basis. Third, the major shippers who purchase capacity allotments are many times unsure of the exact weight and/or size of their shipment until just before the cargo is loaded. As a result, the carrier has a difficult time planning space/weight combination requirements. Sometimes the negotiated capacity can be exceeded and the carrier has the difficult task of determining which cargo is removed (Amaruchkul, Cooper, & Gupta, 2007; Hellerman, 2006). Fourth, itinerary control is not as important as with passenger revenue management. Cargo shippers don't care about the routing their shipment takes, as long as it gets to the right destination on time (Kasilingam, 1996).

While the goal of passenger revenue management is to maintain high levels of high paying business passengers versus discount paying leisure passengers, the goal of freight revenue management is to maximize higher paying contract versus lesser paying free-space shipping.

7.8 The Future of Revenue Management

In this chapter, we discussed revenue management systems for passenger ticketing and cargo that were developed in the latter decades of the twentieth century. In the twenty-first century, ancillary revenue has now become a major part of total airline revenue, especially for LCCs. Ancillary revenue (covered in detail in the last chapter) includes revenue gained from sources other than passenger tickets and cargo. Revenue from baggage fees, extra leg room, meal service, retail sales, boarding priority, and others are all considered ancillary. The percent of revenue varies by carrier, but the clear winner in the ancillary revenue business is Spirit Airlines, where in 2014 they collected 40.7% of their total revenue from non-ticket (ancillary) sources (Spirit, 2015). With ancillary revenue providing such a large part of total revenue, it makes sense that revenue management techniques be developed for use in that area as well.

As with passenger tickets, revenue management for ancillary sales is heavily dependent on historical sales data. However, reservations systems in use for years have not had the capability to provide the level of data concerning ancillaries needed for revenue management. The idea is to correlate the passenger's fare-class (or even the passenger's name) with their ancillary purchases. It's thought that the fare-class (or passengers') history of ancillary purchases could predict their willingness to purchase ancillaries in the future and allow "smart pricing." In doing so, some think airline revenues could be raised as much as 1% (Canaday, 2015). Better data systems on the horizon (like the International Air Transport Association's New Distribution Capability [NDC]) will improve data capabilities somewhat, but not to the extent needed for that level of data processing.

With more advances in data processing, revenue management as we know it today could change significantly. Where we now see a 250-seat aircraft managed into a dozen or so fare categories, future data processing could allow airlines to sell all 250 seats as different products.

7.9 Summary

Airline revenue management attempts to maximize revenue through a combination of several practices.

Overbooking, a process where the airline sells more seats than are available on the aircraft, attempts to offset no-shows by overbooking flights by a rate based on the predicted number of no-shows or late cancellations.

Seat allocation includes assigning segmentation devices, like an advance purchase requirement or stay-over requirement, in addition to limited discounted seat inventory in an attempt to get the passenger to pay the most they are willing to pay for their seat. Seat allocation is accomplished by comparing expected marginal seat revenue at several fare levels, then allocating seats to those fare levels. Seat allocation is continually reviewed and adjusted as the time of departure nears.

Unlike pricing of many other products and services, airline ticket prices are not directly based on the cost of providing travel. Rather, prices are derived from demand and based on an estimate of the passenger's ability and willingness to pay. Appreciating this difference is important to understanding revenue management.

Network allocation expands the single-leg seat allocation idea to include the origination-destination market where passengers probably fly multiple legs to get to their destination within a large network system. In this multiple leg market, network allocation ensures maximum revenue from the entire network.

Is revenue management fair? Price discrimination may run afoul of many peoples' sense of fairness; however, it does have positive aspects: First, it assures that business travelers will generally find seats available near the departure date and, second, it allows some travelers discount fares that would not be available under other systems.

Notes

1 Although this seems contradictory, for charter operators, the high cost of operating these older aircraft was surmounted by the low cost of ownership. This was because they were flown relatively infrequently as compared to the scheduled carriers. This is much like Allegiant's use of the older MD-80 aircraft today.
2 Many airlines cancel reservations for passengers who arrive at the gate late. You must follow the airlines' check-in rules to be eligible for involuntary denied boarding compensation.
3 On the average, vouchers for future travel do not cost the airline the full face value of the voucher because sometimes the vouchers are never redeemed.
4 In industry terms, "non-stop" means just that, "direct" means a stop with no aircraft change, and "connecting" means a stop with an aircraft change.

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Review Questions

1 What is the relationship between airline fixed costs and marginal costs and how is it related to revenue management?
2 Why is a segmentable market important to a revenue manager?
3 What is meant by a perishable product and why are airline seats perishable?
4 Explain why a perishable inventory is a very important characteristic of an airline's product.
5 Why do airlines overbook and why do some overbook more than others?
6 What is the difference between overbooking and overselling?
7 Oversold passengers can be categorized into two groups. What are these two groups and how does their compensation differ?
8 What is expected marginal seat revenue and why is it so important a factor in the seat allocation process?
9 What is fare nesting and how does it protect higher paying seats?
10 How is network seat allocation different from leg seat allocation?
11 How does passenger revenue management differ from air freight revenue management?

Chapter 8

Distribution

Your company might manufacture a great product, but selling that product means running a successful marketing plan that culminates by getting your product into the hands of your customers. As discussed in Chapter 4, marketing a product requires a mix of activities. In business, it boils down to the *four Ps*:

- *Product*. The right product for the right market.
- *Price*. A price that provides value to the customer as well as adequate revenue to the seller.
- *Promotion*. Advertising used to communicate information about the product to the customer.
- *Place*. The distribution channel that connects the product to the customer.

The last P, place, refers to the physical movement or distribution of the product from the manufacturer to the customer. This can be accomplished in several ways, but for many products, it is accomplished through a retail store. A manufacturer creates a product then transfers that product either directly or through a distributor to the retail seller. In some cases, the manufacturer might sell directly to the customer, possibly through Internet sales or a factory outlet store.

The airline product is different than most retail products because it's not a physical product at all, but rather a service. With service industries, there are three tasks that must be accomplished in order to distribute the product. The customer must be able to:

- Learn about the services offered. For airlines, this means finding information about flights and other services offered such as baggage service and in-flight entertainment.
- Find out the prices. This would include the base fare and other additional fees that might apply.
- Obtain the desired service by making payment and receiving the product, in this case, the airline ticket.

Like other companies' products, the airline product is sometimes sold through distributors, often travel agencies, and other times directly from the airline to the customer.

This chapter focuses on three primary distribution channels the airlines use to disseminate their flight schedule, seat availability and fare information to prospective customers and, if they are successful in making a sale, accepting payment and getting a ticket into the hands of the customer.

- *Direct sales* from the airline to the customer through either airline reservations agents at call centers, or airline Internet sites,
- Sales through the *global distribution system (GDS)* which include most "brick-and-mortar" travel agencies, many online travel agencies, and some online search engines, and
- Sales that bypass the GDS but still use an *intermediary* like a search engine to connect through the Internet directly with the airline. (Gunther, Ratliff, & Sylla, 2012)

The so-called *global distribution system* (GDS) plays a very important role in the airline distribution process. Today, several independent GDS companies provide distribution channels for travel-related services; everything from airline tickets and rental cars, to hotel rooms and local attractions. These GDS companies were originally called computer reservations systems (CRS) and most were developed, owned and operated by airlines. They basically grew out of the name CRS in the mid- to late-1980s as they became independently owned and expanded their scope to include multiple airlines and other travel-related services. Sometimes the terms CRS and GDS are used interchangeably, but in recent years "GDS" has prevailed. To best understand the GDS system, let's first start with its evolution.

8.1 Airline Distribution History

As we noted in Chapter 1 about the history of the U.S. airline industry, airlines borrowed and built on many aspects of the railroad industry which they initially supplemented and eventually displaced for long-distance passenger transportation. Initially, like the railroads, airlines themselves disseminated information on schedules and fares and sold tickets directly to passengers. As the airlines began flying early in the 1920s, airline sales distribution was decentralized, consisting of airline representatives selling tickets and controlling inventory for flights at the point of the flight's departure (McKenney, Copeland, & Mason, 1995). Like the railroads, a paper ticket was issued to the traveler which eliminated not only the need for the traveler to carry funds but also the need for the flight crew to collect fares.

To make a reservation, the traveler or their agent contacted the airline's reservations office at the departure city either in person or by telephone to check the flight schedule, seat availability (inventory), and price. Many times these offices were located downtown to better accommodate business customers. The airline reservations agent would usually have to research the request and then call the customer back with information about flight availability. If the schedule, availability, and price were acceptable, the customer would book the flight.

The airline reservations agent would note the transaction with a written reservation slip or notebook and the reservation would be posted to large boards (maybe chalkboards) for all to see. This was known as a *Request and Reply system*. Figure 8.1 shows a depiction of an early reservations center. Reservations agents then communicated reservation information to the airline's centralized inventory control office. R. F. Meyer (as quoted in Copeland, Mason, & McKenney) describes the scene at an early reservations office:

> A large cross-hatched board dominates one wall, its spaces filled with cryptic notes. At rows of desks sit busy men and women who continually glance from thick reference books to the wall display while continuously talking on the telephone and filling out cards. One man sitting in the back of the room is using field glasses to examine a change that has just been made high on the display board. Clerks and messengers carrying cards and sheets of paper hurry from files to automatic machines. The chatter of teletype and the sound of card sorting equipment fills the air. As the departure date for a flight nears, inventory control reconciles the seat inventory with the card file of passenger name records.
>
> (1995, p. 31)

8.1.1 The OAG

In 1929, an organization publishing railroad schedules began publishing a list of flights offered by airlines. Initially, it included 35 airlines, listing about 300

Figure 8.1 Early Reservations Center at Pan Am (Santiago, 2015a).

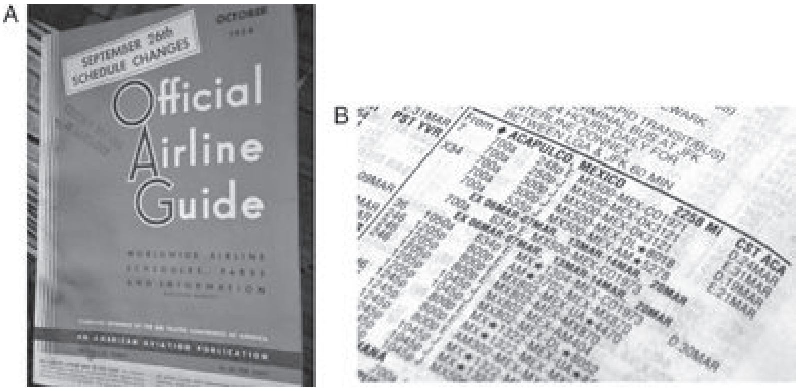


Figure 8.2 October 1954 OAG Cover and Sample Page.

Image courtesy of Official Airline Guide.

flights in a 24-page pamphlet called the Official Aviation Guide of the Airways. In 1948, it merged with a competitor and became the Official Airline Guide or OAG (Figure 8.2). The OAG included schedule information but no information about fares or seat availability. (The OAG is the "thick reference book" Meyer refers to in the quote above.) Although the OAG has gone through many changes over the years, it still exists today as a flight information database and is used as a source by global distribution systems for flight schedule information.With an OAG subscription, travel agents (and maybe corporate travel offices) now had information concerning flight schedules at their fingertips, but they still needed to contact the airline for fare information and seat availability (Gunther et al., 2012). Once the customer determined the availability of a flight they wanted, the customer (or their agent) still had to book the reservation with the airline, make payment and receive a ticket.

Many times, manually constructing complicated linear-type itineraries required agents to make phone calls to multiple airline reservations offices. This made the process of determining availability and confirming reservations lengthy; hours or maybe even days (McKenney et al., 1995). As airlines grew, the job performed by the reservations offices of manually tracking reservations, bookings and available seats was quickly becoming unmanageable.

8.1.2 Payment

In 1938, one of the duties of the new Civil Aeronautics Board (CAB) was to promote and regulate air travel. And regulate they did—they controlled all scheduled airlines' fares, routes, and schedules. A few years later in 1945, a coalition of airlines called the Air Transport Association of America (later called the Air

Transport Association and now called Airlines for America) founded the Air Traffic Conference of America (ATC). The ATC controlled travel agency accreditation and the airline ticket settlement system. All agents selling tickets for airlines were required to be accredited through the ATC (Nicholls, 1985). The ATC also reconciled and distributed funds among airlines based on submitted ticket coupons. The ATC tariff department (later called the Air Tariff Publishing Company or ATPCO) published the scheduled airlines' fares.

8.1.3 Ticketing

Initially, tickets were paper, carbonized, multi-copy coupons. Each airline designed and issued its own tickets, so all airline tickets were different. Tickets issued by the airlines were transferable, negotiable documents and as such, needed to be treated almost like cash. Ticket blanks were kept in safes and needed to be tracked and accounted for (Figure 8.3). Only the airline or a few airline approved travel agents could issue the ticket needed to get on the aircraft. Multiple leg flights needed several ticket coupons and the process involved several steps in which ticket data was transcribed.

After the 1929 Warsaw Convention spelled out the required contents of international airline tickets, the International Air Traffic Association (predecessor to the current International Air Transport Association or IATA) worked with airlines to develop the first standardized airline ticket in 1930. Hand-written tickets (Figure 8.4) persisted until 1971 when the IATA automated ticket printing with the Transitional Automated Ticket (TAT) as shown in Figure 8.5 In 1972, the IATA introduced the neutral TAT ticket ("The Paper Ticket," 2008).

In 1994, electronic tickets began being used by individual airlines, and by 1997 the IATA had instituted a global standard for electronic tickets. A few years

Figure 8.3 Ticket Blanks. ("The Paper Ticket," 2008).

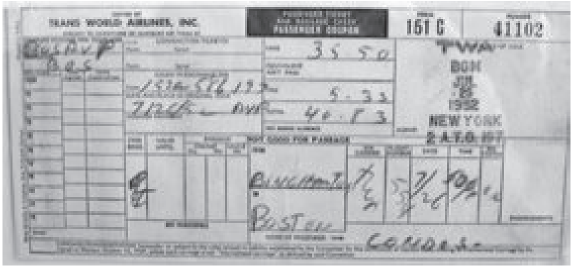


Figure 8.4 Hand-Written Ticket from 1952.

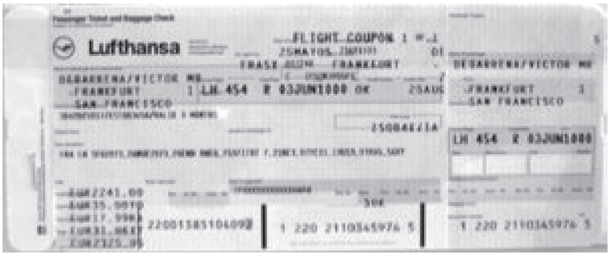


Figure 8.5 Automated Ticket.

later, in 2004, airlines began to phase out paper tickets and, by 2008, the long-used paper ticket was virtually gone ("The Paper Ticket," 2008). In fact, during 2013, the total number of paper airline tickets issued was only 28,400 out of a total of 143 million transactions (Rice, 2014). Twenty-six of the 206 airlines affiliated with the Airlines Reporting Corporation (ARC), a company that settles financial ticket transactions between airlines and travel agencies, no longer accept paper tickets. The ARC also reported that only three airlines do not support e-ticketing (Rice, 2014). Using e-tickets, most people print their own boarding pass either at home or at an airport kiosk. Some airlines now offer smartphone options so travelers can check in at security and board their flight by scanning a bar code on their phones, or with the recently popular smartwatches.

8.1.4 The Growth of Travel Agencies

The technologies developed in aviation during World War II led to many changes after the war ended. Large transport aircraft developed for the military significantly boosted passenger carrying capacity and passengers in the United States were now beginning to routinely fly cross-continent. As the CAB allowed growth of local service carriers, air travel was available between most of the large and mid-sized cities in the United States. However, many itineraries involved traveling on several different airlines to reach your destination. Booking a long itinerary involving several legs on different airlines was a tedious job that required contacting several reservations offices and made the point-of-departure sale very cumbersome.

Even local customers many times found the airline's airport office inconvenient. To improve this situation, airlines also operated distribution offices, or retail outlets, typically in the center of large cities. This made booking travel more convenient for business passengers, who comprised the majority of passengers in the early years of commercial aviation. But as airlines rapidly expanded after World War II, airport reservations offices and downtown offices were not well suited to this new expanding market and did not reach many potential passengers.

Further, accessing and understanding the connecting itineraries and fares was a complex, specialized task best suited to a trained specialist. Expanding their own reservation office system to serve this rapidly growing customer base would have been prohibitively expensive for airlines so they turned to independent agents, travel agents, to distribute their product information and sell tickets.

Airlines liked the idea of not having to burden their bottom lines with the extensive overhead that would be needed to build and operate more airline offices. Travel agents were also attractive to airlines because travel agents were compensated by airlines with a commission on tickets sold. By paying travel agents on commission, the airlines not only avoided the fixed costs incurred by having to pay employees even if no business was being conducted but also gave travel agents an incentive to sell the highest fares they could. Travel agents provided skilled, personalized service needed to help the customer find information, make reservations, issue tickets, and deal with other travel issues like passports, vacation packages, hotels and rental cars. Travel agents soon grew to be the predominant distribution method.

Before airline deregulation, travel agents' commissions were also regulated by the CAB to rates that allowed even smaller agents to stay in business. The regulated airfares and regulated commissions made the travel agency business very orderly (Levine, 1987).

Airline deregulation in 1978 also deregulated travel agencies. The ensuing explosive growth of airline traffic combined with the increased complexity of schedules and routes made skilled travel agents even more a necessity. It's no surprise that travel agencies eventually grew to dominate the airline distribution system selling 80% of all airline tickets by the mid-1980s. Table 8.1 shows the growth rate for U.S. domestic travel agencies from deregulation through the mid-1980s.

8.1.5 The Reservisor

With little or no automation, managing an airline's inventory of seats available for sale was a paper nightmare. A trunk carrier in the late 1960s might have 50 airplanes of 100 seat capacity flying five flights per day. This created a requirement

Table 8.1 Travel Agency Locations, Sales and Commission Rates (Nicholls, 1985)

Year	*Number of U.S. travel agency locations*	*Sales (for domestic and foreign carriers in billions)*	*Commission Rate (average domestic and international)*
1977	15,053	$9.4	8.3%
1978	16,628	$11.4	8.3%
1979	18,121	$14.7	8.0%
1980	17,339	$18.1	8.5%
1981	19,203	$20.0	9.3%
1982	20,962	$21.8	9.5%
1983	23,059	$25.8	10.0%
1984	26,037	$25.9	10.1%
1985	26,297	$33.4	10.2%

to track not only the availability of millions of seats per year but also the fare information. The paper inventory management system was complex, inflexible, unwieldy, and subject to error. The need for a computer-based automation was critical.

In 1943, Charles Amman, the head of American Airlines' Systems and Methods Division, had an idea for electronically automating the reservations process. He was originally trained as a radio engineer and, with that experience, he devised a three-step process that would lead to reservations automation. The first step was to automate seat inventory information, the second step was to automatically adjust inventory, and the third step was to automate the transmission of passenger information (Eklund, 1994; McKenney et al., 1995). Amman's boss, American Airlines CEO C. R. Smith, envisioned substantial growth for American after the war and liked the idea of an automated reservations system. At the time, however, technology like this was not being actively developed, so in 1944 Amman, using his engineering skills, built a working model of a simple electronic inventory control system. Seeing the functionality of such a system, C. R. Smith approved funding which led to a contract with the Teleregister Corporation, a pioneer in the development of special purpose equipment, to design and build a prototype (McKenney et al., 1995).

The project was completed in February 1946 and installed in American's Boston reservations center (Davidow & Malone, 1992). It was called the *Reservisor* (Figure 8.6). This first model resembled the stock trading board that Teleregister was known for.

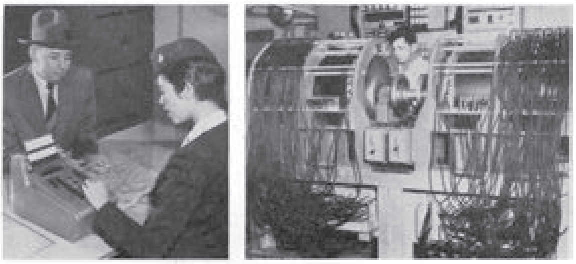
This first generation Reservisor automated activities in the reservations office, but because it had no communication capability, it still required travel agents or travelers to call the reservations office. Another limitation was that it automated inventory control only; index cards with passengers' names were still carried from desk to desk. The Reservisor allowed the Boston office to process an additional 200 passengers daily with 20 fewer employees (Edelman, 2009; Davidow & Malone, 1992).

Figure 8.6 An Early Reservisor Terminal.
Photo from Wikimedia Commons.

8.1.6 The Magnetronic Reservisor

A few years later in 1952, with Amman still leading the project for American, Teleregister built a second generation Reservisor that was called the *Magnetronic Reservisor* (nicknamed Girlie) that included a new-technology dual-magnetic drum storage capability. A travel agent (or traveler) could call a reservations agent, who inserted a notched metal plate, called a destination plate, into the desk set along with the flight date and number of seats needed (Figure 8.7). "Within seconds, lights on the keyset provide[d] availability data on the specific flight" (Teleregister, n.d., p. 8). If the customer decided to purchase the reservation, the reservations clerk could change the seat inventory on the storage drum with the flick of a switch. Figure 8.8 shows a functional schematic of the Magnetronic Reservisor ("Teleregister," n.d.).

The central Magnetronic Reservisor was installed in spring of 1952 at LaGuardia airport in New York (Petzinger 1995; McKenney et al., 1995; "Teleregister," n.d.). It could hold 10,000 units of flight memory, allowing it to store, for example, 1,000 flight legs per day for a 12 day period, while tracking up to 100 seats of inventory for each flight. It also allowed remote access via leased teletype lines. Between 50 and 80 agent desk sets were tied into the LaGuardia Reservisor, most of which were in American's downtown ticket sales office just a few miles away on 42nd Street in New York City.



Electronic Machine Speeds Flight Information to Area Offices

American Airlines has turned to an electronic machine to provide fast, accurate flight information to all its offices in the New York area. The machine, the Magnetronic Reservisor, is already in use, handling reservations automatically. In its new utilization, information on all flights, incoming and outgoing, is fed into the whirling drum that is the machine's "memory," and is then available at any airline office in the area. To obtain the information, an agent has only to push a simple combination of buttons on the branch-office keyboard. The answer is returned in flashing lights. Immediately available flight information allows the agent to answer queries at once instead of checking bulletin-board postings.

Figure 8.7 The Magnetronic Reservisor Desk-Set (left) in Use at a Reservations Office and Drum Storage Units (right) (Santiago, 2015).

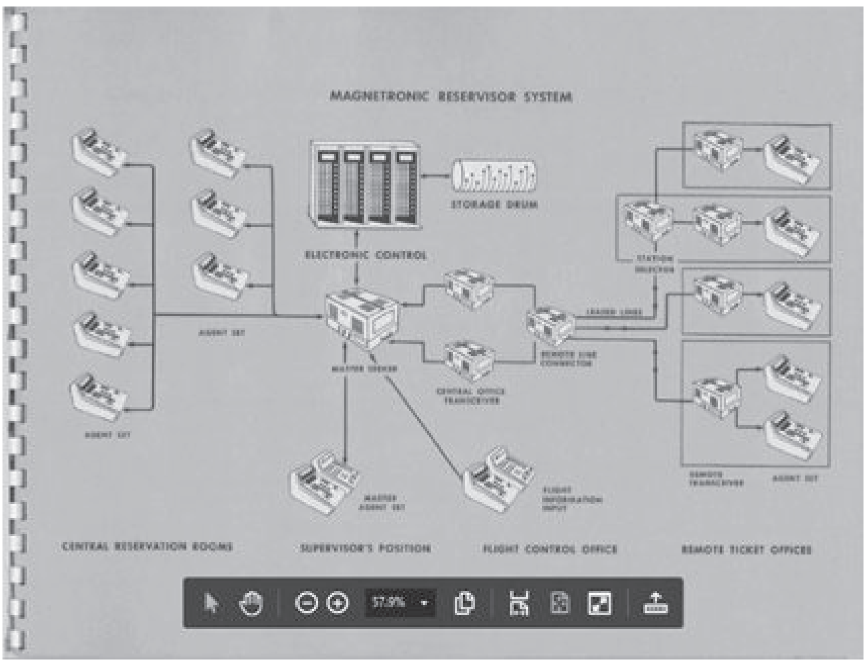


Figure 8.8 Schematic Diagram Showing Elements in a Typical Teleregister Magnetronic Reservisor System ("Teleregister," n.d.).

In 1956, another larger and faster version of the Magnetronic Reservisor was installed at American's West Side Terminal in New York that could handle 2,000 flights for a period of 31 days. At the time, it was state-of-the-art, built with 4,500 tubes and 3,000 diodes (Eklund, 1994; McKenney et al., 1995). The "Reservisor was the first commercial system to combine electronic processing and electronic communications" (Eklund, 1994, p. 68). Although the Reservisor could remotely track inventory (it knew how many seats were left on a given flight), it could not attach a name to a seat, or track any other customer data (like a phone number or address). As a result, passenger manifests were still completed manually (Petzinger, 1995). As larger jets entered the airlines' inventories in the early 1950s, this became a huge limitation.

Teleregister also installed similar reservation systems for several other airlines in the mid-1950s; United's "Unsil" system, as well as unnamed systems for National and Braniff airlines. Teleregister's inventory control systems were used not only in aviation, but also for railroads and industrial warehouse inventory automation ("Teleregister," n.d.).

8.1.7 Reserwriter

Amman's third step, to automate passenger information, began in 1954. Working with IBM, Amman developed a system called the *Reserwriter*. The Reserwriter system read punched cards containing passenger information then converted them to paper tape that could be transmitted over teletype. "By 1956, the Reserwriter systems were linked into a nationwide network" (Davidow & Malone, 1992, p. 45), and "by 1958, Reserwriter terminals were in key locations across the country in American's network" (Santiago, 2015a, p. 5).

Although a vast improvement over the Request and Reply system, the Reservisor/Reserwriter systems were prone to error about 8% of the time and still required agents to fill in many steps not automated. For example, "a round trip reservation between Buffalo and New York LaGuardia required 12 people, 15 distinct steps and could take as long as three hours" to complete (Santiago, 2015a, p. 5).

8.1.8 SABER

Maybe only by chance, but once again, American Airlines led the industry to the next level of reservations automation. In the summer of 1953, a sales representative from IBM named R. Blair Smith was boarding an American Airlines flight from Los Angeles to New York. He chose a window seat in the last row, and he was soon joined by another man named Smith—C. R. Smith, the CEO of American Airlines. At the time, a flight from Los Angeles to New York was an extended journey in a propeller-driven aircraft, requiring 10 hours including intermediate fuel stops. Blair Smith knew of Teleregister's work on American's Reservisor and during the multi-stop transcontinental flight he explained to C. R. Smith that IBM was researching the possibility of building a system that would be much more capable than the Reservisor (Mapstone, 1980). IBM at the time was working on a Cold War project for the Air Force to computerize control of U.S. air defense. This project was named the Semi-Automatic Ground Environment, or SAGE, and was one of the first real-time applications of computer technology (Petzinger, 1995; Eklund, 1994). IBM was also looking for possible commercial applications for SAGE technology which included remote terminals and real-time teleprocessing. IBM named this commercial spin-off project in a similar manner as SAGE, calling it Semi-Automatic Business Environment Research or SABER. C. R. Smith was very interested in what Blair Smith was telling him and he invited Blair to tour the Reservisor facility at LaGuardia Airport. After the tour, Blair Smith consulted with his boss and wrote a letter to C. R. Smith suggesting a joint research and development project between IBM and American Airlines (Mapstone, 1980). The project development with American went on for about five years and eventually led to a contract proposal from IBM in 1958. At first, the team at American did not have a name for their company-specific project, but in 1959, the project manager decided to call it Sabre[1] which stood for Semi-Automatic Business Research Environment. In 1959, American accepted IBM's proposal and in 1960, the first Sabre system was installed in Westchester County, north of New York City (Santiago, 2015b).

Sabre's mainframe computer, the IBM 7090, included magnetic drums that held 7.2 million characters containing records for seat inventories and flight schedules and another 800 million character disk memory that held passenger information. The project became the largest private real-time data processing system in the country at that time. Because of the ground-breaking nature of the project, there were a few setbacks and it wasn't until 1964 that Sabre (Figure 8.9) became fully operational, initially with 1,500 remote terminals, mostly in airline reservations offices and selected travel agencies (Mapstone, 1980). Sabre turned out to be a 400 man-year effort costing American Airlines $40 million; however, Sabre saved American 30% on reservations staffing ("Sabre History," n.d.).

Sabre's big technological breakthrough was the inclusion of *passenger-name record* (PNR) information, tying a passenger's name to a seat reservation (Copeland & McKenney, 1988). The lack of PNR was one of the main limitations of the Reservisor. Sabre allowed agents to book flights directly, bypassing telephone calls to the airline to check flight availability and confirm bookings.

While developing Sabre, IBM was concurrently working on projects for Delta (DELTAMATIC) and Pan Am (PANAMAC). These systems became operational in 1965, just a year after Sabre. They were functionally similar to Sabre, but used different IBM processors (Boyd, 2007; Copeland & McKenney, 1988). At about that time, IBM came out with a new technology computer architecture called System 360. Delta updated their system which they now called the Delta Automated Travel Account System (DATAS II) with the new technology in 1968. The race was now on for other airlines to catch-up and Eastern, TWA and United needed computer-based PNR systems to keep pace.

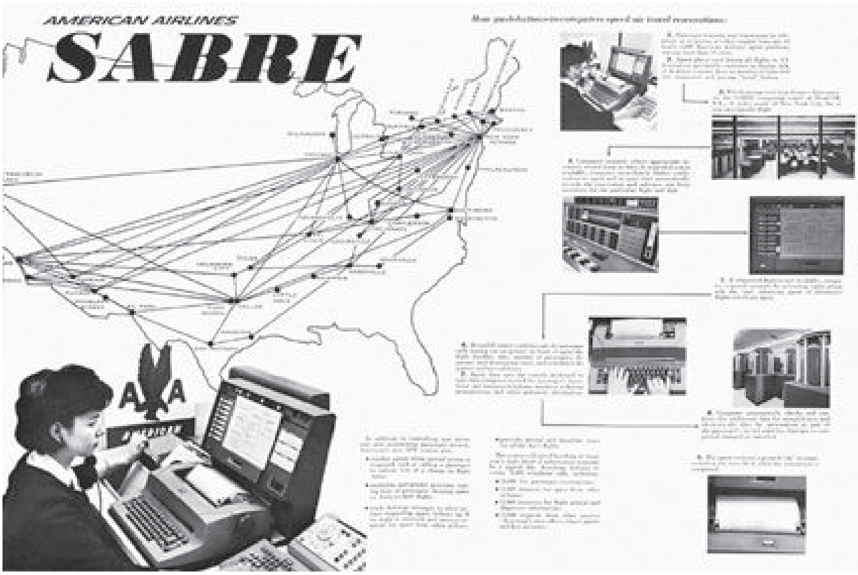


Figure 8.9 Sabre Advertisement. From IBM 100: Icons of Progress, n.d. Image Courtesy of IBM.

IBM's experience gained through the Sabre project and their new System 360 computers helped them develop their own Programmed Airline Reservations System (PARS) which they developed to market to airlines. The only major airline interested, however, was Eastern, and IBM created a unique PARS system for Eastern called System One. United and TWA went to other vendors—United to Univac and TWA to Burroughs (Boyd, 2007). The trouble was that neither Univac nor Burroughs had any experience in teleprocessing systems and both efforts failed. In 1966, even after spending $75 million, TWA was still sorting reservations and managing inventory on index cards (Boyd, 2007; Petzinger, 1995). Both United and TWA eventually went back to IBM and, by the end of 1971, both airlines were using modified PARS systems. TWA's PARS system was similar to Eastern's, and United's was an expanded PARS system they named Apollo. In 1972, American also completed upgrading Sabre with the newer PARS technology. These new systems were descriptively called *computer reservations systems* (CRS). By 1972, Northwest Airlines had a Univac system and was the only one of the 10 trunk airlines that were not running an IBM PARS-based CRS (Copeland & McKenney, 1988).

8.1.9 Travel Agents Get Involved

Although several airlines had automated reservations technology by the early 1970s, most of that technology was used internally within the airline. Either the traveler or the travel agent still had to call or visit an airline reservations agent. As late as 1968, airlines had installed only a few airline-specific CRS machines in a select few travel agencies to support their operations, but there was no overall use of airline CRSs outside the airline. Travel agents needed a system similar to what airlines had, but they wanted a single system that could process reservations for all airlines (Boyd, 2007). In 1972, the president of the American Society of Travel Agents (ASTA) joined with American Airlines to develop a joint computer reservation system for travel agents that would be common to all airlines. As ASTA and American collaborated on the project, named the Joint Industry Computerized Reservations System or JICRS, they tried to build interest from other airlines. Other airlines were quietly avoiding commitment to the project, however, and in January 1976, United officially announced it would not support JICRS and instead outlined a plan to begin installing their Apollo systems in travel agencies the following September. Without United's support, the idea of a single travel agent CRS was going nowhere and was eventually dropped.

Bob Crandall, then CEO of American, quickly found himself in a battle with United's Dick Ferris to see who could hard-wire the most CRS terminals (Sabre and Apollo respectively) in travel agencies the fastest (Petzinger, 1995). Although United took the first step in announcing their plans, their September 1976 target date gave American time to get the jump on them. Crandall at American had already been working on a contingency plan and they moved into action fast. Crandall, who felt he was fighting for the life of American Airlines, decided that the added cost to accelerate the effort was worth it, especially after being told that a travel agent using a Sabre terminal instead of an OAG book could more than double their annual bookings (Petzinger, 1995). American began installing Sabre terminals in April 1976 and by the end of the same year, American had about 130 travel agencies equipped with Sabre. United met its September goal but with only four pilot locations (Copeland & McKenney, 1988).

Over the next few years, both American and United invested millions of dollars installing Sabre and Apollo CRS systems in travel agencies. TWA also opted to install their PARS systems, but to a smaller extent than American and United. Eastern and Delta, who mostly competed with each other, were also less aggressive with their installations of System One and DATAS II, respectively.

"Although multiple computer reservations systems were available to travel agencies, most relied on only one system (Edelman, 2009; "Airline Ticketing: Impact of Changes," 2003). Using more than one system was very inefficient due to additional employee training and customer record keeping requirements.

With most travel agents using only one airline's CRS system, airlines found that in order to have their tickets sold at any and all travel agencies, that they had to list their flights on competitors' systems. For example, most travel agencies in the Dallas area used American's Sabre system, while most agencies in Chicago used United's Apollo system. In order to sell tickets in the Dallas area, United had to make a deal with American to list their flights on Sabre. Likewise, American had to get their flights listed on Apollo in order to sell tickets in the Chicago area ("Airline Ticketing: Impact of Changes," 2003). "Airlines had little choice except to participate in each CRS" and before long, mostly all airlines' flight information was available on all CRS systems ("Airline Ticketing: Impact of Changes," 2003, p. 9). This led to a co-hosted system, where airlines with their own CRS systems agreed to co-host each other's flights.

Airlines that did not own their own CRS system, however, had little choice but to pay the CRS owner airlines to have their schedules displayed in their CRS.

With their CRS systems in travel agencies, American and United, and to a lesser extent, TWA-Northwest, Delta and Eastern Airlines, enjoyed a significant competitive advantage over other airlines who did not own their own CRS. These advantages fell into two principal categories: market intelligence and the ability to monitor its competitors.

Market intelligence

Airlines with CRSs in travel agencies were able to gather real-time information concerning the market preferences of travelers and the success of advertising, promotions or other sales initiatives. Airlines without CRS systems had to rely on data available from the DOT, usually dated, or try to collect their own data. It's easy to see that this lack of real-time intelligence was a big obstacle to overcome for new airlines trying to break into a new market or smaller airlines trying to maintain a market share (Levine, 1987).

Competitor information

CRS owners had not only the ability to track their own sales, but also sales of their competitors who bought space on their CRS. A CRS owner airline could track the sales of competitors' inventory, measure their full-fare business traffic versus discounted leisure traffic and even see utility their competitors' frequent flier program. Non-CRS airlines had to garner what little information they could about their competitors from mostly public sources. Some airlines even resorted to sending employees to count passengers as they boarded competitors' aircraft to try to gain information (Levine, 1987).

8.2 The Birth of the Global Distribution System

As airline CRSs continued to expand, they began to include not only most airline flights but also other travel services including hotels and rental cars. This was the beginning of a new industry term—the systems that were called airline "computer reservations systems" had now turned into *global distribution systems* (GDS), reflecting the increasingly international and diverse nature of travel they encompassed ("Airline Ticketing: Impact of Changes," 2003).

Figure 8.10 Typical Sabre GDS Screen Display.

Figure 8.10 shows a typical GDS display a travel agent might see. This example is from a Sabre system, but the other GDS displays are similar. The top line shows the travel date and origination-destination; in this case, the flight date was Sunday, 20 July, with the origination in San Antonio (SAT) in Central Daylight Time and the destination Seattle (SEA) in Pacific Daylight Time. This is a relatively simple example, showing one non-stop flight and two connecting flights on the first screen (more options would be available on subsequent screen pages). Looking at the non-stop flight on line 1, moving left to right:

- AS is the two-letter abbreviation for the airline—in this case, Alaska Airlines. Each airline, worldwide, is assigned a two-letter alpha-numeric identifier. Also shown in this example is DL, the code for Delta Air Lines, and UA for United Airlines.
- 689 is the flight number.
- The next entries are the available seats, listed by fare categories in descending price order. The top line shows four first-class fare categories (F, U, A, and Y) and the corresponding number of seats available. The second line shows 10 other fare classes with their available seats. To save space on the page, and not disclose proprietary seat allocation figures, airlines show only a single digit for the number of seats available in each fare category. In this example, Alaska's numbers only go up to 7, but the actual number is either 7 *or higher*. If the number of seats drops below 7 the single digit will reflect the actual number of seats. (Other airlines may use different numbers: note that DL and UA on lines below stop at 9 seats.)

Before continuing with the other data, this is a good opportunity to review seat allocation and fare categories from the last chapter. First, look at the four first class fare categories for Delta flight 581 on line 3, and note how the lower fares sell out first. You might recall that with fare nesting, a higher fare will never sell out with a lower fare still available. Now look at United flight 3260 on line 4. It looks like many of the most discounted seats on the second line are sold out. This is explained by looking at the aircraft. It shows an ERJ which is a smaller regional jet that seats only 35 to 50 people.

Now getting back to the line 1 Alaska flight 689 example:

- The flight operates non-stop from SAT to SEA. Note that line 2 indicates a connecting flight; line 2 stops in Salt Lake City (SLC) with a 55-minute layover, then continues with line 3 from SLC to SEA.
- Departure is at 7:25pm CDT and arrival is at 9:55pm PDT.
- The aircraft code is 738 indicating a Boeing 737–800.
- The following 0 indicates non-stop.
- The remaining alpha-numeric entries are for system administration.

Once the agent reviews these flights, he or she can select the next screen to review more flight options. With another keyboard entry, the agent can view the fare information in dollars.

8.2.1 CRS Favoritism

Although many other airlines listed flights on host airlines' computer systems, the host still controlled how the system worked and that meant that whenever and however possible, the system favored the host airline. There were several ways this favoritism worked, but perhaps more than any, CRS display bias or *screen bias* drew the ire of smaller airlines and the attention of Congress and the Department of Transportation.

Screen bias

When looking for a flight for a customer, a travel agent typed in the traveler's needs and the screen would light up with available flights like those shown in Figure 8.10. It didn't take the host airlines long to figure out that agents tended to book the first flight they saw on the screen (like Alaska flight 689). Statistics showed agents booked the top flight on the screen 45% to 50% of the time. If available flights filled multiple screens, the agent would book off the first screen 80% to 90% of the time (Shaw, 2011). In order to favor their airline, the host airline would manipulate the programming so that the screen always showed their flights first (or at least on the first screen if there were multiple screens). This was called screen biasing and led to millions of dollars of extra revenue for the host computer owners. The two airlines with the most CRSs in travel agencies, American and United, were the biggest perpetrators of screen bias, but other airlines did it as well.

Halo effect

Another way host airlines benefited from agents using their system was through the *halo effect*. Information on seat availability and reservations confirmations tended to be more timely, accurate and reliable for host airlines than for non-host airlines. This was due to the fact that generally the host airlines' internal reservations were managed by the same computer as the CRS while non-host airline information needed to be transmitted between systems. As a result, travel agents were more confident booking flights on the host airline than on non-host airlines and tended to disproportionately book on the host airline (U.S. Department of Justice, 2003). Additionally, travel agents favored the locally dominant airline's CRS which was probably the one installed in their office. Override commissions paid to travel agents for surpassing a target sales goal added to this dominance of the local travel market. This broad effect got to be known as the halo effect (Borenstein, 1992).

Co-hosting

The host airlines added another revenue source by selling *co-host* status to airlines. For a fee, an airline could boost their flights to a better position on the agents' screen (but not ahead of the host airline). This could be accomplished by modifying the programming, or by simply assigning penalty minutes to the flight times of the non-host airlines. As an example of how important co-hosting was, in 1981, American had nine co-hosts on the Sabre system, making them an additional $6.9 million just in co-host fees (Copeland & McKenney, 1988).

Screen padding

Airlines who code-shared with other airlines could *screen pad* by listing flights under two different flight numbers. For example, Delta Air Lines and Western Airlines were code-sharing before their merger in 1987. A single flight flown by either company might be listed as both a Delta flight number and a different Western flight number. By listing the flight under both numbers, it gets twice the screen space and therefore twice the travel agent attention as it normally would.

8.2.2 GDS Regulation

After airline deregulation in 1978, airlines were operating without the protection from competition they had been used to—they now had to compete to stay in business. This new competition stimulated the use of computer reservations systems. By 1984, travel agents were responsible for 60% of all airline revenue, and 90% of those sales were made using a CRS. This reliance on CRSs increased the effect of screen bias on non-host airlines. Some non-host airlines complained that the host airlines were using their CRSs to hinder competition, much like a competitive weapon. At least one airline, People Express, met its demise at least partly because of the lack of a competitive computer reservations system (Ravich, 2004). It was very clear those airlines that hosted CRS systems not only exercised a great degree of leverage in the airline business but also created incremental revenues not available to non-host airlines.

In 1984, there were six GDS systems and five of those six were owned by airlines:

1 Sabre (owned by American)
2 Apollo (owned by United)
3 System One (owned by Eastern)
4 DATAS II (owned by Delta)
5 PARS (owned by TWA)
6 MARS PLUS (independent) (U.S. Department of Justice, 2003)

Host airlines, like American, responded that the benefit they gained from screen bias was merely a return on the $467 million investment they made between 1976 and 1983 in CRS/GDS development (Copeland et al., 1995). The debate over the use of screen bias grew to allegations of antitrust violations as non-host airlines claimed the anti-competitiveness went so far as to harm the consumer. The CAB studied the issue and concluded that sufficient evidence existed that airlines' competitive abuse of the CRS system was indeed hurting the consumer.

Regulating bias proved a daunting task. As one example, DOT stated, "Although our rules currently require systems to offer agencies a three-year contract as well as a five-year contract, systems have generally made the terms of the shorter contract so unattractive that most travel agencies have chosen the five-year contract" ("Computer Reservations System [CRS] Regulations," 2002, p.69405). The DOT also sought to make it easier for travel agencies to do business with more than one CRS at a time—another effort to rein in the power of CRSs. But that did not work either. When DOT imposed a rule requiring that CRSs let client travel agencies do business simultaneously with competing CRSs, the CRSs responded by linking the prices they offer an agency to how much business the agency did with the CRS.

In November 1984, one of the last official actions of the CAB came just six weeks before its closing. The outgoing CAB put into effect regulations governing airline-owned computer reservations systems. These rules:

1 Prohibited screen bias. One of the most distinguishing features of CRS regulation was the prohibition against ranking flights based on carrier identity (display bias). The rules did not prescribe specific requirements but did require that CRSs contain at least one integrated display that lists the schedules, fares and availability of all participating carriers. Additionally, the criteria used to rank flight displays had to be disclosed to participating carriers.
2 Required equal functionality. The CRSs must allow equal reliability, accuracy, and accessibility of information for any participating airline. All participating carriers must have equal access to software enhancements and speed of data transmissions.
3 Prohibited discriminatory booking fees. Host airlines could not charge competitors higher booking fees. This rule also helped smaller carriers with

less bargaining power benefit from fees negotiated by larger airlines. (U.S. Department of Justice, 2003)

The feeling in Europe was much like that in North America. The CRSs predominantly used in Europe, Amadeus and Galileo, were both owned by airline consortiums and it was thought that the airline ownership fostered a "market situation...incompatible with the principles of free competition" (Cavani, 1993, p. 446). As a result, the European Community passed three regulations designed to guarantee "complete and nondiscriminatory information, fair access to the computer systems for all air carriers, and a policy to protect free market equilibrium" (Cavani, 1993, p. 447). The primary regulation, Regulation 2299/89, passed in July 1989, instituted a Code of Conduct for Computerized Reservation Systems. Regulation 2299/89 was later amended requiring CRS parent airlines to participate equally in all other CRSs.

After the close of the CAB, the economic regulation of the U.S. airline industry was transferred to the Department of Transportation (DOT). In a 1988 report, the DOT determined that despite the CAB rules, incremental revenues for airlines owning GDSs were still 9–15% higher than those not owning GDSs.

Figure 8.11 shows the travel agent market shares of the top five U.S. systems in 1988. By 1990, 93% of the 35,000 travel agents in the United States were using a CRS (Davidow & Malone, 1992).

In 1992, the DOT reexamined the CAB rules and elected to continue them, noting that GDSs were even more powerful than in 1984. Travel agents now accounted for 75% of airline revenue and over 95% of travel agents relied on a GDS (U.S. Department of Justice, 2003). The DOT also included a sunset date for the rules in December 1997, later revised to March 2003 and again revised to January 2004 ("CRS regulations," 2002).

The non-hosting airlines were not satisfied, however, and filed a $400 million lawsuit seeking $250 million from American and $150 million from United

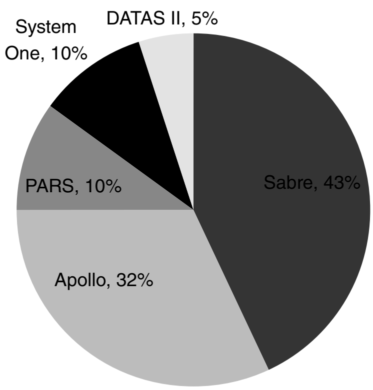


Figure 8.11 U.S. CRS Market Share in 1988.

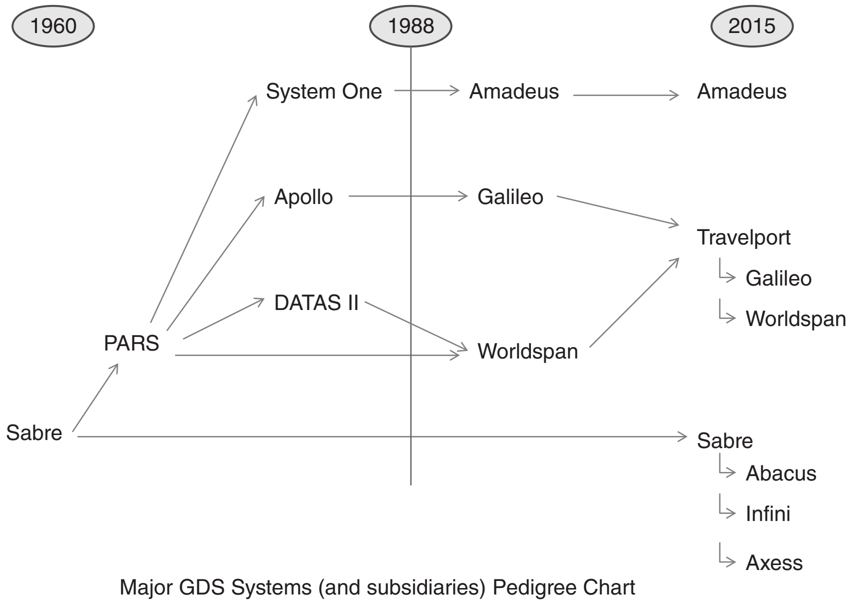


Figure 8.12 Major GDS Pedigree Chart with Current Subsidiaries and Joint Ventures. (Adapted from Schulz, 1996).

charging that they "possessed a monopoly in electronic booking of airline seats and were using that status to limit competition" (Copeland et al., 1995, p. 51). The Government Accounting Office studied the issue and determined there was insufficient data to prove booking fees were substantially above costs and harmful to competition. Some of the claims were rejected and others were settled out of court.

8.3 GDS Mergers, Consolidation, and Sell-Off

As mentioned earlier, in 1984 there were six GDSs, five were developed, owned and operated by airlines and one was independent. Figure 8.12 tracks the history (pedigree) and Table 8.2 shows their relative U.S. market shares.

You may notice that the market shares in Table 8.2 add up to only 88%. The remaining 12% belonged to airlines not using automated systems. As indicated in Table 8.2 it's not surprising that the first two CRSs to become operational maintained the two highest market shares as GDSs.

By 1986, Eastern Airlines had grown System One into a formidable CRS which many travel agents preferred over Apollo or Sabre, but Eastern as a company was in financial trouble. Frank Lorenzo of Texas Air (owner of Continental Airlines) badly needed a computer reservation system for Continental and Eastern's System One

Table 8.2 1984 GDS Market Shares. From Nicholls, 1985

GDS	*Owner*	*Market Share*
Sabre	American Airlines	43%
Apollo	United Airlines	27%
PARS	TWA/Northwest Airlines	10%
System One	Eastern Airlines	4%
DATAS II	Delta Air Lines	2%
MARS PLUS	Tymshare Corporation	2%

Table 8.3 1988 Market Share. From Computer Reservations Systems: Action Needed to better Monitor the CRS Industry and Eliminate CRS Bias. (1992)

CRS	*U.S. Market Share*
Sabre	43.1%
Apollo	27.9%
Worldspan (PARS II and DATAS II combination)	15.1%
System One	13.9%

was the only one in the United States that was even remotely attainable (Petzinger, 1995). To get his hands on System One for Continental, Lorenzo ended up buying Eastern Airlines which subsequently closed down. It's been said that Lorenzo bought Eastern primarily to secure the System One GDS for Continental (Petzinger, 1995). By 1990, PARS II, owned by TWA and Northwest Airlines, joined forces with Delta's DATAS II to form Worldspan (McDonald, 2004).

Unable to compete with airline-owned systems, the only non-airline owned system, MARS PLUS, went bankrupt. The 1988 market share of each system is shown in Table 8.3.

Beginning with American's sale of Sabre in 1996 and United's sale of Apollo in 1997, airlines began selling off their GDS systems to raise cash. By 2003 Worldspan was also sold to private investors and all airline-owned CRS systems were now independently owned and operated ("Airline Ticketing," 2003). Unpopular GDS practices became even more objectionable to airlines after they were spun-off from the parent airline. In a rebate practice that airlines found particularly loathsome, GDSs began charging airlines a booking fee averaging some $12.50 per flight, but then rebated $3.00 to $5.00 of that fee to the travel agent as an incentive to use the GDS. This actually incentivized the agent to book the traveler on a routing that required the maximum number of segments.

8.3.1 European Connections

As Sabre maintained a high market share, competing system owners were worried that they would be pushed out of business unless they could grow. They saw a possible answer to Sabre's dominance through mergers with overseas computer reservations systems.

The first non-North American CRS, Amadeus, was developed in 1987 by a consortium of four European airlines (Air France, Iberia, Lufthansa, and SAS) to serve as an alternative to Sabre. The Amadeus software was an adaptation of System One software and became fully operational in 1992. Later, in 1995, Amadeus consolidated with System One.

Another European system, Galileo, was also formed in 1987. Like Amadeus, Galileo was formed by a collection of nine European airlines and modeled after United's Apollo which it absorbed. Later, Travelport bought the Galileo system and added Worldspan in 2007.

These mergers resulted in the three main GDS systems we see today: Sabre, Amadeus, and Travelport (although Galileo and Worldspan still operate independently under Travelport). Amadeus is most used in Europe, but Sabre is most used in North America.

Although these GDSs are the only ones to provide worldwide coverage, there are several smaller, regional distribution systems including among others, TravelSky, a state-owned travel company serving Chinese airlines, and KIU in Latin America.

Once the three major GDS systems were formed, the industry was fairly stable for a few years because high barriers to entry prohibited most new competition. These barriers included the requirement for significant capital investment in new technology, the requirement for considerable know-how to distribute travel products, the necessity to provide all or nothing coverage of flights, and requirement to establish a global customer base (Granados, Kauffman, & King, 2008). As a result of these barriers, GDSs were an oligopolistic market with a very high return on investment, in fact, the highest in the travel industry—as much as 30% compared to negative return for airlines.

The GDSs had tremendous power to extract money from airlines. To demonstrate, as airline payments to travel agents dropped after 1994, GDS payments steadily rose to about $4.50 per booking.

8.3.2 Deregulation

The GDS regulations imposed in the United States in 1984 were, for the most part, continued for almost 20 years. In 2002, the DOT published a Notice of Proposed Rulemaking (NPRM) asking for comments from the industry concerning the then upcoming (January 31, 2004) sunset of the GDS regulations. After studying the comments, on January 7, 2004, the DOT published its final ruling stating that most of the GDS regulations would be allowed to sunset as planned ("CRS Regulations," 2004). The DOT cited two primary reasons for its decision:

First, "all of the U.S. airlines that had controlled a [CRS] system have divested their CRS ownership interests" ("CRS Regulations," 2004, p. 977). Without airline ownership in GDSs, the GDSs had no incentive to use screen bias to favor one airline over another. As a result, regulators felt that screen bias was no longer an issue.

Second, "airlines are selling an increasingly large share of their tickets through their internet websites and a diminishing share through travel agencies using a [CRS] system" ("CRS Regulations," 2004, p. 977). The emergence of Internet availability took away much of the influence of CRS systems by allowing customers easy opportunity to search schedules, compare fares and purchase tickets.

There was little immediate effect with CRS deregulation as most airlines already had extended contracts with GDSs thru 2006. However, airlines were under no obligation to participate with any GDS and airlines were free to negotiate with any or all systems once their contracts expired.

New Entrants

Deregulation also sparked some new entrant alternatives to the established GDSs. These companies were called GDS New Entrants or GNEs (pronounced "genies"), with the idea that they could lead to the end of the dependence of airlines on traditional GDSs. Two major GNEs were ITA Software and G2 Switchworks (Field, 2007).

ITA Software, best known for a fare-shopping metasearch engine, promised an alternative with all the capabilities of a traditional GDS—display of flight availability, schedules, and passenger information; making reservations; issuing tickets, refunds and exchanges. Google acquired ITA in 2011 leading to widespread fears that the industry might trade one independent distribution system for another.

The other major new entrant, G2 SwitchWorks, attempted to provide a more supplier-friendly GDS and took a travel agency viewpoint. G2 SwitchWorks failed in this attempt as a new entrant and was purchased out of bankruptcy by Travelport. Of course, this is yet another example of the high failure rate of new business ventures trying to break into an oligopolistic market.

In the end, about all the GNEs accomplished was to provide the airlines leverage against the traditional GDSs at negotiations and resulted in some savings for the airlines (Field, 2007).

European Deregulation

The original 1989 European Union CRS regulation (2299/89, as amended) was successful in preventing CRS abuses but was becoming outdated due to market changes. The European Commission reviewed and replaced the original regulation in 2009 with Regulation 80/2009. Regulation 80/2009 gave more flexibility the CRSs and air carriers while maintaining safeguards against "competitive abuse between parent carriers and CRSs and to ensure the supply of neutral information to consumers" (European Commission, 2013, p. 44). This essentially resulted in a partial de-regulation of the European CRS market.

In 2013, a fitness check commissioned by the European Commission found that "regulation continues to be needed to safeguard the gains [made by] consumers and the industry" (European Commission, 2013, p. 109).

8.4 The Rise of the Internet Changes the GDS Environment

Before the mid- to late-1990s, travel agents, long the dominant airline distribution channel, traditionally provided two services to the passenger. The first was information. Travel agents had easy access and the skills necessary to use their GDSs to gain information on schedules, fares, seat availability. Airline destinations and schedules were difficult to access for passengers wishing to shop for fares and schedules as passengers generally had to call each airline. This could turn into a time-consuming process if the traveler wanted to shop several airlines for schedules and prices yet they were still never certain of best service and price. Most passengers chose, instead, to use a travel agent. The second was the need for a paper ticket. Paper tickets were required for all airline travel and because only a travel agent or an airline could issue tickets, passengers were further tied to travel agency distribution.

Two developments rapidly diminished this traditional travel agency hold on airline distribution. The first development was the rise of the Internet in the 1990s. Southwest Airlines launched the first airline website in 1995 (Gunther et al., 2012) and it wasn't long before most airlines had their own websites to serve as online portals to their flight schedules and seat inventories. As the websites matured, passengers could check flight availability, review fare information and make reservations—all of the things passengers previously needed the travel agent and GDS system to accomplish. The money the airlines could save in distribution costs if passengers used their website versus travel agencies was significant—$8.50 for booking through travel agents versus as little as $0.25 if booked on the airline's website.

The second development was ticketless travel. Ticketless travel, or e-tickets, originated with Morris Air in the early 1990s. Morris was owned and operated by a travel and tour agency out of Salt Lake City. Morris was subsequently purchased by Southwest who used Morris's developed technology to initiate ticketless travel in 1994, largely in response to a dispute with Sabre and other GDSs. The cost of issuing a paper airline ticket was about $10 compared to about $1 for an e-ticket (Belobaba, Swelbar, & Barnhart, 2009). Passengers with e-tickets are spared the hassle of having to take possession of tickets, storing them in a secure place until their flight and then finding them to present to the agent. E-ticketing also saves the airlines money. For example, the cost to process an e-ticketed passenger who uses the Internet to check-in for their flight and then prints her boarding pass at home or an airport kiosk is only about 16¢ compared to about $3.62 for check-in with a live agent. The International Air Transportation Association (IATA), which mandated that all 230 of its airline members utilize e-ticketing by 2008, reports that the 100% use of e-ticketing saves the airlines a total $3 billion a year, worldwide ("IATA E-Ticketing," n.d.).

E-ticketing also works very well in conjunction with Internet reservations. Instead of having to physically visit a travel agent or airline office to print a ticket (and pay the additional fee), the e-ticketed passenger gets only a confirmation number from either the airline's website or from an agent over the phone. When the passenger gets to the airport, she provides the airline agent with the confirmation number and her identification and she is issued a boarding pass for their flight. The two main services the traveler needed from travel agents and GDS systems were now available directly from the airline via the Internet.

Using the Internet to sell reservations could save the airlines each tens of millions of dollars in travel agent commissions and GDS booking fees annually. However, it would take time for travelers to transition to the Internet process.

One tactic airlines used to drive potential customers to their Internet site was to charge an additional fee if the passenger used a GDS system versus the airline's preferred system. Lufthansa, who pays about €250 million annually to GDSs, provides the most recent example of additional GDS fees. In June 2015, Lufthansa announced they would charge customers a "distribution cost charge (DCC)" of €16 ($18) for each GDS transaction (Flottau, 2015, p. 1). Amadeus, Europe's largest GDS, naturally opposed the charge, saying it "will penalize travelers based on the shopping channel they use" (Flottau, Buyck & Sumers, 2015, p. 1). In a letter to its customers, Amadeus said that it costs Lufthansa only €2 for the transaction (Sinha, 2015). A survey conducted at an IATA conference indicated that 96 out of 118 airlines said they might follow Lufthansa's example (Flottau et al., 2015).

Another tactic airlines used was to limit the fares available on the GDS. To promote their websites, the airlines came up with the idea of holding back some fares, mostly the highest discounted fares, from the GDSs and making them available only on the airline's site. The airlines began to advertise these "Internet only" fares, hoping customers would give their websites a try. With airlines withholding some fares, travel agents using GDSs could no longer promise their customers they were getting the best fares. This hurt the travel agents' reputation and also the value of the GDS to the travel agent. In response, GDSs negotiated with airlines for all fares (full content), and in return gave discounts to the airline. GDSs now have Full Content Agreements with almost all major carriers.

As the Internet emerged as a viable alternative to travel agent sales, airlines began to encourage direct booking; almost completing the distribution circle that began with airline owned ticket offices. In 2004, America West estimated it costs about $2 to process a booking on its own site versus $15 through a GDS. For example, of the $58 paid for a ticket between Phoenix and southern California booked on America West through a GDS, $15 went to the GDS.

Internet distribution makes comparing airline schedules, products, and fares easy and quick, thereby increasing airline competition. Passengers benefit from this transparency as power has shifted from airlines to passengers. Recently, however, some airlines have been working to obscure some product and price features by burying some additional costs in hard to find places on their websites.

A European study found that airline websites were easy to navigate until the customer commits to purchase, after which they abruptly turn unfriendly. Some 50% of LCC websites included unfair and misleading practices. Airlines often quoted an initial price suggesting it was either "final" or "total" when it was neither. Many fees were revealed only after the passenger had committed to purchase a ticket. These included insurance, priority boarding, baggage, and seat selection, fees that were automatically added to the ticket price unless the passenger specifically opted out, a choice many overlooked. In one example, an initial price of €12.80 increased to €67.00 after fees were added. Airlines didn't make it easy to complain either. Contact information was often difficult to locate and often provided only a regular mail address and fax number. The objective of these practices is to increase revenue through deception and regulatory agencies took notice. In 2009, U.S. LCC Spirit Airlines was fined $375,000, a record amount, for violating a host of consumer protection regulations. The Florida-based airline failed to comply with rules governing denied boarding compensation, fare advertising, baggage liability and other consumer protections according to the U.S. Department of Transportation (Torres, Barry, & Mairead, 2009).

8.4.1 Airline Internal Reservations Systems

An airline's internal reservations system (RES) contains its flight schedules, prices, seat inventories, and real-time operational information. In many respects, the internal reservations system is "the heart of the airline's operation" (Belobaba et al., 2009, p. 447). When the airlines owned the GDSs, most of them used their GDS as their internal reservation system as well. In 1992, United used Apollo, American used Sabre, and Northwest and TWA used Worldspan as their internal reservations system. Only Continental, which owned System One, did not use it internally ("Computer Reservations Systems: Action Needed," 1992). The divesture of the GDSs from airline ownership required new communications relationships to emerge between RES and GDS systems.

Airline planning and operations functions like revenue management, crew scheduling, schedule optimization, and pricing feed solutions into the airline's RES. The internal system then processes information and releases non-proprietary information to the GDSs. The GDS then distributes the schedule, pricing and availability information contained in the RES system to traditional travel agents, online travel agents, and travel management companies. The internal reservations system used by an airline may be purchased from a vendor or developed internally. Similarly, it may be housed in the airline's internal IT system or hosted by a vendor, usually one of the GDSs (Belobaba et al., 2009).

8.4.2 Shift in Travel Agency Approach

Initially, travel agencies were clearly agents for the airlines. They were paid a base commission by the airline based on the value of the tickets they sold—the higher priced ticket they could sell, the more money they made. Some airlines also paid incentive payments to encourage travel agents to meet specific sales quotas. These payments, called TACOs (Travel Agent Commission Overrides), were in addition to the base commissions. Because the TACO was paid only above a negotiated level of sales, agents typically favored the largest airlines in their region.

As airlines sought to decrease their distribution costs, they reduced the base commissions. Prior to these reductions, the standard commission was 10%, but during the period from 1995 through 1997, most airlines decreased their base commissions to 8%. Then in 1995, Delta was the first airline to cap travel agency commissions at $50 for a round-trip fare. A few years later, airlines reduced base commissions to 5%, with a $10 cap. Other airlines followed and the commission cap practice stuck ("Report on Travel Agent Commission Overrides,"1999).

In 2002, Delta went further to eliminated base commissions to travel agents for tickets issued in the United States and Canada. This action was quickly matched by the rest of the industry with Southwest the last major carrier in 2003 to eliminate base commissions. Despite airlines' ties to travel agents, with total distribution costs of more than 12% of industry operating expense, the potential savings were too high to ignore, especially with the growing competition from low-cost-carriers (LCCs).

The elimination of base commissions placed travel agencies under great pressure. Combined with the emergence of LCCs, passengers' interest in low fares, and competition from Internet distribution, the traditional travel agency business model was no longer profitable. One-third of all U.S. travel agencies, or 8,000 businesses, have gone out of business since 1994 ("Airline Consumer Panel," 2002). Travel agency commissions grew steadily from 1978 through 1994, peaking at about 12%, but then declined steadily after 1994. Today, most airlines pay nothing to travel agents.

With the decrease in airline commissions, travel agencies began shifting their fees to the passenger. As a result, their allegiance also shifted to the passenger. Instead of trying to sell the highest fare to improve their commission, travel agents were more likely to provide the best service to the traveler, possibly finding cheaper seats or promotions to save the traveler money and hope for repeat business. If anything, the airlines paid only minor transaction fees to travel agencies for specific services and instead, the traveler now paid a surcharge to the travel agent for their time and service, possibly as much as $25 for a one-way booking or $50 for a round trip booking. Some travel agencies have shifted their business model toward more corporate travel, where they can provide more tailored travel service to a company. This shift has resulted in some changing their names to *travel management companies* to reflect this change.

8.5 The Rise of Online Travel Agencies

As the Internet began to take shape in the early 1980s, American's Sabre was the first to offer limited online availability to the traveler with the introduction of

EAAsySabre in 1985 ("Sabre History," n.d.; Gunther et al., 2012). Customers with Internet capability could access the Sabre system through CompuServe from their personal computers. "For the first time, travelers were able to check schedules (via [electronic access to the] OAG) and book travel [via EAAsySabre]" (Gunther et al., 2012, p. 175). As the Internet became more and more available in the mid-1990s, online travel agencies or OTAs began to appear. Using an online travel agency (also sometimes referred to as an ITA or Internet travel agency) travelers pay a small service fee in addition to the ticket price and the airline pays the standard segment fee to the GDS system if one is used.

8.5.1 Standard Online Travel Services

Online travel agencies (OTAs), sometimes owned by the GDSs themselves, are very much like traditional brick-and-mortar travel agencies, except that they operated as user-friendly computer interfaces directly between the traveler and the GDS. Most still used the GDS to book flights but without the overhead, they can not only offer the service at a lower cost but also provide better transparency to the customer (the ability to compare fares side-by-side). Online travel agencies are generally favored by price sensitive leisure passengers. Initially, the big three online travel agencies were Travelocity, Expedia, and Orbitz.

Travelocity

The first real online travel agency and successor to EAAsySabre's was Travelocity (Gunther et al., 2012). It was started in 1996 as a joint venture between Sabre and Worldview Systems Corp, with Sabre providing the GDS capability and Worldview providing the travel-related content. A year later in 1997, Sabre bought-out Worldview's interest and soon added more content to Travelocity including hotel reservations, car rentals, and vacation packages. In 1999, Travelocity merged with Preview Travel and the new company was called Travelocity.com, Inc. (Craft & Quick, 2002). Travelocity was initially a publicly-traded company with Sabre owning 70% of the company, but in 2002 Sabre purchased the remaining 30% of shares and Travelocity became a wholly-owned subsidiary of Sabre.

Like Sabre in the CRS business, Travelocity got the early lead in the OTA business growing steadily in its first two years and remaining the OTA leader until 2001 (Granados et al., 2008). Its website allows passengers to research information about destinations and make their own bookings. After the passenger enters their travel needs, Travelocity shows available flights including time and price search options. They even offer special deals available through Travelocity only ("Travel Agents Access," 2002). In 2013 Travelocity sold off its business arm, known as TBiz, to travel management company BCD Travel. Later in 2015, Expedia acquired the Travelocity brand from Sabre.

Expedia

Expedia is an online travel booking site catering to both leisure and business travelers. Expedia began in 1996 when a small division within Microsoft launched Expedia.com to give consumers a revolutionary new way to research and book travel. In 1999, Expedia Inc. spun-off into their own company. By 2001, Expedia took over Travelocity's number one online travel agency position. In 2003 the IAC (InterActiveCorp) acquired Expedia then later in 2005 spun it off forming Expedia Inc. Expedia utilizes Sabre, Amadeus and Travelport GDSs ("Expedia, Inc. 2014 Form 10K Report," 2015). Expedia Inc. also operates Hotwire, TripAdvisor, Hotels.com and Egencia which is their corporate booking tool.

In 2014, Expedia derived most of its revenue (70%) from transactions involving the sale of hotel rooms, compared to only 8% of revenue from airline tickets. They "believe that the hotel product is the most profitable of the products [they] distribute and represents [their] best overall growth opportunity ("Expedia Inc. Form 10K report," 2015, p. 49).

Orbitz

In 2000, at a cost of about $100 million, five major U.S. airlines (United, Delta, Continental, Northwest, and later American) teamed up to start Orbitz. Initially, Orbitz used Worldspan GDS for flight information and booking, but their goal was to create a new technology that could book tickets by direct access to the airlines' internal reservation systems. "Supplier Link," as Orbitz called it, was implemented in 2002 and can save participating airlines as much as $12–$16 per ticket in GDS fees. Soon, another two dozen airlines joined in offering their flights including Hawaiian, Midway, Spirit, U.S. Airways, and Vanguard (Ingram, 2004; Government investigation, 2000). Orbitz uses Supplier Link for most (about 70%) of their transactions but still relies on Worldspan as a backup connection for complex transactions ("Airline ticketing: Impact of changes," 2003; Hoon, 2002). Orbitz charges member airlines either discounted booking fees when using Worldspan, or Supplier Link fees if bypassing Worldspan. Airlines that choose to participate in Supplier Link pay a $200,000 initial fee, then pay Supplier Link and transaction fees of about $5. Additionally, Orbitz charges customers a small service fee.

The American Society of Travel Agents protested, saying Orbitz "was part of an effort by the airlines to drive travel agents out of business" (Government investigation, 2000, p. 81). The DOJ and DOT investigated antitrust charges, and eventually dropped the investigation saying Orbitz had "not reduced competition or harmed airline consumers" (U.S. Department of Justice, 2003, p. 1).

After several mergers, buyouts, and public offerings, Orbitz ended up being controlled by Travelport which owns 53% of Orbitz common stock. Orbitz uses all three GDS systems (Amadeus, Sabre and Travelport), and receives incentive payments for bookings processed through the GDSs. The Orbitz brand portfolio also includes CheapTickets, the Away Network, ebookers and Hotel Club (Orbitz Worldwide, Inc., 2014). Orbitz for Business is their corporate booking tool.

OTA industry leaders

In January 2015, Expedia bought Travelocity, then a month later in February, Expedia proposed a merger deal with Orbitz. The U.S. Department of Justice approved the merger in September 2015, and Orbitz is now a wholly owned subsidiary of Expedia who already controls CheapTickets (Orbitz Worldwide, Inc., 2014). As a result, there are currently only two major OTAs towering above the other competition: Expedia and Priceline. The two OTA giants now control about 95% of the OTA business.

8.5.2 Opaque Travel Services

So-called opaque online travel agents are OTAs that do not fully disclose certain information about the flights before booking. As discussed in the last chapter, the marginal cost of producing an airline seat is very low. Because of this, airlines can sell distressed seats remaining in inventory that would probably end up as spoil (empty seats at departure time) at deeply discounted prices. If the airline offers super low fares to fill these seats, however, they risk diluting the value of other seats they have for sale. If the airline offers those seats through an opaque seller, however, they can remain nameless until after the sale. Although the uncertainty of the opaque transaction is uncomfortable for some customers, the savings appeals to others. There are two main opaque online travel agencies, Hotwire and Priceline.

Hotwire

Established in 1999 by the Texas Pacific Group and six major airlines (American Airlines, America West Airlines, Continental Airlines, Northwest Airlines, United Airlines and US Airways), Hotwire launched operations in 2000. Although they are sometimes considered an auction broker, they are not actually bid-based because they allow the customer to see and choose a specific fare ("Travel agents access," 2002). Hotwire is considered an opaque seller because they do not reveal the name of the airline or the departure time until after the sale. Airlines use Hotwire to discount and sell inventory that would otherwise go unsold. By allowing the specific airline to remain anonymous during the pricing process, Hotwire helps generate incremental demand and permits airlines to discount more aggressively than they can in their traditional channels ("Finding Great Travel Deals," 2000). The site uses posted web fares from the affiliated airlines as well as some even lower un-posted fares. Hotwire was acquired by IAC (InterActiveCorp) in 2003 who also acquired Expedia the same year. In 2005 IAC spun off Expedia Inc. in a deal that included Hotwire as a subsidiary of Expedia Inc.

Priceline

Created in 1997 by Walker Digital and launched in 1998, Priceline is generally advertised as a "name-your-own-price" ticketing service. However, in addition to name-your-own-price opaque sales, Priceline also offers standard OTA (price-disclosed) sales. Their revenue from retail sales is derived from commissions from hotel and car rental reservations, GDS booking fees and customer processing fees. Revenue from opaque name-your-own-price sales is offset by cost incurred to purchase the services.

The name-your-own-price "service connects buyers that are willing to accept a level of flexibility regarding their travel itinerary with travel service providers that are willing to accept a lower price in order to sell excess capacity without disrupting their existing distribution channels or retail price structures" (Priceline.com Incorporated, 2004, p. 79). Customers provide a destination, day of departure and day of return information as well as a bid price they are willing to pay. Priceline searches databases of participating airlines for accommodating service. The airlines provide Priceline with undisclosed discounted rates not available to the public.

Priceline primarily serves customers in the United States and includes deals on airline tickets, hotels, rental cars, vacation packages and destination services.

Initially, only two airlines, TWA and America West, participated in Priceline, making it difficult to meet their demand. But in 1998 "Priceline signed on its first major airline, Delta. As part of that deal, the company agreed to warrant some 12 percent of its stock to Delta. With Delta onboard, the company could make steady gains in convincing other airlines to make their surplus seating available through Priceline" (Priceline.com Incorporated, 2004, p. 297).

In 2012, Priceline entered an agreement to acquire meta-search engine Kayak (see below).

8.5.3 Fare Aggregators and Metasearch Engines

The highly profitable GDSs are a good target for competitive attack. As airlines were doing their best to bypass the GDSs by promoting their own websites to book travel, search engine technology was being developed that could search airline websites for flight information. These so-called metasearch engines or vertical search engines do not sell travel services at all—they search airline websites and then redirect the customer to the airline or online travel agent for the final purchase of a ticket. The metasearch engines make their revenue from advertising and some referral fees if a customer uses an online travel agency (GDS) to book their travel. The biggest metasearch travel site is Kayak, but there are several others including Skyscanner, Dohop and more.

Kayak

In 2004, the original co-founders of the major online travel agencies came together to create a different type of online travel site. Kayak is a search engine only, comparing hundreds of travel sites including airline websites and online travel agent websites, saving the traveler hours of searching websites for the best deal. Once the customer finds the deal they want, Kayak allows them to choose which site they want to purchase from. There are no direct booking fees for using Kayak; however, airlines still pay Kayak for advertising and referrals. Since 2012, Kayak has been a subsidiary of Priceline.

8.5.4 Travel Agents Using GDS Alternatives

Travel agents are most efficient using GDSs for bookings. If they attempt to search airline websites, searching each site would prove very time-consuming and significantly alter their normal booking/buying behavior. Adapting new procedures, potentially to fit each airline's individualized system, would be very costly and time consuming for travel agents. Also, when using the airline website, the agent probably has to log in as if he were the passenger. This includes using the passengers' personal and credit card information.

American Airlines rocks the boat

In an attempt to avoid GDS fees, American wanted online travel agencies to use their direct online booking system called DirectConnect. American claimed this would not only give the passenger more flexibility concerning fares and unbundled services offered by American (like baggage fees) but also save the carrier tens of millions of dollars a year by not using the GDS systems typically used by online travel agencies. Critics claim that "consumers will have a harder time comparing fares and finding the best price if alternative systems such as American's replace [current GDSs]" (Jones, 2011). American says the use of newer software enables them to

> customize pricing offers based on the buyer's characteristics and travel history. For example, based on the customer's frequent flyer status, prior airline purchases, frequency of travel or current request, an airline might offer a monthly rate for inflight WiFi, a day pass for lounge access, a trip cost that includes a free checked bag, or some package of options at a discounted rate.
> (Compart, 2010, p. 2)

Some say that American is trying to reshape the distribution model, but it's not just American. Several airlines have been attempting to take more control over how their product is sold, but with contracts expiring, American's move is just the first as their GDS contracts were the first to be renegotiated.

American's first target was Orbitz. Orbitz uses the Worldspan GDS and refused to make the switch to American's DirectConnect. As a result, American pulled its flights from Orbitz, leading to a lawsuit from Orbitz's owner, Travelport. (Travelport also owns Worldspan, Galileo and Apollo GDSs.) American responded with their own antitrust lawsuit against Travelport. Orbitz and American settled their suits in 2013 and signed new distribution agreements ("American Airlines, online travel company settle," 2013).

American also had an issue with Travelocity online travel agency owned by Sabre. Like Orbitz, American wanted Travelocity to sell tickets using American's DirectConnect website instead of Travelocity's Sabre GDS. Sabre retaliated by going back to the old screen bias system, essentially biasing American out of Travelocity screens. As an example, a New York (JFK) flight to Los Angeles (LAX) that used to be the first flight on Sabre's listing now moved to the 46th position. (It's ironic that Sabre, the GDS that American used to invent screen bias, was now using screen bias against American.)

American also says Sabre doubled American's fees and that Sabre's retaliation cost American $993 million. American took Sabre to court and initially won an injunction stopping the screen bias. Later, American and Sabre settled with Sabre paying American an undisclosed sum and American renewing their contracts (McLaughlin & Harris, 2012).

8.6 New Distribution Capability

The GDS systems developed before the rise of the Internet, and use an inflexible pre-Internet message protocol called EDIFACT (U.S. Department of Transportation [US DOT], 2014a; Popovich, n.d). This capability provided the basic information travel agents needed—fares and travel classes—and worked efficiently when airlines were selling only seats (Figure 8.13). However, now that

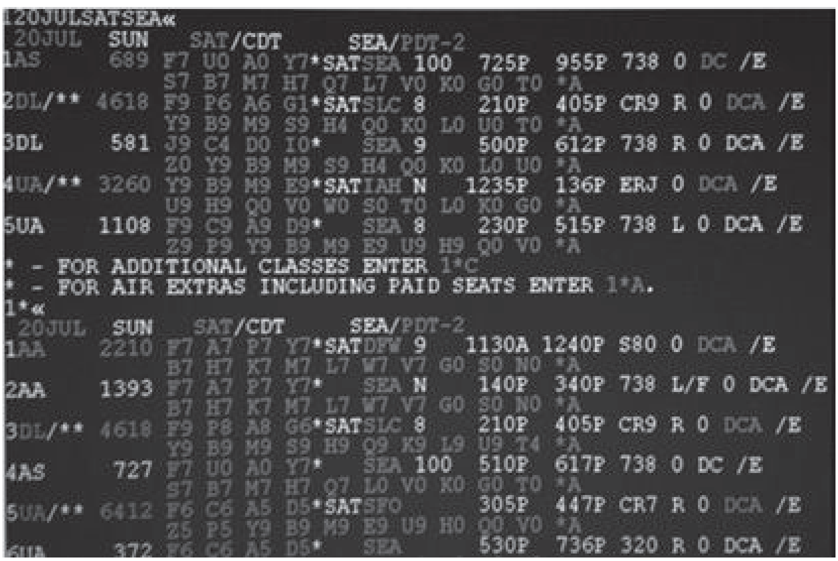


Figure 8.13 EDIFACT Screen Presentation.

airlines have unbundled their products, the sales process has become more complex and GDS processing using EDIFACT has become impractical.

Airlines, using modern-day Internet language XML (Extensible Markup Language) to build their websites, can make very user-friendly sites to sell their multitude of new unbundled products. Airlines can also customize travel packages based on their customers' travel history and stated desires. These services are either totally unavailable, or at best not easily available to travel agents using EDIFACT GDS.

In an effort to update the EDIFACT system, the International Air Transport Association (IATA), an airline consortium, has begun development of a new system called *New Distribution Capability* or NDC designed to establish a new technical standard for data exchange using XML. Using XML, the NDC displays resemble current airline Internet sites. Figure 8.13 shows the original EDIFACT presentation, still in use today as shown in this Sabre display. In comparison, Figure 8.14 shows the new XML presentation used by the NDC, which looks much like current-day websites. According to the IATA, the

> NDC will enable the travel industry to transform the way air products are retailed to corporations, leisure and business travelers, by addressing the industry's current distribution limitations: product differentiation and time-to-market, access to full and rich air content and finally, transparent shopping experience.
>
> ("New Distribution Capability," n.d., p. 1)

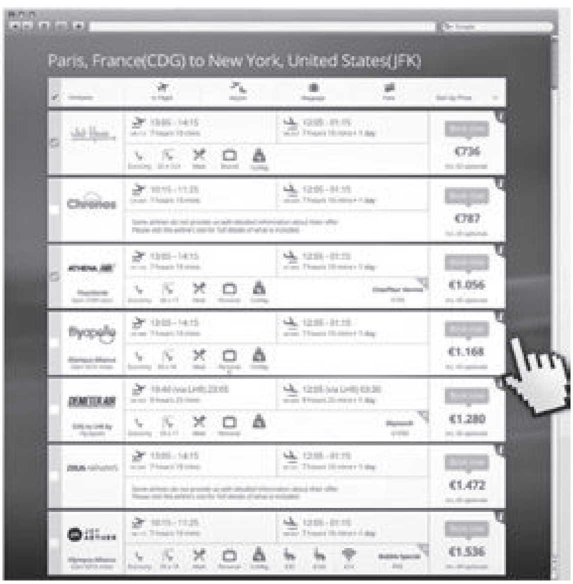


Figure 8.14 NDC Screen Presentation.

In accordance with Title 49, U.S. Code, the DOT must review inter-carrier cooperative agreements related to transportation (like the use of NDC) and approve them only if they do not substantially reduce or eliminate competition (U.S. DOT, 2014a). In October 2013, the IATA passed Passenger Services Conference Resolution 787, the foundation for NDC, and petitioned the DOT in March 2013, to approve the use of NDC.

8.6.1 Airline Perspective

Most airlines are very excited about the prospect of NDC. They feel that the old technology of the GDSs has stifled their ancillary sales and they see the new XML-based standard as a new "vibrant marketplace that is not possible with today's closed proprietary systems" (Popovich, n.d., p. 1). Airlines claim NDC will help travel agents better service their customers by making more airline ancillary services available and by allowing customers to make fully informed choices.

8.6.2 GDS Perspective

Initially, GDSs Sabre, Amadeus, and Travelport, were opposed to NDC. They felt that NDC would be used to bypass their services and destroy their businesses. Travel trade association ETTSA (European Technology & Travel Services Association), which includes the three GDSs, reported that NDC is a "model which is founded on the use of opaque fares and ancillaries to make real comparison shopping difficult, if not impossible" (Klenner, 2013, p. 1). ETTSA also pointed out that several other travel associations that have no link to GDS companies share their sentiment and urged the U.S. DOT to reject the IATA's request for NDC approval (Resolution 787) (Klenner, 2013).

However, after the IATA reasserted that NDC was not mandatory and GDSs (or something much like them) would still be needed with NDC, opposition lessened. The GDSs changed their minds and agreed to support a collaborative approach (US DOT, 2014a).

In May 2014, the DOT tentatively approved Resolution 787, finding that the NDC is in the public interest (US DOT, 2014a). According to the DOT,

> Resolution 787 would help modernize airline product distribution by generating common industry-wide, real-time communications standards and protocols so that all the participants in the distribution chain—airlines, travel agents, GDSs, and consumers—could speak the same electronic language in their communications with each other.
>
> (U.S. DOT, 2014a, p. 10)

The DOT followed up with final approval in August 2014 (U.S. DOT, 2014b).

By 2014, airlines were beginning to use early versions of NDC (NDC 1.0); United, for example, is using NDC 1.0 with Amadeus GDS. Also, the IATA expects to release preliminary standards for an updated version, NDC 1.1, during 2014. By the end of 2015, small-scale deployments will help work out bugs and the IATA expects to release NDC 1.2. During 2016 NDC will continue to be updated and deployed (Canaday, 2014).

8.7 Summary

The goal of the airline's distribution system is to provide the *place* or the distribution channel that connects the product to the customer. Figure 8.15 shows this graphically. Initially a manual system, airlines soon developed computer reservations systems, or CRSs, to automate the data processing. Airlines who owned CRS systems enjoyed a significant marketing advantage over non-CRS airlines and used that advantage to thwart competitors' entry into the market. These CRSs, eventually sold off from their airline owners, became global distribution systems, or GDSs, when they began to offer multi-airline flights and later, other travel services like hotels and rental cars.

As the air transportation system expanded after WWII, travel agents stepped up and took on the job as airline ticket offices couldn't keep up with expansion. The travel agents used the GDS systems to access airline flight and inventory status and book reservations. Airlines paid the travel agent a commission based on their sales as well as a booking fee to the GDS to complete the transaction. This system worked well until the advent of the Internet.

As the Internet took shape, online travel agents began operation, performing many of the same tasks as their brick-and-mortar counterparts. Also, the airlines began to develop their own websites offering passengers the opportunity to book reservations directly, saving the airline both travel agent commissions and GDS booking fees. The role of the brick-and-mortar travel agent has diminished greatly over the last 15 years. Now, airlines pay little, if any, commissions to travel agents, and as a result, travel agents have shifted to travel management companies, catering to the client rather than the airline.

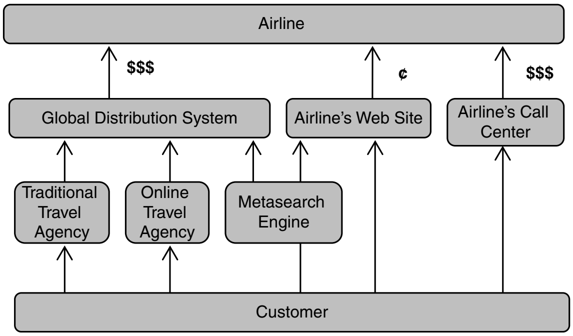


Figure 8.15 Airline Distribution Diagram.

With the availability of airline websites, new online travel agencies started which use metasearch engines to search airline sites for the best prices.

It's no surprise that the airlines attempt to distribute their product for the least cost possible. The least cost distribution from customer to the airline in Figure 8.15, is through the airline's website. This method costs the airline just a few cents to complete. Alternatively, any booking that goes through the GDS system costs the airline a substantial booking fee. Even using the airline's call center requires expensive additional overhead and labor costs.

The future of airline distribution will find traditional travel agencies continuing to transition more to corporate travel functions, and calling themselves travel management companies (TMCs), as they now see themselves as consumer travel consultants rather than airline agents. Airlines will attempt to increase direct booking on the Internet and re-kindle relationships with TMCs in order to develop global business strategies for corporate travel. Airlines will also work with their GDSs to transition to the New Distribution Capability (NDC) and shift away from EDIFACT. High airline booking fees will still be key issues in the airlines' continuing shift away from GDSs to direct booking and GDSs' airline revenue will continue to decrease. GDSs feel they will still maintain airlines as a major part of their revenue, but they also understand they will need to diversify to reduce their dependence on airline revenue. That will require changing their business model and developing new pricing mechanisms for airlines (Alamdari & Mason, 2006).

Note

1 Accounts vary, but apparently IBM's umbrella SABER project was also being looked at by Delta and Pan Am, so American needed a unique name for their system presumably in order to copyright it (Mapstone, 1980). Most say Sabre stands for Semi-Automatic Business Research Environment (simply swapping the last two words from the original SABER), but others say the name came into being after an executive saw an advertisement for a Buick LeSabre in a magazine (Boyd, 2007; Petzinger, 1995; Copeland & McKenney, 1988; McKenney, Copeland, & Mason, 1995). The *Sabre*® company today states that historically the name was an acronym for Semi-Automatic Business Research Environment, but now treats the name as if was not an acronym at all ("Sabre History," 2013).

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Review Questions

1 What was the Request and Reply system?
2 Why was the Official Airline Guide produced and what is its use today?
3 What were the factors that led to the government's regulation of the computer reservations systems? What led to its deregulation?
4 Why did the travel agent become the predominant distribution channel for airlines and what two services did travel agents provide that were needed by passengers?
5 How have GDSs been transformed in recent years?
6 How has Internet distribution affected traditional travel agents?
7 Why did airlines offer Internet-only fares?
8 What is the NDC and how will its use improve airline sales?

Chapter 9

International Air Transportation and Public Policy

In this chapter, our attention switches from an emphasis on domestic operations to international air transportation. It begins with the history of international air transportation economic regulation instituted after World War II. Next, we consider the reasons for increasing liberalization of world airline markets and the impact on airline competition, efficiencies, and management. From the earliest days of the industry, most airlines were state-owned and controlled. The systemic problems afflicting government-owned airlines have led governments to either partial or full privatization. Airlines across the world are joining global alliances to increase market reach and offer customers seamless travel around the world. We consider the nature of these alliances, the benefits, and the costs of membership to both the airlines and the traveling public. Finally, mergers and acquisitions, particularly among the largest U.S. carriers, have accelerated in the twenty-first century bringing some promise of long-term stability. Consolidation and the eventual emergence of true multinational airlines, as has occurred in other large industries, may be the future of the airline industry as well.

9.1 Air Service Agreements

In 1944, with World War II still raging, 52 nations gathered in Chicago to draft international aviation protocols. The Chicago Convention established the International Civil Aviation Organization or ICAO, later an agency of the United Nations. ICAO is charged with developing and promulgating international aviation standards including licensing of airmen and aircraft, rules of the air, meteorology, aviation charts, telecommunications, air traffic services, and noise and emissions standards. This worldwide standardization has proven very effective in promoting safe and efficient international air transportation.

The Convention also considered the protocols and restrictions for establishing international air transport among the various nations. The United States pushed for minimal restrictions allowing airlines to operate routes without government approval or economic regulation. Most other countries, however, feared U.S. hegemony because of its dominant position in aviation near the end of WWII. But, instead of a relatively free market in international aviation, the Convention settled on a system of negotiated government to government agreements regulating flights between two countries. Known formally as Air Service Agreements (ASA), these agreements are more commonly referred to as bilateral agreements, or just bilaterals, because each agreement is the result of negotiations between two countries.

Although not the first bilateral, the United States–United Kingdom ASA completed in 1946 set the pattern for many agreements that followed. Known as Bermuda I for the locale of the negotiations, this ASA provided for restricted air service between the nations and to some points in Latin American and the British Colonies of Hong Kong and Singapore ("Bermuda Agreement," n.d.). The Agreement limited the number of airlines, gateway cities, the capacity or number of seats offered by each carrier, flight frequency, and tariffs or ticket prices. Tariffs were based on a formula developed by the International Air Transport Association, a body formed by the airlines. Since the Chicago Convention and Bermuda I ASA, hundreds of Air Service Agreements have been negotiated worldwide between states. Many, although often revised and updated, are still in place.

In 1977, the United States and United Kingdom revised their first agreement replacing it with the Bermuda II ASA that remained in place until 2007. This second agreement was also highly restrictive. Access to London's Heathrow Airport, the most advantageous gateway to continental Europe, was a major point of contention as it has been since. Bermuda II allowed only two airlines from each country—American and United for the United States and British Airways and Virgin Atlantic for the United Kingdom—to fly between London and a limited number of U.S. cities. Flight frequency, code sharing and pricing were also restricted.

Air Service Agreements provide for economic control of flights between countries not unlike the way the CAB once controlled U.S. domestic flights. These agreements generally seek to split the traffic between the two countries' airlines and ensure some level of profitability. ASAs vary significantly in detail and restrictions, but all address the following points:

- Number of routes and gateways served.
- The airlines designated by each country allowed to provide service.
- Citizenship requirements which generally specify that designated airlines must be owned and controlled by citizens of states who are party to the bilateral. The United States, for example, requires that U.S. citizens own at least 75% of the voting stock in a designated public carrier.
- Capacity including the number of seats and frequency of flight permitted.
- Tariffs or prices charged by each carrier. These have traditionally been set according to formulae developed by the International Air Transport Association and subject to the approval of both governments.

Some provide for air service continuing beyond the signatory countries, known as fifth freedom rights. Cabotage, the carriage of passengers wholly within the other party's country, is rarely permitted.

9.1.1 US Open Skies

In 1978, the United States formally renewed its goal of less restricted air commerce between nations when President Jimmy Carter declared "Open Skies" as U.S. international aviation policy. The announcement coincided with domestic airline deregulation. The policy, which remains in effect, seeks to promote international airline competition with a minimum of government interference. Open Skies, however, stops well short of complete deregulation. It restricts foreign ownership of U.S. airlines to 25% of the voting stock and prohibits effective control by foreign citizens. Second, it does not allow for cabotage, so foreign airlines may operate between two points in the United States as part of continuing service, but may not carry passengers solely between the two points.

Following the declaration of the Open Skies policy, the United States sought nations willing to negotiate much more liberal Air Service Agreements. The United States stated its goals: (a) innovative and competitive pricing; (b) no restriction on capacity, frequency, and routes; (c) elimination of discrimination against U.S. carriers in foreign services provided; (d) multiple destinations; and (e) liberal charter and cargo rights. To provide maximize pricing flexibility, the United States proposed that airlines be allowed to set fares unless both governments disapproved. This rendered government protection of the home carrier difficult.

The Open Skies policy enjoyed the support of U.S. airlines because the domestic market had matured such that international flights offered a better opportunity for growth. U.S. network carriers, with their expansive domestic route systems, could tap a large U.S. market to feed international routes, an advantage that most foreign carriers could not match.

US/Netherlands Open Skies

Open Skies agreements were not immediately forthcoming. The first true Open Skies agreement was not reached until 1992 when the United States and the Netherlands penned a new agreement. The impetus behind this innovative ASA was a proposed investment in financially struggling Northwest Airlines by the Netherlands-based airline KLM. As shown in Table 9.1, the new ASA met the U.S. policy objectives.

The United States subsequently granted antitrust immunity for Northwest and KLM allowing the airlines to closely coordinate their businesses in an international alliance. Northwest and KLM were allowed to share each other's airline codes on their flights thus allowing each to seamlessly market the other airline's flights as their own. Further, the immunity allowed for the coordination of schedules, fares, and other commercial aspects that, in the absence of antitrust immunity, would be illegal.

The agreement became a U.S. precedent. In 1995, the Department of Transportation established a policy making code-sharing and antitrust immunity with foreign airlines contingent upon an Open Skies agreement between the two

Table 9.1 Elements of US/Netherlands Open Skies ASA

Full route and destination access	No frequency or capacity control
Unlimited 5th freedom (the right to fly between the two countries and then continue to a 3rd country)	Change of aircraft for beyond flights permitted (break of gauge)
Full charter access	No pricing or tariff control
Multiple airline designation	Code sharing permitted

countries. The promise of Open Skies was largely fulfilled in 2002 when the United States and France signed an agreement bringing the number of U.S. open-skies partners to 56. At the time, only four European Union nations—the United Kingdom, Ireland, Spain, and Greece—were without fully liberalized aviation markets with the United States. The US–France accord allowed for an antitrust immunity for the global SkyTeam alliance members Delta, Air France and several smaller partners.

US/EU open skies

Coincidently in 2002, as the US–France Open Skies agreement was concluded, the European Union court ruled that bilateral agreements between the US and individual EU countries violated the EU's single market principles. The EU and US then began negotiating an agreement to replace all US/European bilaterals with a single agreement covering all EU countries and the US. After years of difficult, on again, off again negotiations, an agreement was reached in March 2006. The key points of the agreement which took effect in March 2008 are:

- US and EU member states are allowed open access to each other's markets with freedom of pricing and unlimited rights to fly beyond the EU and US to points in third countries.
- US carriers may fly between any EU cities but a reciprocal right was not granted to EU airlines.
- London's Heathrow airport was opened to all US international airlines as well as to all European carriers wishing to fly between the US and London subject to acquiring takeoff and landing slots. This last restriction is significant because Heathrow operates at capacity and is slot controlled. Still, slots are occasionally available albeit at a high price. Two trades in 2013 were valued at $25 million per daily slot pair (one takeoff and landing) ("Heathrow Airport's slot machine," 2013).
- The EU's demand for elimination of US restrictions on foreign ownership of US airlines (limited to 25% voting stock) was left for later negotiations. Dropping citizenship rules would allow for trans-Atlantic airline mergers.
- Cabotage is still not allowed.

In 2011, the US and EU essentially agreed to continue the Open Skies agreement without further liberalization sought by the EU. US carrier Virgin America illustrates how important and contentious the citizenship restriction can be. Virgin Chairman Richard Branson was the driving force behind Virgin America and the many other Virgin airlines in other countries. Although Branson held only a 25% voting share in the new carrier, Continental and other US carriers succeeded in delaying the Virgin America's new service for nearly a year by convincing the Department of Transportation that Branson would, in fact, control the airline in violation of the US citizenship rules. Virgin was forced to make substantial changes in its financing and governance before finally winning DOT approval and starting flights in the fall of 2007.

With the US and EU together accounting for nearly 50% of world airline traffic, the US–EU Open Skies agreement was expected to lead to more flights and lower fares across the Atlantic. Ryanair, Europe's aggressive LCC, proposed transatlantic service (Figure 9.1), but, as of 2016, was still in the planning stage. The world recession beginning in 2008 caused carriers to retrench so the effects of the Open Skies agreement have been muted.

US/China free skies

The early bilateral agreement between the US and China was highly restrictive. But in 2004 the US and China inked a "landmark" air services agreement that would more than doubled the number of US airlines that may serve China and permit a nearly fivefold boost in weekly flights between the countries over the following six years. US officials called the deal "free skies," indicating it fell short of an Open Skies agreement. Negotiations, however, continued, and in 2007, a further liberalization was concluded allowing more carriers to serve US–China routes.

Figure 9.1 Ryanair's Proposed EU–US Service Under Open Skies.

United and Northwest, the incumbent US carriers on China routes, were joined by the remaining US network carriers in fierce lobbying for additional routes to be awarded by the Department of Transportation under the terms of the agreement. American, Continental, and Delta all received some route awards. Chinese airlines were less aggressive, but with the gradual addition of routes, more carriers have begun China–US service. With US consolidation, the three US international network carriers—American, Delta, and United—all operate various routes to China. By 2014, China had designated 4 airlines: Air China, China Eastern, China Southern, and Hainan carriers ("Air route authority," n.d.; Anonymous, 2004).

US/Japan Open Skies

The US and Japan reached an Open Skies agreement in late 2009 following three decades of sporadic negotiations. The agreement lifted restrictions on carrier designation, cities served, capacity, frequency, pricing, and cooperative marketing arrangements including code-sharing. The previous, restrictive bilateral Air Service Agreement dated from 1952. It had granted highly privileged positions to Pan American World Airways and Northwest Airlines (formerly Northwest-Orient, now merged into Delta Air Lines) which were later obtained by United and Delta through a merger. This allowed Delta to control 22% of capacity at Tokyo's Narita International Airport, the main international gateway. United held another 12% of Narita's capacity.

The agreement was contingent on Japan's two major airlines, Japan Airlines (JAL) and All Nippon Airways (ANA), being granted antitrust immunity with US airline partners, a process concluded in 2011.

Long-struggling Japan Airlines filed for bankruptcy in late 2009 precipitating a short but intense competition as Delta tried to lure JAL away from the American Airlines and the oneworld alliance. JAL's new management team decided to stay with American. Immediately following the decision, American and JAL filed for antitrust immunity, granted in 2010, to allow close coordination on flights between the US and Japan. United, which already had a code-sharing agreement with ANA for connecting passengers in Tokyo, was also granted antitrust immunity allowing it to create a trans-Pacific venture with ANA.

9.1.2 EU Open Skies

In 2003, the European Union joined the United States in aggressively pursuing Open Skies and subsequently concluded agreements with the United States, Canada, and Brazil, and created a common aviation area with several neighboring states. In 2015, the EU announced an "ambitious package of proposals" to negotiate comprehensive aviation agreements with the Association of South East Asian Nations (ASEAN) States, Gulf Cooperation Council (GCC) States, Turkey, China, Mexico and Armenia (European Commission, 2015).

9.1.3 Air Service Liberalization Support and Opposition

With open or free skies in place in all the major aviation markets in the world, the US push to liberalize international air transportation has been proven successful over time. The Department of Transportation lists Open Skies agreements with 118 countries although some remain provisional (Open Skies Partners, 2015). Liberalization is not limited to agreements between the US and other countries as other world regions have reduced economic restrictions on the airline industry. In 2015, the ASEAN member states agreed to Open Skies forming the ASEAN Single Aviation Market intended to increase connectivity and enhance regional trade.

U.S. Open Skies policies have historically enjoyed the support of U.S. airlines. But in 2015, faced with unwelcome competition, American, Delta, and United charged the rapidly expanding Middle East airlines Emirates, Qatar, and Etihad with unfairly benefitting from massive government subsidies violating the intent of Open Skies. The Partnership for Open and Fair Skies, a lobbying group created by the three U.S. airlines and their unions, requested that the U.S. Department of Transportation open an inquiry, a first step to imposing restrictions on access by the Middle East airlines to U.S. markets. The attack on the Middle East carriers has been supported by Lufthansa which has lost one-third of its Europe–Asia market share since 2005 but opposed by the International Airlines Group, owners of British Airways and Iberia. Divisions also arose in the United States as FedEx, Atlas Air Worldwide, JetBlue, and Hawaiian Airlines formed a counter-lobbying group, U.S. Airlines for Open Skies Coalition, to support the existing Open Skies agreement.

9.2 State-Owned Airlines

Coincident with the trend toward liberalization of international air transport markets, governments have moved to privatize state-owned airlines. In contrast with the United States, most countries chose to develop commercial aviation through state ownership and control of airlines. Many reasons are offered in support of government ownership:

- Early in airline history, airlines were not financially viable, but governments recognized the benefits of developing an air transportation system. The United States chose initially to subsidize mail service and opted later for economic control under the CAB, but U.S. airlines were privately owned. Elsewhere, most airlines remained in government ownership.
- National pride often demands and is reflected in a national flag carrier.
- A state-owned airline can provide low air fares with government subsidies. Railroads are subsidized and/or state-owned in most of the world for the same reason.
- The national carrier provides a link to dispersed ethnic groups worldwide, again often with a subsidy.

- A national airline earns hard currency for foreign exchange, usually U.S. dollars.
- The airline provides employment, technical skills, and training, but also patronage jobs for political advantage.
- The flag carrier helps domestic aerospace industries develop by providing a market for products.
- The airline is considered critical for national defense. Transport aircraft developed in the former Soviet Union, for example, included design features for military use.

As Figure 9.2 shows, the majority of airlines in the Americas and Europe are now privately owned; the opposite is true in much of the rest of world. The remaining state-owned European carriers are mostly small with governments attempting to shed or reduce their ownership shares. SAS is 50% owned by Denmark, Norway and Sweden, all of which would like to sell their stake. The flag carriers of Poland and the Czech Republic are also attempting to privatize. Outside Europe, the largest state-owned carriers[1] include perennially struggling Air India, Air New Zealand, Singapore Airlines and the 3 Gulf carriers. The Chinese government also exercises substantial control over the Chinese Big 3 (Baigorri & Rothwell, 2012).

The reasons for early state ownership of the nation's flag carriers were compelling, but state-owned airlines are usually inefficient, perpetually lose money, and serve as a drag on the economy. Subsidies, though substantial, are often indirect and hidden with minimal or below market airport fees, sub-market interest rates on loans, and below market fuel prices. The carriers are highly politicized and pressured to provide cheap fares or free travel for government officials, patronage jobs which change with each change in government, and services on unprofitable

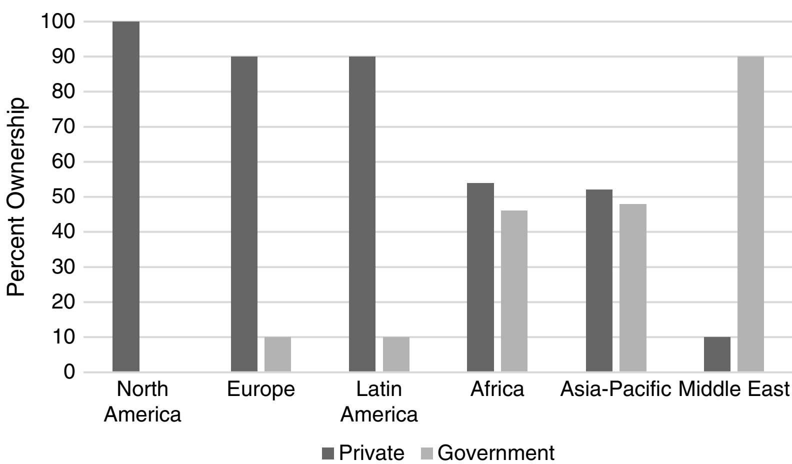

Figure 9.2 Private versus State-Owned Airlines.

Data source: IATA Vision 2050.

foreign and domestic routes. Unions become strong and entrenched, usually demanding and obtaining a say in all management decisions, and often resist improvements in efficiency, and cultivate a culture of no layoffs. Staffs become bloated and unproductive. Frequent management changes and other government interference result in a lack of strategic direction, an overextended system with money-losing routes, and an aging fleet poorly matched to demand. Poor passenger service becomes endemic. Consequently, the typical bureaucratic management is unable to adapt and succeed in an increasingly competitive marketplace.

Faced with continuing losses and a liberalizing marketplace, many countries have decided to privatize their state-owned airlines. This decision is driven by several considerations:

- a growing realization that free market capitalism increases national wealth and the standard of living;
- a need to increase the efficiency and competitiveness of the airlines and, consequently, relieve the fiscal burden caused by continuing subsidies;
- a desire to create stakeholders with a vested interest in the financial success of the airline, including owners, employees, suppliers, and customers; and,
- especially within the European Union, restrictions on government subsidy of business.

The European Union has been forceful in encouraging privatization. EU member countries can only provide state aid to airlines in order to restructure the airline so it can successfully operate on a commercial basis without state interference.

The steps to privatizing a state-owned airline are often difficult and protracted. The government and the unions must be fully committed to privatization. This usually occurs only when the airline is faced with insolvency and liquidation, a point at which privatization also becomes more problematic. State-owned airlines are invariably in debt to the government; these loans must be written off as few outside parties are willing to assume the debt. An infusion of funds is often necessary as subsidies are ended. Costs must be reduced to a competitive level by layoffs, wage and salary cuts or freezes, increasing flexibility in work rules, and management restructuring free from government interference. Finally, network and fleet rationalization is necessary including dropping of unprofitable routes and reducing the number of fleet types.

When these preliminary steps are completed, several options are available to privatize the state-owned airline. The state may simply auction the airline to the highest bidder and keep the proceeds. Rather than an open auction, the state may negotiate the purchase with a single party. In some instances, the management and/or employees can arrange financing to purchase the airline. Employees can be granted stock, generally in return for concessions and efficiency improvements. Granting stock to employees aids in transition to competitive market. British Airways, for example, offered employees stock at a discount as it was privatized in the 1980s. If the country has a large, developed stock market, the state may issue an initial public offering of shares in the company. In such instances, the state often remains a minority owner.

The results of privatization efforts are mixed with many examples of success and failure. In the early 1980s, the British government under Margaret Thatcher successfully privatized much of the UK-owned industry including flagship British Airways. BA, of course, remains one of the world's premier airlines. Air France and Lufthansa were successfully privatized later and more gradually than BA (Morrell, 2013). The Spanish national airline Iberia was fully privatized when it was acquired in 2011 by the International Airlines Group (IAG), the holding company formed to facilitate the merger of BA and Iberia. IAG, which also owns several other smaller airlines, added to its stable in 2015 with the acquisition of the Irish national airline Aer Lingus. Similarly, Air France/KLM and the Lufthansa Group have grown through acquiring previously state-owned airlines resulting in three large European airline groups—IAG, Air France/KLM, and Lufthansa—similar in many ways to the three largest U.S. network carriers.

Elsewhere in Europe, several attempts at privatization suffered repeated failures before finally meeting with some success. Under several administrations, the Italian and Greek governments repeatedly failed to privatize the state-owned carriers Alitalia and Olympic Airways. At Alitalia, employees often struck when faced with cuts and restructuring and the government usually backed down. Eventually, with cash depleted and the EU prohibiting more government bailouts, Alitalia was broken-up and the airline operations merged with the Italian LCC Air One, but it continued to struggle. In 2014, Etihad Airways added Alitalia to its stable of airlines with a $2.4 billion deal that gave Etihad effective control and a 49% stake. Similarly, Olympic was privatized and merged into the Greek carrier Aegean. The Hungary government tried repeatedly to sell its flag carrier Malev finally finding a buyer in 2007. But, Malev was renationalised in 2010 and then ceased operations in 2012 when the European Commission ruled that continuing state subsidies were illegal.

Nearly all South and Central American airlines have been privatized. As in Europe, some have done well while others have failed. One example is Brazil's national airline, Varig, which was for many years pampered and protected by the government but was forced to file bankruptcy in June 2005 following industry deregulation. As the *Wall Street Journal* stated at the time, "When politicians wanted flights, Varig was lavish in handing out courtesy tickets. As the government sought to weave together this massive country, Varig flew to the hinterlands, whether or not routes were profitable. When Brasilia strengthened ties with Africa in the 1980s, Varig started flying to unprofitable destinations there" (Samor, 2005, p. A18). Through bankruptcy, the airline was split into several parts and sold off. One division was purchased by the low-cost-carrier Gol which continues to operate the Varig brand. In sharp contrast is the success story of Colombian airline Avianca, the region's oldest airline founded in 1920. Rescued from bankruptcy in 2004 by Bolivian-born entrepreneur German Efromovich, Avianca has more than tripled its fleet from 40 to 150 aircraft and serves more than 100 cities

(Crowe & Munoz, 2013). Avianca Holdings which includes Avianca and several other acquired airlines is the second largest South American airline group behind LAMTAM (Karp, 2013). By 2016, however, the weak South American economy forced Avianca to seek a capital injection of $500 million. United and Delta were both reported to be interested (Mattioli, Hoffman, & Carey, 2016).

Equally mixed results in other parts of the world show that privatization is no guarantee of success, but state-ownership has mostly been a failure, although with notable exceptions. The big three Chinese airlines are partially privatized, but the state retains significant control. The three big Gulf carriers, all of which are state-owned, have been expanding rapidly with Emirates reporting sustained profitability.

9.3 Global Alliances

Membership in a global alliance allows an airline to offer destinations that cannot be served economically, such as international routes with relatively low demand, or legally because of restrictive air service agreements. For example, no single airline currently provides service between Albuquerque, New Mexico and Cape Town, South Africa, but US carriers and their international alliance partners such as Delta/Air France, American/British Airways, United/Lufthansa do provide convenient flights between these cities. The coordination of schedules and other product features through a global alliance provide a competitive advantage over carriers without similar arrangements. Ultimately, the global alliance seeks to capture passengers from origin to destination anywhere in the world.

9.3.1 History of the Big 3 Global Airline Alliances

Prior to deregulation, Pan American World Airways and TWA were the only US carriers to operate international routes. TWA had some domestic routes for passenger feed, but Pan Am had none. Pan Am was thus dependent on US domestic airlines to provide traffic from the US interior to its gateway cities in New York, Miami, and San Francisco. But, US domestic carriers seeking to offer international destinations often entered into marketing agreements with foreign flag airlines rather than with Pan Am or TWA; this practice, of course, weakened both US flag carriers. These various marketing agreements were the forerunners of today's global airline alliances.

Domestic alliances, another precursor of today's international alliance structure, date to the 1960s when Local Service Carriers petitioned the CAB to withdraw from some small communities. The CAB responded by allowing commuter airlines, the predecessors to today's regional airlines, to provide substitute service. Allegheny Airlines, later part of US Airways, obtained CAB approval for Henson Airlines to operate to several Allegheny cities. This pattern was later adopted by other carriers and the trend accelerated after deregulation with industry vertical integration.

The beginning of modern global alliances, however, dates to the 1992 Open Skies agreement between the US and Netherlands and KLM's equity stake in Northwest Airlines. Northwest and KLM were granted antitrust immunity permitting them to coordinate schedules and prices and to code share on flights through their "Wings" alliance.

The Northwest/KLM alliance demonstrated the benefits of international airline alliances with its early success. The alliance proved extraordinarily successful in capturing traffic across the Atlantic between Northwest's hub in Detroit and KLM's Amsterdam hub. Traffic on the route grew 55% annually over the first 5 years of the partnership increasing nearly 10-fold from fewer than 63,000 passengers per year in 1992 to more than 572,000 by 1997. This dramatic increase shows the power of the dual-hub system established with the alliance. More than 60% of the traffic on the Detroit–Amsterdam flights did not originate in either Detroit or Amsterdam, but rather beyond each of those hubs in the spoke cities. Figure 9.3 show a hypothetical itinerary from Indianapolis, Indiana to Frankfurt, Germany. By connecting these two hubs and the many spoke cities each airline served, some 16,240 city-pairs were united under each airline's code.

A passenger could travel from Indianapolis to Detroit on a Northwest flight, from Detroit to Amsterdam on either a Northwest or KLM flight, and then make a connection in Amsterdam for Frankfurt on a KLM flight. Through the codeshare agreement, if the passenger booked this itinerary with Northwest, all flights would show as Northwest flights. The opposite, of course, would be true if the booking were with KLM. Coordinated flight schedules provided convenient connections at both hubs.

Other similar partnerships soon followed. In 1993, British Airways took a $300 million stake in US Airways from which BA sought valuable US domestic feed. This arrangement failed to meet BA's expectations and, in 1997, it wrote off the entire investment in US Airways. BA subsequently formed an alliance with American Airlines which was the foundation for today's oneworld alliance (Ito & Lee, 2005).

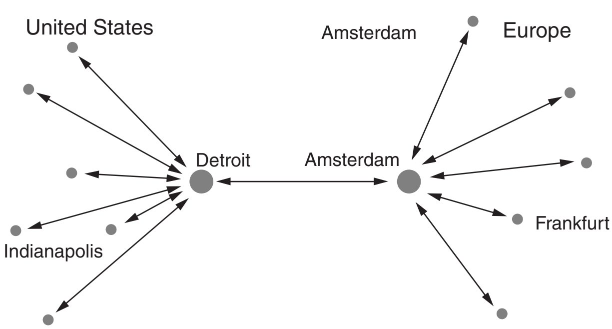

Figure 9.3 Northwest/KLM Alliance.

By 2000, three international alliances emerged—oneworld, Star, and Skyteam—but a series of mergers and fluid marketing agreements throughout the decade frequently shifted the members. In 2002, the US Department of Justice disapproved a merger between United and US Airways citing the potential harm from a reduction in domestic competition. The two airlines reacted by forming a domestic alliance which brought US Airways into the Star Alliance of which United was a founding member. In response to the United/US Airways domestic alliance, Delta, Continental, and Northwest formed another domestic alliance which the DOT and DOJ approved with some restrictions.

Air France merged with KLM in 2004 with Air France as the dominant partner. KLM, of course, was an alliance partner with Northwest, but Air France was a SkyTeam member. So, in September 2004, Continental Airlines, KLM Royal Dutch Airlines, and Northwest Airlines all joined SkyTeam. Then in 2008, Northwest merged with Delta becoming the world's largest airline. Continental left the Sky Team alliance and joined Star. In contrast to the earlier mergers, Continental's merger with United in 2010 did not disrupt the existing alliance memberships, but the American–US Airways merger in late 2013 resulted in US Airways leaving the Star Alliance for oneworld. Meanwhile, American Airlines and British Airways were granted code-sharing rights on many routes, but initially not including the trans-Atlantic routes between the US and the UK. The US/EU Open Skies agreement opened the way for full antitrust immunity for AA and BA across the Atlantic.

The frequent shifting of members over the last 15 years has resulted in three competitive global alliances of comparable size as shown in Table 9.2

Table 9.2 Global Airline Alliances

Alliances	*Star*	*SkyTeam*	*Oneworld*
Members	Lufthansa, United, Air China, Avianca, Egypt Air and 22 others	Air France/KLM, Delta, China Eastern, China Southern, Aerolineas Argentina, Kenya Airways and 14 others	British Airways, American Airlines, Japan Airlines, LATAM Airlines, and 11 others
Market Share	24%	20.8%	19%
Passengers per year	653.8 million	588 million	512.3 million
Countries	193	177	155
Destinations	1,321	1,052	1,010
Fleet Size	4,561	4,634	3,428
Employees	410,274	481,691	389,788
Revenue (billions USD)	196	156	143
Daily Departures	18,521	16,323	14,296

Source: Airline Business, Wikipedia

Note that China Airlines, the largest Taiwanese airline, is easily confused with Air China, the Beijing-headquartered airline and one of China's big 3 network carriers.

Notice that each alliance has, at least, one airline member from the United States, Europe, South America, and Asia. Star and SkyTeam each also have a member from Africa. The three global alliances carry nearly 60% of the world's passengers, but many airlines are not members of the alliances. The growing number of low-cost carriers are not members mostly because their Spartan product is not compatible with the broader offering of the alliance members.

9.3.2 Marketing and Revenue Benefits

Global alliances offer members many benefits that include both revenue enhancement and cost reduction. First, let's look at the potential revenue benefits. An international or global alliance allows each member carrier to expand the destinations offered well beyond what it could do independently due to financial or Air Service Agreement constraints. A member of any of the big 3 alliances can offer the world to its passengers through its alliance partners promising a consistent level of service and convenience. If the alliance is successful in generating additional traffic, frequency can be increased which, in turn, increases the product attractiveness.

Through the various member sales and marketing organizations, distribution is greatly expanded over a large geographical area including all major business markets. Joint advertising and sales efforts similarly are expanded over the globe. Frequent flyer and other passenger loyalty programs become more attractive as passengers earn rewards, or rebates depending on how these are viewed, on all member airlines.

Alliances strengthen the hubs of the largest members increasing market power and pricing flexibility. These airlines typically dominate their respective hubs so that partners may be able to share gates, customer service space, and even slots providing entry to airports otherwise not accessible.

Most of these marketing benefits should be familiar as they are essentially the same as those that arise from large, single-airline hub-and-spoke systems. Global alliances simply extend these benefits to a worldwide scale.

9.3.3 Operating Benefits

Alliances also provide potentially significant operating benefits. In the absence of an Open Skies agreement, an alliance allows members to access markets that would otherwise be unavailable. Even with Open Skies, alliances allow the marketing of routes that might not be allowed under cabotage restrictions.

By combining facilities, expertise, and purchasing power, alliances can also reduce operating costs. Joint use of airport facilities reduces total space requirements and facilitates better staff utilization. London Heathrow's new terminal two, for example, provides common check-in and ground handling for 23 members of the Star Alliance. Maintenance of modern generation aircraft requires large capital investments. Participating carriers can specialize in specific aircraft types providing maintenance to all members. Likewise, pooling of replacement parts can reduce required inventory levels. Last, alliance members can engage in joint purchasing of aircraft and parts which increases negotiating power and potentially reduces prices.

9.3.4 Antitrust Immunity

To reap many of the benefits of global alliances, immunity from antitrust laws is needed. The United States, the European Union, and many other countries have laws that prevent firms from coordinating pricing and other business practices that might reduce competition. The US Congress passed a series of laws beginning with the Sherman Antitrust Act of 1890 that are collectively termed antitrust legislation. Without a grant of antitrust immunity, independent airlines are not allowed to engage in practices such as fixing prices, schedule coordination or jointly determining capacity. However, nothing prevents one carrier from contracting services from another as network carriers do with their regional partners.

Alliances have the potential to reduce competition as previously competing airlines cooperate as alliance members. In granting antitrust immunity, the US, EU, and other governments must weigh the potential consumer benefits against a loss of some competition. As part of its Open Skies policy, the US has granted antitrust immunity to many partners in the big 3 alliances. The EU has similarly granted immunity from their competition laws. With antitrust immunity, airlines may coordinate flight schedules, codeshare on routes, fix prices, pool revenues and costs, and set capacity at the level their analysis determines will be most profitable. These are all essential elements of a successful partnership.

9.3.5 Establishing an Alliance

Forming and maintaining an alliance is a complex management challenge. An alliance begins with a vision that capitalizes on each partner's strengths and develops common goals that allow for all partners to benefit. The founding members of the big 3 jointly developed their respective alliance visions and objectives.

As the alliance expands, a top-level organization helps foster a common culture that values all partners. A fact-based decision process is required to build an integrated, seamless travel network. Teams representing the members must be established to set goals and monthly performance measures, communicate effectively, and establish arbitration procedures to resolve disputes among members.

A dedicated staff sets prices and coordinates flights. Revenues, costs, and profits must be allocated among the members. Successful alliances require extensive information sharing and compatible information technology systems. Integrating hardware and software is a long, complex, and expensive endeavor.

As the big 3 alliances have expanded adding new members, the process for joining an alliance has become lengthy and expensive. New members must meet the alliance criteria that often require extensive modifications of existing business practices. Computer reservations systems, ticketing, and baggage processing must be compatible with those of other alliance members. Further agreements are needed on joint fares, joint sales and e-commerce ventures, reciprocal use of airport facilities, and codesharing. Associate or affiliate memberships offered to some smaller carriers require less accommodation (Dunn, Gubish, & Waldron, 2015).

Airline alliances and partnerships take many forms, essentially along a continuum. The most basic partnership involves interline agreements and prorated pricing where each airline agrees to accept the other tickets and transfer baggage. Although interlining was once commonplace, many carriers have dropped interline agreements with other carriers as a cost saving method. Of course, many LCCs such as Southwest, have never interlined. A codeshare agreement takes interlining a step further. Each partner places its airline code on some of the partner's flights marketing and selling these flights as their own. At the other end of the continuum, the joint venture is a step just short of merger in which two or more airlines closely coordinate their operations and frequently share revenues.

As Figure 9.4 shows, the first stage of cooperation is primarily aimed at increasing revenue as the airlines offer more destinations through the partnership. Establishing reciprocal frequent flyer programs, joint sales and shared airport lounges are all intended to attract more passengers. These marketing or commercial alliances do not require substantial changes in either airline's business practices and are relatively easy to dissolve. Commercial alliances are common even between airlines in different global alliances.

At the next level of cooperation, airlines also seek cost reductions as they combine operations at common destination airports. Joint maintenance and purchasing offer potential savings. As the degree of cooperation increases through scheduling and capacity agreements, carriers give up some control and must modify their schedules and operating practices for the good of the alliance. As cooperation deepens, so does the cost of exit; thus, it was common for early alliances to focus on revenue enhancement rather than cost reductions.

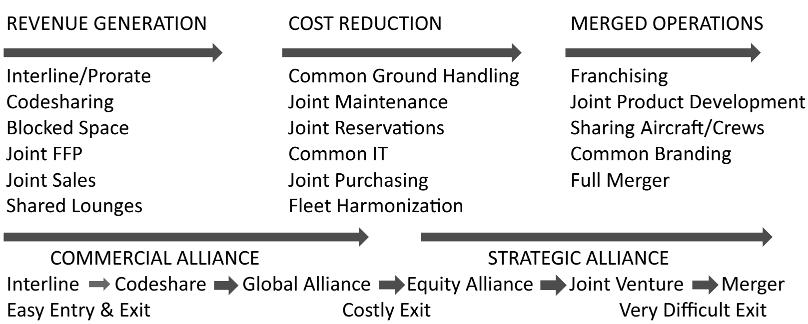

Figure 9.4 Continuum of Alliance Cooperation.

Adapted from Doganis, 2006.

Moving closer to merged operations, such as joint product development, tie the partners together and bring them close to operating as a single company. While the benefits may be significant, dissolution of the agreement is like ending a marriage: expensive and probably bitter. Although numerous joint ventures between some alliance partners have been established, the global alliances have not progressed to this level of cooperation and probably never will.

9.3.6 Passenger Benefits

Alliances can potentially either benefit or harm passengers. If international travel convenience is improved at lower fares, then the consumer benefits from alliance formation and expansion. Alliances can also be pro-competitive. If weaker competitors form an alliance, they are better able to compete with a more dominant airline, so competition is increased.

On the other hand, alliances may limit competition resulting in higher prices. If an alliance reduces competition on routes by combining carriers within the alliance that previously were in competition, prices will probably rise and service may suffer as well. This may benefit the alliance but passengers would suffer. Because US and EU regulators feared anticompetitive effects, American Airlines and British Airways were long refused antitrust immunity for the Atlantic routes in the oneworld alliance. Regulators believed reduced competition would lead to less service and higher fares.

Most academic studies show consumers benefit from alliances with improvements in service including more flight frequency, shorter total trip time, easier booking and ticketing, more convenient service, and lower fares. Brueckner (2003) found that code sharing on international itineraries reduced fares by 8% to 17% while antitrust immunity reduced fares by 13% to 21%.

9.3.7 Alliance Instability

The potential benefits of a global alliance notwithstanding, early alliances proved unstable. Some collapsed entirely and membership changes in the current global alliances are still common. There are many reasons for these failures. Of course, examining the reasons for failure also provides insight into the elements necessary for success.

- Misaligned expectations: Partners sometimes don't have similar expectations over many aspects of operating the alliance. Expectations, objectives, and governance procedures were not fully explored prior to joining the alliance.
- Governance problems: No clear procedures are established for decision-making and resolving disputes. Governing by committee may leave some or all partners dissatisfied.
- Flight schedule consolidation requires compromise—the optimal schedule for the alliance will not be optimal for one or more partners.

- Transfer pricing and revenue sharing: Disputes often arise over the allocation of revenues and expenses. These are difficult to solve analytically and require partners to compromise with a focus on the greater objective for the alliance over each airline's individual interest.
- Unwillingness to share information: For the alliance to operate seamlessly from the customers' view, airlines must share operating and customer information. Members may be unwilling to share information which could provide an advantage to other carriers or weaken an existing competitive advantage.

As Michael Porter (1990) noted, alliances are transitional devices that arise in industries undergoing structural change and increasing competition, certainly an apt description of the airline industry with spreading liberalization. Alliances are not just an airline industry phenomenon but are common in many industries. Consider, for example, the many partnerships and cross-equity holdings in the automobile industry. Although the big 3 alliances have matured and gained stability with only a handful of new members being added in recent years, members continue to shift and realign, especially in response to airline mergers and the rapid growth of the Gulf carriers. In 2013, Qantas joined Emirates in a codeshare agreement, a blow to its long-standing partnership with British Airways and the oneworld alliance. At the same time, Qatar joined oneworld ("Qantas and Emirates," 2012). When an alliance leaves a service gap in some world markets, carriers will occasionally enter into codeshares across alliances. The American and Korean Airlines codeshare between Dallas and Seoul is a recent example. American is a founding member of the oneworld alliance, but Korean is a Skyteam member. The big 3 alliances have matured leaving each with only a few gaps in world coverage.

9.3.8 Equity Alliance

There's a long history of large airlines purchasing an equity stake in other airlines to solidify commercial cooperation. Delta Air Lines owns a piece of Latin American carriers Gol and Aeromexico plus its stake and a joint venture with Virgin Atlantic. In 2015, Delta purchased a 3.5% stake in fellow SkyTeam member China Eastern for $450 million. The Lufthansa Group includes Lufthansa, SWISS, and Austrian Airlines which are wholly-owned plus equity stakes in Brussels Airlines and SunExpress (Lufthansa Group, n.d.).

Etihad Airways, however, appears to be taking a different approach to building what may become the fourth global alliance. As of 2016, Etihad had purchased part of seven airlines scattered across Europe, Asia, and Australia (see Figure 9.5), the most ambitious of which was a 49% purchase of long-struggling Alitalia with whom it has a substantial code-sharing agreement. With this equity stake in airlines, most of whom were in some degree of financial distress, Etihad gains substantial influence if not full control that it exercises to expand destinations and gain feed traffic for long-haul flights across its hub in Abu Dhabi.

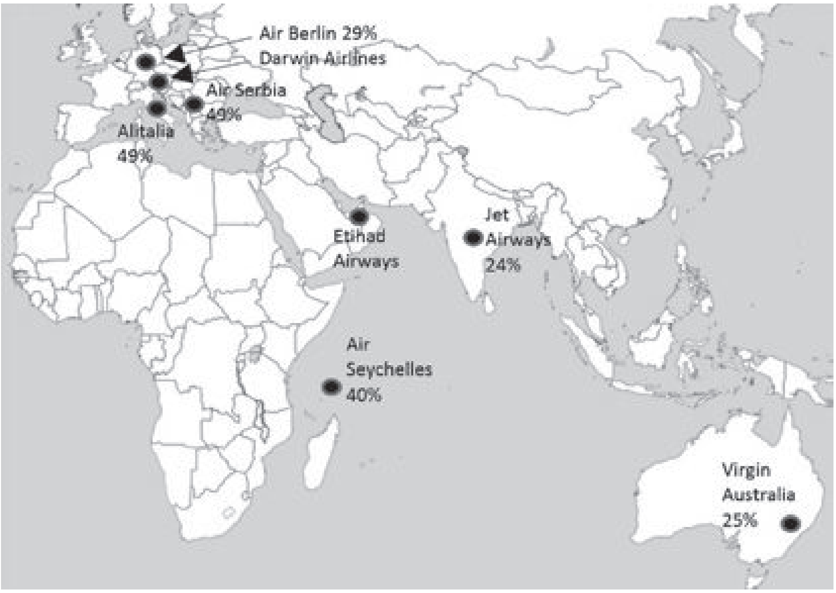

Figure 9.5 Etihad Airways Equity Alliance.

Source: Adapted from The Cranky Flier

At this point, the partnerships pale in comparison to the big 3 alliances, but Etihad has seemingly unlimited funds from the United Arab Emirates, so it's capable of continued rapid expansion. For long-term success, it will need partners in the Americas.

The history of airline equity investments in other carriers is one of limited success; indeed, airline analyst Brett Snyder labels them disasters ("Etihad is building a fourth alliance," 2013). Yet, this alternative approach to building a global network bears watching.

9.4 Consolidation—Mergers and Acquisitions

Airline analysts have long lamented that the world airline industry is too fragmented leading to chronic overcapacity, low fares, and marginal profitability. Citizenship requirements often prevent cross-border mergers and acquisitions, but, where allowed, consolidation through merger and acquisition seeks the same benefits as global alliances: seamless travel, revenue enhancement, cost synergies, and elimination of competition. Indeed, the new century has accelerated industry consolidation. European deregulation permitted citizens of any EU state to own EU-based airlines. This liberalization led to the merger of Air France and KLM in 2004. Although the airlines are under a single management, both brands have been maintained. More recently, British Airways, Iberia, and Aer Lingus along with several smaller carriers have been combined under the holding company International Airlines Group. Similarly, Lufthansa also owns several smaller European carriers. In contrast to practice with the US and Latin American mergers, the European airline holding companies have maintained the independent branding of the airlines. A passenger flying on Swiss International Air Lines would likely not recognize that Swiss is part of the Lufthansa Group. Aaron Karp (2015) attributes this difference to Europe's long airline history and established brand loyalties.

In the US, consolidation of the largest airlines concluded with the merger of American Airlines and US Airways in late 2013 forming the world's largest carrier. This followed the mergers of Delta and Northwest in 2008, United and Continental in 2010, and Southwest and AirTran in 2011 leaving the US with four large airlines controlling about 80% of US domestic traffic. In contrast to European consolidation where merged airlines continue to operate under separate brands, mergers in the US result in a single surviving brand. When US Airways Flight 434 from San Francisco landed in Philadelphia on October 17, 2015, the US Airways website was turned off; the airport kiosks and signs changed to American Airlines.

In Latin America, the Chilean flag carrier LAN completed its takeover of Brazil's TAM in 2012 to form LATAM, the region's largest airline. Earlier, Colombia's Avianca merged with El Salvador's Taca Airlines. The Avianca Group now subsidiaries all under the Avianca nameplate. The integrated cargo carriers are much less fragmented than the passenger airlines with UPS, FedEx, and DHL controlling much of the market. A UPS agreement to purchase the Dutch carrier TNT Express would have placed the package delivery industry firmly within the grip of the big 3, but in 2013 the European Commission refused to permit the $7 billion deal on antitrust grounds. UPS subsequently gave up its efforts to restructure the acquisition, but FedEx, seizing the opportunity, reached an agreement to acquire TNT for $4.8 billion all cash in 2015. European regulatory approval was pending at the time of this writing.

9.5 Summary

The airline industry remains under more economic restrictions than most other industries, especially with limits of foreign ownership that almost universally prohibit a foreign citizen from owning or exercising control of a domestic carrier, thus preventing the formation of truly multinational airlines. Faced with the likely failure of General Motors and Chrysler during the Great Recession of 2008, the US federal government bailed out both. The Italian automaker Fiat was enlisted to take control of Chrysler Motors Corporation. The United Autoworkers initially held a 41% stake in Chrysler which Fiat purchased in 2014 making Chrysler a wholly-owned subsidiary. A similar arrangement, however, is not possible in the airline industry. US airline consolidation promises to put the US industry in a position of sustained profitability and stability comparable to other large industries, but consistent profitability eludes most of the world's airlines. The era of multinational airlines has yet to arrive, but could provide for a more predictable, less turbulent industry than has been achieved through global alliances.

Note

1 Airlines in which the government owns or controls more than 50% of the stock.

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Review Questions

1 What were the positions of the US and the remaining nations at the Chicago Convention on regulating international air commerce? What was the outcome and why did most other nations not agree with the US position?
2 What aspects of the air transportation service between two countries are typically addressed in a bilateral agreement (such as Bermuda I)?
3 What does the US mean by "Open Skies"? Compare and contrast recent "Open Skies" agreements with earlier bilateral agreements.
4 In negotiations with the US to obtain a single air transportation agreement, the EU has proposed eliminating or significantly reducing the restrictions on citizenship and cabotage. What are these restrictions? Who might win and lose from such an agreement? What is the position of the US Airline Pilots Association? Why?
5 Foreign airlines have traditionally been state-owned. Why have states felt that public ownership of national airlines was beneficial?
6 What are the typical characteristics of state-owned airlines that render them uncompetitive with privately (or public stock) owned airlines?
7 What are the means by which a state government can privatize a state-owned airline?
8 Provide an example of a domestic alliance and an international alliance.
9 What benefits do airlines attempt to obtain through an alliance? Why doesn't an airline simply add the new destinations it wishes to serve instead of entering an alliance?
10 Why do alliances seek antitrust immunity? Under what conditions will the US grant such immunity?
11 Many international alliances have come and gone with members frequently changing partners. Why have alliances proved unstable?
12 Under some circumstances, alliances benefit the customer (pro-competitive), but in others, the customer may suffer. Explain.
13 Curiously, the three largest airline markets, the US, EU, and China, each has three dominant network carriers. Who are these network carriers in each market?
14 Name the three global airline alliances. Are the three largest network carriers in the US, EU, and China evenly divided among the alliances?

Chapter 10

Looking Ahead

The global airline industry is dynamic, constantly adapting to changes in passenger demand, technology, government regulation, and new entrant competition. Although predicting the future of the industry is perilous, this concluding chapter looks ahead to challenges facing the industry. Some are a continuation of those that airline managers have confronted since deregulation and liberalization began in 1978 with U.S. domestic deregulation. Others, such as managing a portfolio of separate airlines under a holding company or within an equity alliance, are relatively new. The chapter begins by examining the perennial challenge of cyclical demand and profits and ends with a look at emerging airline strategies.

10.1 Cyclical Profits

Irregular cycles of profits followed by steep losses have historically plagued the world airline industry, a trend exacerbated by deregulation and liberalization. Demand for the airline product is derived from the travel needs of business and leisure passengers that are correlated with the global business cycle. When economic growth slows or becomes negative as in a recession, firms reduce employee travel as part of cost reduction aimed at weathering the downturn. Airlines then suffer a loss of some of their highest-paying passengers. Leisure passengers, who often buy discounted tickets, find themselves with tighter budgets and less disposable income. This leads to cutbacks on family vacations and airlines scrambling to fill even the discounted seats. Cargo shipments tend to follow the same pattern. Figure 10.1 illustrates the correlation between world airline profits and global gross domestic product (GDP) growth. Periods of slower, but still positive, world GDP growth are accompanied by often large airline losses.

Reasons for these large profit variations are numerous and explored in previous chapters. Although recent consolidation seems to have tamed some of the profit fluctuation, especially in the United States, other factors suggest that instability is likely to be a continuing long-term problem.

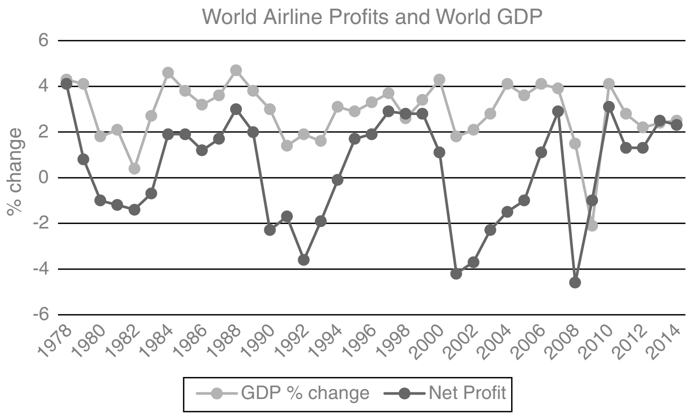

Figure 10.1 World Airline Profits and Global Gross Domestic Product.

Profits are measured as a percentage of total revenue. Global GDP is year over year percentage change based on 2009 USD. Correlation coefficient = 0.55.

Data sources: A4A and the World Bank.

10.1.1 Fixed Cost

During a recession, airlines drop some routes and curtail flight frequency on others, but many costs are fixed so that expenses cannot be reduced commensurately with lower capacity. Some aircraft may be returned to lessors if the end of the lease coincides with the downturn; indeed, this is a reason for maintaining a portion of the fleet on operating leases with staggered return dates. But the majority of aircraft ownership costs remain even when utilization is reduced. Similarly, employees whose employment is tied to the airline's capacity may be furloughed after capacity cuts, but the highest seniority and most expensive employees remain. Organized labor vigorously opposes management efforts to reduce compensation. Other expenses such as headquarters, maintenance facilities, and airport gates are also largely fixed. Thus, costs will not fall as rapidly or as deeply as revenues leading to lower profits or losses.

10.1.2 Fuel Expenses

Fuel and labor top the list of airline expenses, with fuel often holding the top spot. While labor expenses are mostly fixed for the short-term, the price of jet fuel varies substantially and defies reliable prediction. Many airlines use financial instruments to hedge against changes in petroleum prices, but hedging is essentially a gamble that has recently gone out of favor, especially in the United States, after fuel price reductions left airlines who held hedges paying higher than the market rate for fuel. As fuel prices again climb in the future, however, airlines may seek the protection hedging offers because ticket price increases in response to higher fuel prices are usually insufficient, or too late, to offset the increase in fuel cost.

10.1.3 Cost Control

During periods of high profits, labor groups push for higher wages and benefits that they view as payback for concessions during leaner times. The hefty raises granted to U.S. airline employees during the record profits of the mid-2010s are a recent and, for some, troubling sign of potential future cost problems. Competition in new and upgraded products also tends to intensify in good times further increasing costs. At the same time, airlines are prone to expand their orders for new aircraft that will not be delivered for several years, possibly coinciding with an economic downturn. Even airlines with unhealthy balance sheets are able to place large new aircraft orders through various financing sources including direct and bank debt and sale-lease options.

10.1.4 Airline Failure and Restructuring

Airline profitability has historically lagged other industries. Economic theory suggests that some airlines should go out of business until the profitability of the remaining carriers meets the cost of capital. Yet airline failure and liquidation are rare in the industry. Bankruptcy rules in the United States, Canada, and elsewhere are often blamed for allowing failed airlines to restructure and return to flying. Bankruptcy judges find themselves under pressure to preserve well-paying jobs. Many governments are also willing to provide subsidies to keep the national carrier operating. Even when an airline does liquidate, a reincarnation often appears. Swissair's resurrection as Swiss International Air Lines and Brussels Airlines' emergence from the failure of Sabena, both in 2002, are examples.

10.2 Environmental Regulation and Cost

The International Civil Aviation Organization (ICAO) estimates that airlines contribute only 2% to world greenhouse emissions but have a 3.5% impact on global warming due to other factors including condensation trails. Without mitigation, the contribution will rise to 15% by 2050 (ICAO, n.d.). The industry has been under pressure to reduce emissions for several years, especially from the European Union which included airlines in the EU Emissions Trading System (EU ETS) in 2008. The System covered both European and foreign airlines, many of which objected strenuously. Several countries including the United States, India, and China, forbade their airlines' participation in this "cap and trade" system. In November 2012, U.S. President Obama signed legislation directing the U.S. Secretary of Transportation to prohibit U.S. airline participation in any plan unilaterally developed by the European Union ("European Union Emissions," 2012). As a result, flights to and from non-European countries were exempted in

2012 with a "Stop the Clock" plan, allowing for negotiations on a global emissions standard through 2016 (European Commission, n.d.; Buyck, 2014). Faced with the probability of having different emissions standards across countries or world regions, the airlines turned to the International Civil Aviation Organization (ICAO) to develop a world standard acceptable to airlines and government environmental regulatory agencies. Given the large number of airlines, experts, and interest groups involved, it was somewhat surprising that a tentative agreement was reached in early 2016 (ICAO, 2016).

Under the proposed agreement, which is subject to ratification by the ICAO 36-State Governing Council, emissions will be cut in half by 2050 compared to the 2005 baseline. The standard applies to aircraft manufacturers who will have to show reduced emissions on new aircraft with the reductions varying by aircraft size. While the proposal represents real progress, it may be less ambitious than it seems. As several observers have noted (see, for example, Cranky Flier, 2016), with Airbus and Boeing just beginning to deliver many new fuel-efficient models including Airbus's 320s and 350s and Boeing's 737Max and 787 Dreamliner, the target should be easy to meet. Indeed, Boeing says that it fully supports the standard.

Even with the new standard, however, the industry is likely to be pressured for further emissions reductions. Biofuels reduce greenhouse gas emissions and have been successfully tested by many airlines. However, biofuels are much more expensive than petroleum-based jet fuel. Production cost will decrease with scale, but biofuels are likely to remain economically uncompetitive with petroleum for the foreseeable future. If airlines are forced to blend biofuels in order to reduce emissions, operating costs will increase.

10.3 Turmoil in Distribution

Airlines have historically struggled for control of distribution and ticket sales. The earliest passenger carriers adopted railroad practices by selling tickets at their departure airports (still sometimes called "ticket counters"), but independent travel agents offered widespread distribution without airline-owned infrastructure and gradually gained control of most sales and ticketing. Early computer reservations systems restored distribution dominance to a few of their airline owners, but these were later spun off ultimately evolving into today's three major global distribution systems (GDS). Travelers, without direct access to the GDSs, needed either a traditional travel agent or some other intermediary to book travel. Airlines paid travel agency commissions as well as high transaction fees to the GDSs to distribute their product. With the development and advancement of the Internet in the 1990s, airlines were quick to offer direct sales via their own websites, saving GDS fees and slowly putting many travel agencies out of business. As airline internet sites developed and menu pricing began to take hold, airlines started offering many optional auxiliary products via their websites. Instead of offering just two or three products—economy, business, and perhaps first class—airlines realized that products can be tailored to appeal to a large range of passenger preferences.

However, the older GDS computer languages, in use decades before the Internet, are unable to offer the full range of sales now available from the airlines' websites. Those travel agents still in business found themselves having to book many auxiliary services outside of the GDS, directly with the airline. Today, airlines encourage both travel agents and passengers to bypass GDSs entirely booking directly online with the airline.

The IATA set out to improve the GDS system in 2012 by introducing a new distribution model called the New Distribution Capability (NDC). The NDC uses newer Internet protocols to display information and gives the travel agent the availability to find the full range of airline products on the NDC in a similar fashion as the airlines' websites. The NDC also allows agents to offer tailored products based on passenger profiles and thus improve their service to the traveler. But inherently conflicting interests within the airline distribution system are unresolved.

10.4 Complex Airline Structures

Airline corporate structures are becoming more complex with holding companies attempting to manage several airlines with differing business models and cultures often scattered across countries. Despite rapid liberalization in many world regions, ubiquitous restrictions on foreign ownership and control remain. Unlike other global industries, airlines are unable to become truly multinational corporations. The result is a fragmented industry. Expansion-focused airlines attempt to overcome the citizenship restrictions by setting up subsidiaries outside their home countries, usually in partnership with a home-country airline or investment firm. Fast-growing Norwegian Airlines has faced opposition to its expansion based on citizenship arguments, although much of this opposition by airlines and labor groups is disingenuous with the real objective of reducing low-cost competition. In response, Norwegian has developed a complex portfolio of fully and partially-owned subsidiaries in Norway, Sweden, Denmark, Finland, Ireland, the United Kingdom, and Singapore. Norwegian explains its rationale forthrightly on its website: "In 2014, the group reorganised (sic) its operations in several new entities to ensure international growth and necessary traffic rights" (Norwegian Airlines, n.d., p. 1). The AirAsia Group is another example of an airline holding company following a similar strategy for expansion.

Europe's Lufthansa Group and China's HNA Group are among the most complex of many world examples. The Lufthansa Group includes 540 subsidiaries in five business segments: passenger airline, cargo, maintenance/repair/overhaul (MRO), catering, and financial services. Passenger transport is the largest business segment comprising Lufthansa Airlines, Germanwings, Eurowings, SWISS, Austrian Airlines, Brussels Airlines and SunExpress (Lufthansa Group, n.d.). The HNA Group, a relatively young Chinese conglomerate with divisions in aviation, capital, tourism, and logistics, rivals the Lufthansa Group in complexity. Its website lists an astonishing 14 airlines that it fully or partially owns lead by flagship Hainan Airlines (HNA, n.d.).

Some holding companies extend the geographical coverage of their airlines through coordinated flights in much the same way as global alliances but with more management control. The Etihad equity is an example of a collection of airlines designed to form a large route network by coordinating the products and schedules of the member airlines. Other airline groups seek to broaden their product line to appeal to more passenger segments with different airlines within the group targeting specific passenger segments. In the Qantas group, JetStar, with its lower cost structure, serves price sensitive markets while Qantas targets premium travel. The two airlines have little overlap and are not intended to feed one another. Many groups combine both strategies as with International Airline Group (IAG) which includes both full-service international airlines and low-cost-carriers.

There's no precise demarcation between airline groups and equity alliances, but the former usually have greater ownership shares and exercise more management control of the airlines. Ownership shares of the various members of an equity alliances vary greatly as in the Etihad stable of airlines. The recent formation of an alliance among the US's JetBlue, Brazil's Azul, Portugal's TAP, and China's HNA Group, is even more complex and convoluted. Atlantic Gateway, partly backed by JetBlue and David Neeleman, CEO of Brazil's Azul, acquired 61% stake in TAP from the Portuguese government in 2015. Azul will facilitate the expansion and upgrade of the TAP fleet by subleasing 17 aircraft to TAP including A330, EMB E190, and ATR 72. Contemporaneously, HNA Group purchased a 24% stake in Azul for $450 million. This equity alliance could soon span the globe (Hoffmann, 2016).

10.5 Governance

Although not unique to the airline industry, large holding companies are difficult to manage. The airlines within a holding company may work at cross purposes rather than cooperate as each airline's management tends to push for its own growth and profitability even at the expense of the best interests of the group. Several governance structures have evolved to resolve the competing interests of the airlines and maximize the group's profits. With the Air France/KLM merger, the CEO of Air France also became CEO of the combined carriers leading the Dutch airline employees to see favoritism to Air France even though KLM was the more efficient and profitable of the two airlines. Combative management-labor relations at Air France continue to hinder the group's growth and profitability. With the later formation of IAG, Willie Walsh, the previous British Airways CEO, became Group CEO. Perhaps from having studied the problems at Air France/KLM, he appointed a new CEO for British Airways. Nonetheless, he was similarly accused of favoritism as he restructured a loss-making Iberia into a profitable airline. He has since successfully managed the Group's airlines which include both network and low-cost carriers with their inherently different management philosophies. At Lufthansa Group, the many company CEOs report to different members of the executive board. Although the Lufthansa Airlines' CEO is a member of the board, the other Group airline CEOs report to other executive board members ("Holding structures," 2014).

Outside of Europe, the management of Qantas Group, with its primary airline subsidiaries Qantas and Jetstar, has another unique structure. Qantas Airlines is a single airline but has two CEOs, one for domestic and another for the international division. Jetstar is similarly structured with different CEOs for the short and long-haul markets. The overall Group is managed by a *flying committee*. Early contentious relations among the CEOs have reportedly settled into a more comfortable cooperative management style ("Holding structures," 2014).

While the management of airline holding companies has proved challenging, management of equity alliances is more daunting. The dominant airline does not hold a controlling stake in the other alliance airlines, an ownership relation that may be further complicated by other cross-company equity holdings among the members. Indeed, it is government restrictions on foreign ownership and control of domestic airlines that drive equity alliances. But the very nature of the restricted ownership leads to management by committee. In most instances one carrier will lead, but conflicting interests of the individual airlines may make consensus building difficult. The proliferation of joint ventures between airlines that sometimes extend across other existing alliances or groups further complicates governance.

10.6 Evolving Airline Strategies

10.6.1 Business Model Evolution

As long-time industry observer, airline manager and scholar Michael Levine notes (2010), the world's airlines have survived many crises by relying on their governments for financial support and protection from competitors. Even in the United States, a bastion of free markets and forceful advocate of open skies, all of the legacy airlines have taken refuge in bankruptcy laws that allowed them to remain in business rather than liquidate. But governments are increasingly reluctant to invest their citizens' money in keeping failing airlines afloat. The European Union forbids member countries from subsidizing or bailing out their domestic airlines, a restriction that has led to several ceasing operation. As we've seen, airlines have responded to market pressures by reducing costs, tailoring products to specific passenger wants and needs, forming alliances and joint ventures with domestic and foreign partners, and focusing on profitability rather than market share and growth.

Two business models, albeit with many variants, now dominate the industry: LCCs and comprehensive network airlines. LCCs offer passengers a low price for the sacrifice of amenities and product features. LCCs' point-to-point routes are simple and the least costly to operate. At the other end of the spectrum, global network carriers offer service to most of the world's largest destinations through hub-and-spoke systems that extend beyond their network through various partnerships and alliances. Product offerings range from basic service with limited features designed to compete with growing LCCs to luxurious first-class suites. Network airlines are complex and expensive to operate. Perhaps because of their longer history and complex operations, network carriers also seem vulnerable to restrictive and high-cost labor agreements. But, as Levine observes, both models are subject to growth limitations.

To retain a cost structure that is profitable at low fares, LCCs must maintain simple operations. This means avoiding the complex hub-and-spoke operations, although connections at focus cities are viable options for many LCC travelers. But only larger city pairs generate sufficient demand to operate low-CASM mainline aircraft on a point-to-point route system. The LCC can enlarge the market with lower fares, but the number of viable markets is limited and eventually exhausted. As Levine states, "There just simply aren't very many markets in the world in which one can operate stand-alone, high frequency, point-to-point service" (Levine, 2010, p. 33).

Network carriers, on the other hand, can offer passengers service from anywhere to everywhere with one or more connections at their hub cities, yet, even with spreading liberalization, the network is often limited by restrictive air service agreements. The hub-and-spoke operation is inherently expensive and vulnerable to attack in many high demand city-pairs by LCCs. The network carrier then finds itself increasingly reliant on its long-haul service for profitability, but the long-haul routes must have feed traffic from many cities to generate sufficient demand for economical operations of larger long-range aircraft.

Airlines strategies to address these obstacles to growth have evolved over time. Interline agreements in which carriers accepted tickets and facilitated the transfer of passengers and baggage between airlines date to the earliest years of the industry and remained the dominant method for selling service to international destinations throughout the regulated era. However, with expansion allowed by liberalization, airlines that previously complemented each other's service became competitors. Interline agreements have not disappeared but are being replaced by more complex partnerships and joint ventures.

Beginning shortly before U.S. deregulation and rapidly expanding as part of the development of the hub-and-spoke route structure, the former trunk airlines contracted with commuter airlines to operate feeder routes between smaller cities and new hub cities. This strategy was successful for several decades but now seems to be unraveling as regional airlines have lost much of their cost advantage as many have transitioned from economical turboprop aircraft to high-CASM regional jets.

With the entry of low-cost competitors, network carriers fought to preserve market share by establishing LCC divisions within the airline. In the United States, these were universally unsuccessful as evidenced by the failure of Continental's Lite and Delta's Song subsidiaries. The management focus, philosophy and culture needed for an LCC is very difficult to maintain within the larger network carrier structure. Even then, if the LCC is deployed on point-to-point routes to compete with independent LCCs, it will undoubtedly cannibalize some of the passengers from its premium mainline network. On the other hand, if the LCC is designed to feed the existing hub-and-spoke system, it loses much of its lower cost structure because the subsidiary's operating and fixed costs are the same as for the mainline, as the failure of United Airlines' TED revealed.

Global alliances allowed network carriers to offer worldwide destinations overcoming both regulatory and financial obstacles. The surviving three global alliances have generally been a marketing and financial success but are mature with limited growth potential.

Airline conglomerates and equity alliances have much in common as each tries to maximize the cooperative benefits from the member airlines and reap whatever synergies may be available from size. As important, these vehicles ensure that members operate as partners thereby reducing competition.

Meanwhile, the LCC business model is resilient with the oldest of the LCCs in the United States and Europe earning the highest margins and return on invested capital. The limits to growth are apparent especially evident in Southwest's gradual evolution to a hybrid model and its venturing south of the border into Mexico, Central America and the Caribbean to capture new passengers. Ryanair, however, is true to the basic tenants of the LCC model and maintains it sees no limits to its expansion.

10.6.2 Emerging Models

A few intriguing business models are on the horizon. AirAsia is combining its short- and long-haul airlines into a global LCC with a hub at Kuala Lumpur, Malaysia where its short-haul units feed long-haul traffic to AirAsiaX. The risk is that, with increasing connections and complexity, the distinction between it and traditional network carriers will fade. Another often-discussed possibility is a strategic partnership between independent LCCs and network carriers. Speculation that easyJet and Ryanair might agree to feed one or more of the European network carriers is widespread, but many obstacles remain (Powley, 2016).

Airline distribution remains unsettled with airlines attempting to wrest control from entrenched GDSs which, in turn, are struggling to offer all of the products that airlines wish to sell. While some see NDC as an industry solution, others worry that future distribution could be captured by a Google, Amazon, Facebook or other social media company ("Virtual Airlines," 2014). A successful intruder might operate a *virtual airline*, literally without aircraft. It controls distribution, sales, and, critically, passenger information, but contracts for the actual air transportation at a specified level of service go to the lowest bidder. The largest freight forwarders control much of the air cargo business in exactly this way. An airline that markets another airline's flights as its own under a codesharing agreement has some of the elements of a virtual airline. Virgin Australia operates a few long-haul international flights, but most of its international service is actually provided by its codesharing partners ("Virtual Airlines," 2014). Considering how Uber and Lyft have entered the taxi industry without ever having operated a taxi, perhaps it is not too farfetched to imagine an "airline" taking the next logical step and contracting for all of the flight operations.

10.7 Still Fragmented

The path to sustained profitability, however, is likely through consolidation. U.S. airlines have been reduced through bankruptcy, liquidation, merger, and acquisition from 20 at the beginning of the century to just 11 independent airlines today. With the sale of Virgin America to Alaska pending in the spring of 2016, competition will be further reduced. U.S. consolidation may not be at an end with conjecture that JetBlue and Hawaiian would make a good match and that Spirit and Frontier are natural mates. Whatever the future outcome, U.S. consolidation has resulted in several years of record profits amid weak economic growth. The world airline industry remains fragmented with more airlines than needed to meet demand. Although the first truly multinational airline outside of the European Union will have to await the lifting of restrictions on foreign ownership and control, the world is ripe for further consolidation whether through outright merger or various forms of partnerships and alliances.

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Glossary

This glossary includes the definitions for all terms in the chapters that are printed in *italics* as well as other significant and/or commonly used terms in the airline industry whose definitions are important to a student's understanding.

Air Mail Act of 1930 (AKA the McNary-Watres Act) gave the Postmaster more power concerning awarding mail contracts. It also changed the method used to pay carriers for carrying mail, basing the payment on the size of aircraft and not the weight of mail carried. This change discouraged the carriage of junk mail and stabilized carriers' revenue. The Act also authorized the Postmaster to offer longer term contracts to the carriers.

Air Mail Act of 1934 imposed new rules on the awarding of contracts to private airmail carriers, and allowed carriers to re-bid on routes that were cancelled after the Spoils Conference. The Act returned the mail to private carriers after being temporarily carried by the Army Air Corps's AACMO.

Air Service Agreements (ASA) (AKA Bilateral Agreements) are official agreements between two countries to authorize and regulate air travel between the countries. ASAs are generally developed by the State Departments and designate specific airlines, destinations, aircraft size and frequency of flights.

Aircraft Utilization refers to the time an aircraft spends flying during a 24-hour day. Generally low cost carriers have high aircraft utilization—sometimes 12–14 hours a day. Network carriers might have slightly less utilization due to more complex schedules with more aircraft slack time built in to their schedules.

Airline Deregulation Act (1978) lifted the CAB's restrictions on fares and routes and began the phase-out of the CAB. Under CAB control, airline fares were high, load factors were low and airlines were rewarded for inefficient operations. The economic liberalization allowed airlines to fly routes and charge fares that the market would support. Existing airlines rushed to gain profitable routes and new airlines formed rapidly. Fierce competition drove down fares and passengers began flying in record numbers.

Airline Operations Control Center (AOCC) is the name given to the airline's operations command center. An AOCC will usually have dispatchers, schedulers, weather experts, air traffic control experts, pilots, and other essential personnel needed to make decisions concerning the airline's tactical control. The names of AOCCs vary across airlines; some might be called Network Operations Center (NOC) (like United's AOCC), or Network Operations Control Center (NOCC) (like Southwest's AOCC). The AOCC is probably located at the airline's headquarters campus.

Airport & Airway Trust Fund (AATF) was started in 1970 to help the government finance aviation projects. The AATF's source of funds is from taxes on passenger fares and cargo fees, as well as airline fuel purchases. This tax, which is charged as a percent of the fare, provides the majority of funding for the FAA's operation.

All Cargo Carriers are carriers that carry all cargo in freighter aircraft. They do not provide door-to-door services and are often under contract from large freight forwarders.

Ancillary Revenue is revenue earned by an airline from sources other than the sale of passenger seats. Ancillary revenue could include fees for checking luggage, printing a boarding pass, assigned seats or carry-on luggage. Additionally, ancillary revenue could come from a credit card company for their issue of frequent flier miles.

Antitrust Immunity gives an airline the ability to work closer with its alliance partners. To protect consumers, antitrust laws prohibit collaboration between competitors. With antitrust immunity, airlines may collaborate with their alliance partners to coordinate flight schedules, fix prices, and set capacities at profitable levels.

Army Air Corps Mail Operation (AACMO) was formed to carry mail after airmail contracts were cancelled following a Congressional Investigation of the Spoils Conference. The operation was a failure, as mostly untrained pilots were used to fly in bad weather conditions. There were 66 major accidents with 13 crew deaths during the short 78-day operation.

Available Seat Mile (ASM) (or ASK for kilometers) is the term used to describe the basic unit of airline production. It is defined as one seat flown one mile (or kilometer) regardless of whether the seat is occupied or not. An airline's annual total ASMs, also called its capacity, is generally a very large number, usually in the billions for a large airline.

Bank (AKA Wave) is a group of aircraft arriving at a hub airport or departing from a hub airport. A hub complex starts with a bank of aircraft arriving from spoke cities, and ends with a bank of aircraft departing for spoke cities.

Bermuda I was the first Air Service Agreement developed between the United States and the United Kingdom in 1946. It allowed restricted air service between the US and the nations then in the United Kingdom including some points in Latin America, the British Colonies, and Singapore.

Bermuda II was the first revision of the Bermuda I Air Service Agreement between the US and the United Kingdom in 1977. It placed more restrictions on the growing Heathrow Airport and remained in effect until replaced by Open Skies in 2007.

Big 3 alliances are the Star Alliance, SkyTeam and Oneworld.

Bilateral Agreements (See Air Service Agreements).

Block Hour is the term used to describe the time an airliner is in operation off the gate. Block time starts when the door closes and the aircraft begins pushback from the gate. It ends when the aircraft arrives at the destination and the door is reopened.

BOAC (British Overseas Airways Corporation) was a British-owned airline formed to operate wartime services during WWII. After the war, BOAC continued to operate air services for Britain destined outside Europe. BOAC merged with BEA (British European Airways) in 1974 under the brand British Airways.

Breakeven Load Factor (BLF) is the average percent of seats that must be sold for the airline to break even. Breakeven load factor can be determined by dividing the airline's cost per available seat mile by the yield (CASM ÷ yield).

Brick-and-Mortar Travel Agency is a traditional travel agency with an office that travelers can visit or call to make travel plans. Brick-and-mortar travel agencies typically are connected to one or more Global Distribution Systems that they use to make the reservations.

Cabin Crew is the term used when referring to the flight's flight attendants.

Cabotage occurs when a foreign airline carries passengers between two points in a foreign country. To protect their domestic airlines from foreign competition, most countries do not allow cabotage. As an example, Air France carrying passengers from Los Angeles to Honolulu would be considered cabotage.

Capacity (See Available Seat Miles).

Capacity Purchase (See Fee for Departure).

Capital Lease is an aircraft lease that is similar to a rent-to-own agreement. A capital lease is usually used for long-term aircraft purchases. At the end of the capital lease, the aircraft belongs to the airline.

Chicago Convention of 1944 brought together countries to draft international aviation protocols. The International Civil Aviation Organization was founded at the Chicago Convention. Attending countries agreed that they would use a system of bilateral Air Service Agreements to regulate international air commerce.

City-Pair is a routing between any two cities. A city-pair includes an origin (O) and destination (D) and may include connections between the O&D.

Civil Aeronautics Act (CAA) (1938) was signed to ensure a governmental focus on aviation safety. Before the CAA, the Department of Commerce oversaw aviation. Several crashes led President Roosevelt to sign the CAA, which formed an independent Civil Aeronautics Authority that would investigate accidents. The Act also gave the CAA power to regulate airline fares and routes. In 1940, the CAA was split into the Civil Aeronautics Administration and the Civil Aeronautics Board. The new CAA retained responsibility for air traffic control, airman and aircraft certification and safety, while the new

CAB was responsible for safety rulemaking, accident investigation and economic regulation of airlines.

Civil Aeronautics Board (CAB) was formed initially as the Civil Aeronautics Authority (See Civil Aeronautics Act). Changed to the CAB in 1940, it became responsible for safety rulemaking, accident investigation and economic regulation of airlines. As part of economic regulation, the CAB controlled three broad categories of airline operations: initial approval to operate, routes flown, and fares charged. The CAB earned a reputation inaction, taking sometimes years to approve new routes requested by airlines.

Codeshare is a form of airline alliance whereby airlines share identification codes within the reservations system. Code sharing allows passengers to easily book multiple leg flights that require two or more different airlines to travel from the origination to the destination. Using a code share, a ticket might be purchased from airline A, but travel might include flights on airline A and airline B.

Co-Hosting occurs when an airline owning a computer reservations system (host) gives host status to another airline. A co-hosting airline would enjoy the same status as the host and not be subjected to bias.

Combination Cargo Carriers are passenger airlines that also carry cargo. This includes most airlines that carry cargo in either the belly (cargo compartments) of the aircraft (with luggage) or some airlines that carry cargo on the same deck as passengers. Cargo accounts for only about 10% of revenue.

Complex is the term used to describe the sequence of events at a hub airport that includes aircraft arrivals, connections, and departures. A typical complex would include several aircraft arriving at the hub from spoke cities, passenger and luggage transfer, and aircraft departing for spoke cities. Usually, hub airport will conduct several (sometimes 8–10) complexes throughout the day.

Comprehensive Network Carrier (CNC) is a term that describes an airline offering a wide range of products from premium first class to budget coach class. CNCs also usually offer connections to alliance airlines further expanding their networks. Examples of CNCs include Delta, American, United, Air Canada and Lufthansa, to mention only a few.

Computer Reservations System (CRS) are computer systems used to manage airline seat reservations. Initially, airline seat sales were tediously managed by hand, then slowly, computer system were developed to automate the process. Eventually, CRSs grew to include other areas of travel and are now called Global Distribution Systems.

Connecting Flight is a flight from one point to another with intermediate stops and aircraft changes.

Contract Air Mail Act of 1925 (AKA the Kelly Act) provided for the award of government contracts to private airlines to carry U.S. Mail. Previously, airmail was carried by the Post Office using Post Office planes and pilots. The Kelly Act is often attributed as being the "birthplace of the airline industry."

Contract Air Mail Routes (CAM Routes) were airmail routes developed by the Post Office and contracted out to private companies after the Kelly Act.

Designated by a number, there were initially 12 CAM routes awarded after the Contract Air Mail Act was passed. As the airmail route system grew, so did the number of CAM routes, eventually forming a network covering the entire US.

Cost Leadership Strategy is a business strategy that refers to a company that sells at minimum price, generally in high volume. In the airline business, a cost leadership airline markets their flights as minimum fare, no frill flights in attempt to appeal to cost-conscience customers.

Cost Per Available Seat Mile (CASM) (AKA Unit Cost) is the total cost to the airline to produce one seat flown one mile. CASM is calculated by dividing the total cost by the total available seat miles (total cost ÷ ASM). CASM is usually described in cents per mile.

Cost-Based Pricing is the term generally used to describe pricing determined by the retailer's cost plus a mark-up (profit).

Crew Pairings are schedules built by the airline for crewmembers. A pairing could be a simple one-day trip (starting and ending the day at the domicile), or a trip consisting of a several days out of the domicile. A typical 3-day pairing would start at the domicile, fly one or more legs to an overnight city, then fly one or more legs on the next day ending at an overnight city, then finally one or more legs back to the home domicile to end the pairing.

Crew Schedulers track individual crewmembers as they move through the airline's route network, maintaining up-to-date status, and calling in reserve crewmembers or readjusting crewmember schedules as necessary when schedule disruptions occur. Crew schedulers are often located at the Airline Operations Control Center.

Cumulative Distribution Function (CDF) is the plot of the area under a normal distribution curve. It graphically represents the probability the sample data will be equal to or less than a selected amount. The cumulative distribution function will look like a spread-out S, start at zero percent (corresponding to zero on the normal distribution function), pass through 50% at the mean, then increase to reach 100% at the far-right end.

Debt Financing is the term used to describe financing available to an airline in the form of loans. Debt financing is similar to an individual getting a loan from a bank for a car purchase, except in the airline's case, aircraft are used as collateral.

Defined Benefit Plan is a retirement plan which, like a pension, an employee receives a set amount per month after retiring. Airlines that offer defined benefit plans will invest money throughout a person's employment to be paid out after they retire. Defined benefit retirement funds remain under company control and can become underfunded or even terminated through bankruptcy court.

Defined Contribution Plan is a retirement plan, such as a 401k, where an employee makes contributions to their account and the company matches the contributions to a predetermined level. Defined contribution plans grow tax-deferred and are held separately from the company. Defined contribution plans are safe from company failure.

Denied Boarding occurs when a passenger is present for a flight but denied transportation on that flight because the flight was oversold. Denied boarding is generally considered involuntary.

Depeaking (See Rolling Hub).

Deregulation (See Airline Deregulation Act).

Derived Demand is a term used to describe a situation where a customer does not purchase a product for its own sake, but rather for a purpose derived from it. An airline traveler does not purchase a ticket just to go for a ride in an aircraft. They purchase a ticket because they need to be at a different location. As a result, demand for air travel is derived from the need to be somewhere else.

Differentiation Strategy is a business strategy that refers to a company creating a unique product tailored to varied consumer groups. Airlines that employ a differentiation strategy produce various service offerings, some for cost-conscious customers (like coach fares) and some for travelers wanting first-class service.

Direct Flight is a flight from one point to another with a stop in an intermediate airport, but no aircraft change.

Direct Operating Costs (DOCs) (AKA Variable Operating Costs) are costs that result directly from the operation of the aircraft. If the aircraft is not in operation, DOCs are not incurred. The largest direct operating cost for an airline is usually the cost of fuel.

Direct Sales are airline ticket sales directly from the airline. Direct sales might be through the airline's Internet site, through a phone reservations agent, or at an airline's ticket office.

Directional Hub is a simple method to reduce congestion, delays, infrastructure and personnel requirements at a hub. With a directional hub, only flights from spoke cities on one geographical side of the hub are scheduled to arrive for a complex. After passengers and luggage transfer, aircraft depart for spoke cities on the opposite geographical side of the hub. For example, a complex at a directional hub in the center of the US might begin with arrivals from the East Coast spokes, and end with departures to the West Coast spokes.

Dispatchers are FAA licensed professionals responsible for flight planning, issuing flight plans to captains, and following each flight's progress. The dispatcher and captain are legally jointly responsible for safe operation of the flight. Dispatchers are usually located at the Airline Operations Control Center.

Display Bias (See Screen Bias).

Domicile is the term for the home base of a pilot or flight attendant. Medium to large airlines will usually have more than one crew domicile, while small airlines might have only one. Pilot and flight attendant schedule pairings will all start and end at their domicile.

Dynamic Scheduling is the term used to describe a process for rescheduling an aircraft to better fit the passenger demand. The passenger demand forecast for a specific flight leads schedulers to assign a certain size aircraft. As passengers book flights, the airline might revise the passenger forecast and re-assign a bigger or smaller aircraft to better fit the demand. Dynamic scheduling can be used to avoid spill and spoil.

Equity Alliance is an alliance brought about by one airline purchasing an equity stake in another airline.

E-Ticket is an airline ticket issued electronically with no actual paper ticket. E-tickets usually have a several-character alpha-numeric code that identifies the passenger and flight.

Expected Marginal Seat Revenue (EMSR) is the amount of revenue the airline can expect from selling a particular seat on the aircraft. EMSR is determined by multiplying the fare by the probability of selling that seat. For example, historical data show that for a $300 fare, a flight sells the 91st seat only 25% of the time. The EMSR of that 91st seat would be $75.

Fare Aggregators (See Metasearch Engines).

Fare Buckets are a figurative way to categorize seat allocation when fare nesting. As reservations for a particular flight are made, seats are removed from the respective fare buckets. The highest fare bucket would contain all of the seats on the aircraft. The most discounted fare bucket would contain a limited number of seats as determined be the seat allocation.

Fare Nesting is a process of making sure that seat allocation restrictions never deny the sale of a higher priced seat while allowing the sale of a lower priced seat.

Fee for Departure (AKA Capacity Purchase) is a term used to describe a contract arrangement between a network carrier and its regional carrier(s). In a fee for departure or capacity purchase agreement, the major carrier agrees to pay the regional carrier a fixed fee to operate the flight, regardless of the number of passengers paying. In this case, the major carrier assumes all of the risk of the operation. As the name suggests, the major is simply buying capacity on the regional, whether it's filled or not.

Fixed Costs are costs an airline incurs even if their aircraft are not flown. Fixed costs for an airline might include insurance or hangar rent.

Fixed Short-Term Capacity means the capacity of an airline flight becomes more and more fixed as the departure time approaches.

Fleet Rationalization is a term used to describe a reduction in the different types of aircraft used by an airline. Although a fleet of diverse aircraft are sometimes required to meet the needs of a major carrier, minimizing the fleet diversity increases efficiency and decreases cost.

Flight Crew (AKA Cockpit Crew) is the term used when referring to the flight's pilots.

Flight Crewmembers are considered pilot and flight attendant assigned to a flight.

Focus Strategy is a business strategy (AKA Niche Strategy) that refers to a company attending to the needs of a particular market segment. In the airline business, a focus airline might include Eos and MAXjet.

Frequency is the term used to refer to the number of times an airline flies to a destination from a given origination. With a given demand, an airline might fly several smaller aircraft with high frequency, or only one or two flights in a large aircraft.

Fuel Hedging is the term used to describe a financial means of protecting an airline from the volatility of fuel prices. Hedging instruments lock-in the price of an airline's fuel for the duration of the hedge, providing an insurance policy against catastrophic fuel price increases.

Generic Business Strategies are three strategies developed by Harvard Business School Professor Michael Porter. They include cost leadership, differentiation and focus.

Global Distribution System (GDS) (AKA Computer Reservations System) is a third-party integrated system to sell airline tickets and other travel needs. As an analogy, the GDS is to airline tickets as Ticketmaster® is to concert seats—a middle man who facilitates sales from the producer (the airline) to the consumer (the traveler).

Globalization broadly refers to the increasing integration of world economics and societies. Long-distance trade existed for years but accelerated after WWII as firms took advantage of relaxed restrictions on trade.

Gravity Model is a demand estimating tool used to predict passenger traffic between two cities. Demand between two cities is hypothesized to vary directly with the product of the populations and inversely with the square of the distance between cities. The name came from the similarity to Newton's law of gravity.

Hidden City Ticketing (AKA Point Beyond Ticketing) is a way passengers can circumvent an airline's segmentation devices by planning a trip to a destination with the intent to get off the aircraft at an intermediate stop.

High Density Rule (HDR) Airports (AKA Slot Controlled Airports) are airports that limit the number of takeoff and landing slots. The HDR began in 1968, initially limiting takeoffs and landings at five highly congested airports in the US: three in the New York City area (LaGuardia, Newark and Kennedy), Washington National, and Chicago O'Hare.

Homeland Security Fees were added to passenger fares after 9/11 to cover the cost of the Transportation Security Administration's providing of civil aviation security. These fees are flat rates added to the cost of one-way tickets.

Hub and Spoke Route Structure (H&S) became the industry standard after deregulation. In a simple H&S system, passengers from outlying spoke cities all fly to a common hub airport where they transfer to another flight to their destination—another spoke city. H&S networks offer service from anywhere in their network to anywhere else in the network with the minimum number of aircraft. The number of cities connected (See City-Pair) in a H&S network can be found with the formula [N(N–1)]/2, where N is the total number of destinations (including the hub).

Hub Dominance results as a hub grows and a predominant carrier establishes the highest market share of carriers at the hub. Hub dominance brings a degree of market power enabling the carrier to charge premium fares on flights to and from the hub. (See S-Curve)

Hybrid Airline is a term for an airline that fits between a low-cost carrier and a comprehensive network carrier, exhibiting traits of both types. Their in-flight product might be better than a typical LCC, but they do not have the broad international networks typical of CNCs. Examples of hybrid airlines would include Alaska, JetBlue and Southwest.

Hybrid Route Structure is a route structure that uses a combination of the three main route structures: point-to-point, linear and hub and spoke. Most larger carriers operate hybrid route systems offering passengers a variety of hub and spoke connections as well as some point-to-point and linear routings.

Integrated Cargo Carriers operate door-to-door services using aircraft of all sizes and ground vehicles to deliver cargo. Examples are FedEx, UPS and DHL.

Interline is a process whereby airlines work together to the benefit of the passenger. Airlines that interline accept each other's tickets and transfer checked luggage between them.

Internal Financing is the term used to describe a method airlines use to finance purchases simply by using funds available in the company. Internal financing would be like using your savings to buy a car.

Internal Reservations System (RES) is a computer system used to manage an airline's reservations internally, within the airline. RES systems can be developed by external vendors (possibly Global Distribution System companies) or by the airline itself.

International Civil Aviation Organization (ICAO) is the international organization charged with developing and promulgating international aviation standards.

Involuntarily Denied Boarding (See Denied Boarding).

Joint Venture A business arrangement in which two or more airlines agree to extensive cooperation and coordination and to pool resources to service specific markets.

Kelly Act (See Contract Air Mail Act of 1925).

Linear Route Structure was first used in the beginnings of air travel. Much like a train, an aircraft originates in a city and makes several stops on the way to its destination city. Passengers can travel between any two cities on the route, sometimes with several intermediate stops.

Load Factor (LF) is the term used to describe the ratio between ASM and RPM, in other words, the percentage of the airline's production that is sold. The load factor is found by dividing revenue passenger miles by total available seat miles (RPM ÷ ASM). Load factor is usually expressed as a percentage and can be calculated for an entire airline over a period of time, or for a single flight.

Local Service Carriers were those airlines approved by the CAB air service between small communities or from small communities to trunk airline cities. Sometimes called "feeders," the Local Service Carriers were first approved by the CAB in 1945. Initially, there were 20 companies allowed to fly in 45 states.

Low-Cost Carrier (LCC) is a term that has evolved to represent any airline that offers no-frills flights. As compared with comprehensive network carriers that offer a wide range of products, LCCs typically follow a simpler business plan. Some traits associated with LCCs include: open seating, no interlining, distribution via website only, single class seating, lower fares, shorter flights, minimal in-flight service and a single aircraft type. Example of LCCs include RyanAir and easyJet. Also see Ultra-Low Cost Carrier.

Maintenance Controllers coordinate with line mechanics for aircraft maintenance, especially when malfunctions occur, ensuring that required parts are available to meet aircraft and mechanics have access to the appropriate aircraft maintenance program procedures to troubleshoot and correct malfunctions. Maintenance controllers work closely with dispatchers and are usually located at the Airline Operations Control Center.

Marginal Costs is the term used to describe the cost of carrying one more passenger on a flight. Marginal costs for an airline are usually very low because the added weight of one passenger is almost negligible compared to the weight of the aircraft.

Market Share is the percentage of total demand earned by a particular company over a specified time period. Market share is calculated by dividing a company's sales by the total industry sales over the same period. Market share is a measure of consumers' preference of one company over another for a similar product.

Marketing Concept is the idea that a company must first determine customers' needs and wants and then offer a product satisfying those desires at a price that yields a profit.

Marketing Mix is the term that refers to the four variables that make up an airline's marketing plan. The four variables include product, price, promotion and place.

McNary-Watres Act (See Air Mail Act of 1930).

Mega-City is a term used by Airbus in their Global Market Forecast. They define it as an area of urbanization and wealth creation capable of supporting 10,000 or more daily long-haul passengers. Mega-cities are sometimes categorized into three levels: greater than 10,000 passengers a day, greater than 20,000 per day, and greater than 50,000 per day.

Menu Pricing (AKA Unbundling) is the term used to describe an airline pricing scheme that allows passengers to specifically choose which of the airline's services they want included in their total fare. With menu pricing, the basic fare might include only the transportation. Travelers can then add in fees for additional services like checked baggage, early boarding, or even sometimes carry-on baggage.

Metasearch Engines (AKA Fare Aggregators) are systems that search airline Internet sites for fares and display flight and fare data for purposes of comparison. Metasearch engines typically do not sell tickets, but rather earn revenue by selling Internet advertising on their websites. They provide the traveler the comparison information, then the traveler goes to the airline website to purchase the reservation.

Narrow Body Aircraft is the term used to describe a passenger airliner with a single isle.

Net Profit Margin is the term used to describe the percentage of total revenue that remains after paying all expenses. Net profit margin is calculated by dividing after-tax net income (profit) by total revenue. Net profit margin is a common denominator useful to compare the earnings of firms of varying sizes.

Network Allocation is the process of allocating seats on a particular flight based on possible passenger connections. For example, a flight from San Antonio to Houston might often sell out with passengers traveling just from San Antonio to Houston. An airline might want to allocate some of that flight's seats to travelers connecting in Houston to travel on to London.

Network Revenue Management is the process of revenue management considering the potential revenue from connecting passengers.

New Distribution Capability (NDC) is an upgrade to the original global distribution system software that allows more options to the user. An NDC display is much more like an airline's website, allowing the GDS to display more options, like checked baggage sales, to the travel agent booking the flight.

Niche Strategy (See Focus Strategy).

No Frills is the term sometimes given to airlines that offer only basic transportation with very limited amenities and services. Generally, low-cost carriers are many times considered no-frills airlines.

Non-Stop Flight is a single flight leg from one point to another with no stops in between.

Non-Transferable Tickets are tickets that cannot be transferred from one traveler to another.

No-Show Rate is the percentage of passengers who make reservations for a flight but then do not show up or cancel.

O&D (See Origination and Destination).

Official Airline Guide (OAG) originally a publication, is now an electronic listing of all scheduled airline flights.

Online Travel Agency (OTA) is a travel agency that performs a similar function as a brick-and-mortar travel agency, but through the Internet, with no physical retail office.

Opaque Travel sellers sell airline seats to customers without disclosing the airline name or flight information until after the sale in finalized.

Open Skies is a system of less restricted air commerce between countries. Open Skies agreements are replacing the more-restrictive Air Service Agreements and allow for airline competition with a minimum of government interference.

Operating Lease is an aircraft lease similar to a car lease. When the lease is over, the aircraft is returned to the lessor. Operating leases are generally made for varying lengths from months to 5 years or more.

Origination and Destination (AKA O&D) is the city-pair where a passenger begins travel (origination) and ends travel (destination). A traveler flying from JFK to DFW with a stop/transfer in ATL, is considered O&D passenger for JFK and DFW, but not ATL.

Overbooking occurs when airlines allow customers to make more reservations than there are seats on an aircraft. Overbooking refers to reservations only. If more people actually show up for a flight than there are seats, it is called overselling (See Oversale).

Oversale is a situation that occurs when more passengers actually show up for a flight than there are seats on the aircraft. Overselling is a possible result of overbooking.

Pacing Spokes are spokes within a hub and spoke route system that are usually the farthest from the hub. Flights to and from pacing spokes will generally set the hub complex timing. Aircraft operating from closer spoke cities must sometimes wait for the return of those aircraft from these more distant spokes.

Paris Convention (1919) was the first international conference to address the conflicting claims of nations concerning the sovereignty of airspace. Conferees agreed that nations had sovereignty over the airspace over their territorial land and waters and could restrict flights through that airspace; however, they also encouraged as much freedom as possible.

Passenger Facility Charges are collected by the airlines (added the fare) and paid to local airports to fund federally approved improvement projects. These funds are used for both air-side (taxiway and runway) and ground-side (terminal) improvements. Passenger facility charges are added as a flat fee per flight segment.

Passenger Segmentation is a process airlines use to help implement their revenue management. Potential passengers are segmented into groups based on their buying or traveling needs. Airlines then devise fare restrictions (See Segmentation Devices) based on traits associated with the categories. The major passenger segmentation involves categorizing passengers as either business or leisure, but other categories exist.

Passenger Service System is the computer system that electronically stores the airline's flight schedule. The PSS is developed and customized by each airline; individual systems vary in sophistication and capability.

Passenger-Name Record (PNR) is passenger information from a flight reservation. A PNR correlates an actual passenger name (not just a number) to a reserved seat.

Payload is the term used to describe the weight of passengers and cargo carried on the aircraft.

Perimeter Rule is a federal law that limits the distance an airline can fly from certain airports. Washington Reagan and New York LaGuardia airports are both affected by perimeter rules. Reagan's perimeter rule limits flights to 1,250 miles from Washington; LaGuardia's perimeter rule extends to 1,500 miles from New York. The perimeter rules were instated when nearby larger airports (Dulles and Kennedy respectively) opened in an attempt to steer airlines and travelers to the new airports. The federal government seems to be loosening their hold on perimeter rules, granting many exceptions on a case by case basis.

Perishable Inventory is product inventory with little or no shelf-life.

Point Beyond Ticketing (See Hidden City Ticketing).

Point-to-Point Route Structure is the simplest means to connect two cities. Passengers board at the origination city and deplane at the destination. In a pure point-to-point system, passengers do not connect to any other flights. Point-to-point provides the least travel time from origin to destination and is often the preferred routing for passengers. Point-to-point is generally used between larger markets, where larger aircraft can profit from economies of size. Some lower density markets might have point-to-point service with smaller aircraft.

Power-by-the-Hour is the term used to describe an agreement an airline makes to pay for engine use by the hour. A third party (possibly the engine manufacturer) might actually own the aircraft engines and the airline pays only for the time they operate the engine.

Price Discrimination is the term generally used to describe a situation where the same product is sold for differing prices based on a customer's willingness to pay.

Price Diversion occurs when a customer who is segmented into a particular fare category, is able to circumvent the segmentation device and move into a more discounted fare category. An example would be a business passenger who spends a weekend at their destination to get a cheaper fare.

Price Elasticity is the responsiveness of demand to price changes. It can be defined as the change in quantity demanded divided by the change in price. If the quantity demanded changes by 5% as a result of a price change of 5%, the elasticity is 1. An elasticity greater than 1 means that changes in price have a relatively large effect on the quantity demanded. An elasticity less than 1 means that a change in price will have little effect of the quantity demanded.

Privatization is the process of turning a state-owned airline into a private airline. Privatization can occur with the state simply auctioning off their airline, or the state can negotiate a purchase. In some cases, employees have arraigned financing to purchase the airline.

Probability Density Function is the plot of sample data that includes every possible outcome. Airline seat sales fit a normal distribution, that is, a standard bell curve. Normal distributions can be plotted when the mean and standard deviation of the data set in known.

Product Scope refers to the range of products an airline offers. It might include a range that starts at a no-frills economy seat and go up to a first class premium service seat. Some low-cost carriers, like RyanAir in Europe, have a narrow scope, while comprehensive network carriers usually have a broad scope.

Productivity Index is a measure of how productive an aircraft is as measured by available seat miles per year. It is the product of three factors: seat capacity, speed and aircraft utilization. A small, slow aircraft has a very low productivity index, while a large, fast aircraft has a large productivity index.

Pro-Rate Agreements are a type of contract between major carriers and their regional partners. With a pro-rate agreement, the regional carrier and major airline split the passenger fares. In this way, both the regional and the major airline share in the risk associated with the operation. Major-regional contracts are usually either pro-rate agreements or capacity purchase (See Fee for Departure) agreements.

Quality Function Deployment is a concept of designing quality into a product rather than something obtained after production by inspection and correction of defects. The basis for this concept is the conviction that high-quality products are ultimately cheaper to produce and sell.

Re-Banking refers to the process of turning a rolling hub back into a peaked hub. Considered the opposite of depeaking, re-banking adds cost to the airlines operation, but regains revenue lost from poor connections associated with rolling (depeaked) hubs.

Rejected Demand (See Spill).

Request and Reply System was an early airline ticketing system that required an agent to call the airline reservation office to request a seat for a customer, and then wait for the airline to reply to the request.

Reserve Crews are spare crews (pilots and flight attendants) assigned to be on-call in the event they are needed. There are a number of reasons spare crewmembers might be required; sometimes they are needed to fill flights that are uncovered—that is, there were no crewmembers assigned to the flight. Reserve crew may also be used to replace crewmembers that call in sick, or have timed-out (flown the FAA or union limits). Crewmembers can time-out due to delays incurred during irregular operations.

Return on Invested Capital (ROIC) is the term used to describe the ratio of profit to all invested capital—both equity and debt-financed capital. ROIC is a good measurement of how efficient a company puts its capital to work to earn profits.

Revenue Management (AKA Yield Management) is a pricing method used by airlines and some other retailers to maximize revenue by exploiting a customer's willingness to pay. Products are segmented based on customer preferences, with each segment priced at a point the customer is willing to pay.

Revenue Passenger Mile (RPM) (or RPK for kilometers) is the term used to describe how many of the airline's available seat miles were actually filled with paying passengers. An RPM is defined as one filled seat flown one mile. Like available seat miles, RPM is usually a very large number.

Revenue per Available Seat Mile (RASM) is the revenue an airline earns from each unit of production. RASM is calculated by dividing total revenue by the total available seat miles (Revenue ÷ ASM). RASM is generally reported in cents per seat mile.

Rolling Hub (AKA Depeaking) is an approach used to reduce the costs and increase efficiency of personnel and equipment at hubs. Working tight connections between arrival and departure banks is labor and infrastructure intensive, yet personnel and equipment sit idle between complexes. Rolling hubs spread out the arrivals and departures to depeak the spikes in workload during the complex. Rolling hubs also improve aircraft and flight crew utilization, but passenger convenience can suffer with increased connection times.

Scope Clause is a pilot contract inclusion that limits the size of aircraft that an airline might employ as a regional carrier. Major airlines with no scope clauses are free to contract large regional jets (and lower-paid regional pilots) to fly their otherwise mainline flights. Major airline pilots use these clauses to protect their jobs from being transferred to large-aircraft-flying, lower-paid regional pilots.

Screen Bias (AKA Display Bias) is a term used to describe bias built into computer reservations systems to favor the airline that owned the system (host airline). Originally, computer reservations systems were developed by one airline, but used by many. The owning airline would write software to favor selling their seats over their competitors'.

Screen Padding is a computer reservations system biasing scheme to list one flight under several flight numbers to increase visibility on reservations screens.

S-Curve is a graphical representation of a phenomenon by which airlines with a frequency-share advantage at a major hub also attain a disproportionately high market share, measured in revenue or total passengers. As an example, if one airline in a market city offers 70% of the total capacity from that city, it will gain more than 70%, maybe even 80% of the passengers.

Seat Allocation is the process of allocating seats in an aircraft to different fare categories, then offering seats for several different prices by controlling the seat inventory and restrictions to purchase.

Segment Length (AKA Stage Length) is the length of a flight leg in miles. Generally, segment length is averaged over a period of time for an airline's entire operation, or the operation of a single type aircraft. Segment length is used to tell whether an airline is considered a long- or short-haul airline.

Segmentable Market refers to a customer base that can be categorized by their purchasing habits. Although several others can be identified, the two most recognized passenger segments are business passengers and leisure passengers.

Segmentation Devices are restrictions an airline makes on seat reservations to force passengers into a predetermined group. Typical segmentation devices might include a required weekend stay at your destination, advance purchase restrictions, or non-refundable.

Selling Up refers to a situation where a passenger fits into a reduced fare segment, but instead purchases a higher fare. Selling up is, in a way, the opposite of price diversion. As an example, a leisure passenger fits all of the segmentation devices to purchase a deeply discounted seat, but they instead purchase a higher fare, probably because the deep discounted seat is already sold out.

Single-Class Seating is an aircraft cabin seat arrangement where all passenger seats in the aircraft are in a single class. In single-class seating, there are no first-class or business-class seating sections. Single-class seating has grown to become a trait of low cost and ultra-low cost airlines.

Slack Time is time built into flight schedules to account for possible irregular operations. Slack time makes it easier to recover from irregular operations, but is costly to the airline.

Slot-Controlled Airports (See High Density Airports).

Southwest Effect is a term used to describe the increase in originating travel as a result of a low-cost carrier entering a market. The lower fares and additional capacity offered by the low-cost carrier result in the incumbent airlines lowering fares as well in order to remain competitive. The overall result is a rise in sales for all carriers. An example is when Southwest entered the Buffalo–Baltimore market, traffic increased 300% while fares dropped 60%.

Spare Aircraft are kept on hand at times to help offset aircraft taken out of service due to mechanical problems. If not used, spare aircraft result in a cost to the airline. Aircraft sitting on the ground are not earning revenue.

Spill (AKA rejected demand) is a term used to describe a potential customer who was turned away due to lack of capacity. Spill can be defined as total unconstrained demand for a flight minus the total capacity of the flight. Because exact total demand is generally unknown, spill is also usually unknown. Researchers have developed spill models based on normal distributions to estimate spill.

Spoil is a term used to describe airline seats that were produced but left empty. It's much like the term used for a grocer. Food that is produced but not purchased eventually spoils. Airline seats are produced when the airline schedules a route and sets a desired capacity. The product (passenger seat) spoils when the aircraft departs with unused capacity (empty seats).

Spoils Conference (1930) was a set of closed-door, semi-secret meetings held by Postmaster General Walter Folger Brown to re-distribute airmail contracts. Brown, using new powers gained from the McNary-Watres Act, set out to re-award contract mail routes to only the largest and most established carriers. His goal was to make the carriers more profitable and end government subsidies. Four big carriers emerged from the conference, however, the awards were put aside later after accusations of collusion by Brown and The Department of Commerce.

Stage Length (See Segment Length).

State-Owned Airline is an airline owned and controlled by the national government. Although the United States never had state owned airlines, many other worldwide airlines are either state-owned, or were at one time state-owned and now privatized.

Survivor Function is the plot of complement of the cumulative distribution function (1-CDF). The plot resembles a spread-out number 2, starting at 100% and dropping to zero percent, passing through 50% at the mean.

Travel Agent Commission Override (TACO) is an incentive paid to travel agencies, in addition to the base commissions, for exceeding predetermined sales targets.

Trunk Carriers were those airlines approved by the CAB for long-distance flights. Sixteen carriers were grandfathered as trunk carriers when the CAB began in 1938 (See Civil Aeronautics Board and Civil Aeronautics Act). No new trunk carriers were added in the CAB's 40 years of control (although there were 79 applications); however, six trunk carriers either ended business or merged.

Ultra-Low Cost Carrier is a spin-off of the typical LCC that offers even less amenities than LCCs, typically with unbundled pricing. In the US, there are three Ultra LCCs: Spirit, Allegiant and Frontier.

Unbundling (See Menu Pricing).

Uncertain Demand means that although demand can be approximated for a particular flight, the exact demand cannot. Scheduled airlines generally have uncertain demand, as compared to charter airlines who probably know an exact passenger demand.

Unit Cost (See Cost Per Available Seat Mile).

Warsaw Convention (1929) established the first rules of liability for international airlines carrying people, cargo, luggage or other goods. The convention recognized the right to compensation for the loss of luggage and cargo, as well as injury or death of passengers, but limited the airlines' liability. The Warsaw Convention was amended several times, including in 1955 at The Hague, Netherlands and in 1971 at Guatemala City, Guatemala.

Wave (See Bank).

Weighted Average Cost of Capital (WACC) is return investors would receive if their money were invested elsewhere at similar risk. The return on invested capital (ROIC) is often compared to the WACC to determine how well the airline is performing with respect to an industry average.

Wide Body Aircraft is the term used to describe a passenger airliner with two (or more) isles.

Yield is the term used to describe the average dollar amount each passenger pays to fly one mile. Yield is calculated by dividing the total revenue by the revenue passenger miles (Revenue ÷ RPM). Yield is usually described in cents.

Yield Management (See Revenue Management).

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