# Airline Economics:
## *Foundations for Strategy and Policy*

by
Michael W. Tretheway
and
Tae H. Oum

c·t·s
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# ABOUT THE AUTHORS

*Michael W. Tretheway* is associate professor in the Transportation and Logistics Division of the Faculty of Commerce and Business Administration, University of British Columbia. He holds a PhD in economics from the University of Wisconsin, and was formally Senior Economist at the Economic Research and Consulting firm of Laurits R. Christensen Associates Inc. Since joining the Faculty at University of British Columbia in 1983, Dr. Tretheway has taught courses in airline management, international business logistics, project evaluation and urban transportation. He served as Director of Research to the Canadian Ministerial Task Force on International Air Policy, and on the Board of Advisors to the Canadian Minister on the transfer of federal airports to local airport authorities.

*Tae Hoon Oum* is Van Dusen Professor of Business Administration and chairman of the Transportation and Logistics Division of the Faculty of Commerce and Business Administration, University of British Columbia. He holds a PhD in economics and managment science from the University of British Columbia. He has taught at Queen's University, Osaka University and Shanghai Shio Tung University, and specializes his teaching in the areas of transport economics and business statistics.

*This book is dedicated to the innovative airline managers and entrepreneurs at Federal Express, American Airlines, Wardair Canada, Laker Airways, Cathay Pacific, Singapore Airlines, SAS, and at other carriers throughout the world.*



# FOREWORD

Transportation has been a fertile field for the generation of economic concepts. Unfortunately, the regulatory constraints under which the various modes of transport operated for many years not only stifled innovative management but, also, inhibited the development of well formulated explanations of the economic principles on which corporate and public policies should be built.

Deregulation of the airlines has allowed corporations to pursue new strategies in many key aspects of the business. Fundamental decisions about the network to be operated and the planes to be used have crucial effects on the levels of costs and customer service. Some companies have got the fundamental economics (and timing) right and have been successful. Others have got the fundamentals wrong and are no longer in the business. Airlines have been innovators in the successful management of "inventory" in a service industry and have developed methods of gaining customer loyalty in a service industry in which opportunities for service differentiation are limited. Companies in other service industries are following the airlines' lead.

The corporate strategies have implications for public policies. The development of the airline networks has serious implications for the economics of the airports, which in this continent are mainly a public sector responsibility. Issues of regulatory policy now come up in the more general context of competition policy rather than in the straight jacket of transport regulation.

As a result, there is now a need for a book that provides a clear explanation of the economics that underlies the strategies of airlines. It is a subject that is crucial for private and public sector decision makers in the aviation field, and for those in other fields interested in the development of the industry. Economics must be the basis for any financial analysis of this industry.

Michael Tretheway and Tae Oum are particularly well suited to tackling the challenge of producing such a book. They are an economists who have studied the airline industry from many perspectives. They have advised airlines, governments, and financial analysts. Their knowledge and talents are self evident in this book.

The Centre for Transportation Studies is pleased to publish this book as a part of its ongoing program to publicize transportation research and to bring the benefits of transportation research to the widest possible audience.

Trevor D. Heaver, Director
Centre for Transportation Studies



# ACKNOWLEDGEMENTS

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The original impetus for this work came from the need to provide a background paper in modern airlines economics for the Ministerial Task Force on International Air Policy and for other work undertaken with Transport Canada. An earlier and somewhat shorter version was published as a working paper with the title "The Characteristics of Modern Post Deregulation Air Transport." Some sections of this monograph draw on materials published in the articles indicated with an asterisk in the bibliography.

Typing of the original manuscript was proficiently provided by Susanna Lui. Formatting for the final version was provided by Teresa Cheung and Betty Gelean. All of their services are highly appreciated, but it was their smiles which were most valuable of all.

The views expressed in this report are those only of the authors. They do not necessarily reflect the position or endorsement of the University of British Columbia.

# EXECUTIVE SUMMARY

This report describes the underlying economic principles of the modern post-deregulation airline industry. The emphasis on the *post-deregulation* industry is important, as the methods of doing business have changed radically since the first tentative steps toward deregulation were taken by the U.S. in 1976.* The characteristics of the industry described in this report include the underlying economics of the industry, including both cost and demand elements; pricing practices and methods; marketing practices in the area of product distribution and brand loyalty; the construction of airline route systems; the role of public infrastructure (airports and airways); and airline finance. The main characteristics revealed in this study are summarized as follows (the heading numbers correspond to chapters of the report):

## II. Airline Economics: Cost

- Cost per seat declines with the size of the aircraft.
- Cost per kilometre flown declines with the stage-length (number of kilometres flown) of the flight.
- The cost per passenger declines as the load factor (the percent of seats filled with paying passengers) increases toward 100 percent.

* Formal deregulation of the U.S. airline industry did not occur until October, 1978. However, in 1976, carriers were given initial freedoms in the area of pricing. Canada's first steps toward deregulation began in 1979. An additional step forward took place with the 1984 New Canadian Air Policy of the then-Liberal government. Formal deregulation took place on 1 January 1988 when the Conservative government implemented the National Transportation Act of 1987.

- There are significant economies of *traffic density*, in this industry. This indicates that as the level of traffic increases, in a network of a given size, the cost per passenger falls. One way of viewing this is that costs per passenger fall as additional flights become viable in a particular market. Airlines the size of the former CP Air and PWA were too small to fully exploit available traffic density economies. Carriers the size of Air Canada appear to have reached the mass necessary to exploit available economies.

- There are roughly constant economies of *firm size*. This means that when holding the amount of traffic per route constant, adding additional routes/cities to the network does not lower costs per passenger.

## III. Airlines Economics: Consumer Demand

- In the deregulation era, there are at least two distinctly different types of airline consumer: business travellers and leisure travellers.**

- Leisure travellers are highly sensitive to price. In general, lowering price results in a more than proportionate increase in patronage.

- Business travellers, in general, are less sensitive to price, although not totally "inelastic."

- First class travellers tend to be insensitive to price.

** Sometimes business travellers are referred to as "must-go" travellers. The latter term embraces more than just business trips, but also includes travel for family emergencies, etc. Leisure travellers are often further sub-divided into vacationers, generally heading to popular tourist destinations, and visiting friends and relatives traffic (VFR) who travel to a widely dispersed set of destinations.



- The business traveller is highly sensitive to the schedule convenience of air services.

- The most important convenience attribute for the business traveller is the frequency of airline service.

- Business travellers tend to book their tickets at the last minute and need the ability to change their flight at a moment's notice.

- Business travellers do not always show up for flights they book, as their plans change at the last moment. This has led to the airline practice of overbooking flights to offset the loss of revenues due to "no-shows."

- Leisure travellers generally are able to book their tickets well in advance, tend not to change their flight plans, and are more willing to travel at less popular times.

- Consumers prefer large network airlines due to the ease of obtaining information on schedules and fares.

- Consumers strongly prefer same airline service (on-line service) to interline service requiring connections between different air carriers.

- An S-curve effect appears to exist whereby the carrier with the most flights in a market gains a disporportionately large share of the market.

- Consumers have proven to be very responsive to incentive programmes such as frequent flyer reward plans.

- Cargo is segmented into two distinct markets: air freight and air express.

- Air freight consists of large items which tend to be price sensitive with expected delivery times of 24-48 hours. This segment is best accommodated by cargo belly space in passenger aircraft. The incremental cargo revenues are very attractive to passenger carriers.

- There is a small service sensitive air freight market requiring dedicated (and expensive) cargo aircraft.

- Air express consists of small packages which are highly service sensitive. The high willingness to pay for the service combined with low weight provide economic justification for dedicated overnight cargo aircraft. A single nation-wide hub and spoke network works well for such cargo operations.

## IV. Airline Pricing

- Airlines have abandoned simple uniform pricing policies in favour of complex pricing schemes, such as *yield management*.

- Yield management systems have maximizing flight revenues as their objective. They achieve this by reserving only as many seats as necessary to accommodate full-fare paying business passengers, and selling remaining seats at a discount to leisure travellers.

- For yield management to be effective, it is necessary to prevent business passengers from availing themselves of discounts. This is done by attaching restrictions to discount tickets such as required Saturday night stayovers and advanced purchase requirements, which business travellers are unwilling to abide by.

- As the date of the flight approaches, the airline is able to more accurately predict the number of seats which will be required for full-fare passengers. Thus the airline may increase or decrease the number of discount seats which are available.



## V. Airline Marketing

- Airline tickets are sold by the airline, rival carriers, or a travel agent.

- 70 percent of airline tickets in Canada are sold by travel agents.

- 80 percent of travel agents in Canada use a computer reservation system (CRS) terminal to access flight and fare information.

- The order in which information is presented to the agent on the CRS screen strongly influences the choice of air carrier.

- CRS displays are regulated by governments to prevent bias of information presented to consumers.

- CRSs are owned by one or more air carriers. The owning air carrier tends to be preferred by travel agents when booking tickets.

- CRS displays are regulated by governments to prevent bias of information presented to consumers.

- Frequent flyer programmes create brand loyalty among airline consumers, in the sense that they raise the cost of switching patronage to another airline.

- Large carriers can offer frequent flyer programmes at a lower cost, and can provide the consumer with a wider choice of destinations.

## VI. Airline Route Systems

- Airline networks should be viewed as logistical systems for moving passengers from origin to destination.

- Consumers will switch their patronage to the air transport logistical system which provides them with the greatest convenience (or lowest price).

- Since deregulation, hub and spoke network systems have emerged as the most effective logistical systems for moving passengers.

- In order to extend their market coverage, the trunk (mainline) air carriers have forged alliances with smaller feeder carriers serving smaller communities.

- Although the traffic from feeder carriers is small relative to the overall air traffic volumes, it is very profitable traffic for trunk carriers.

- In order to ensure continuity of market coverage, the trunks generally take equity positions in their feeder carriers.

- Similarly, traffic from foreign destinations feeding into domestic routes is also important to domestic trunk carriers.

- To build their international market coverage and enhance feed traffic to domestic flights, carriers are forging alliances with carriers of other nations. In a few cases, the alliances are being made more permanent by taking minority equity positions in the foreign airline.

- Advances in aircraft technology are threatening the traditional flow of traffic through "gateway" airports. Longer range aircraft such as the Boeing 747-400 allow non-stop flights which overfly coastal gateways. Smaller capacity inter-continental aircraft such as the Boeing 767ER make international services to smaller communities possible.



- Airline scheduling is a critical element in consumer choice of carrier, as well as a major determinant of airline costs and productivity.

- The flight schedule determines the times and routes which are offered to consumers.

- Aircraft assignment attaches a specific aircraft to a flight, and is a major determinant of carrier productivity.

## VII. Other Issues

- Air carriers use publicly provided infrastructure (airports and airways).

- Both airports and airways are becoming increasingly congested, negatively affecting air carrier operations, service quality and cost. This is also making entry of new air carriers difficult.

- Because of advantages enjoyed by existing airlines, it is extremely difficult for a new air carrier to start operating. Economists refer to this phenomena as one of very high "entry barriers." Major entry barriers facing carriers include:

  *Economies of Scale*: The lowering of cost achieved by serving more cities (referred to as economies of firm size) seems not to be an issue for carriers the size of Air Canada and Canadian Airlines International, but could be for smaller carriers.

  *Economies of Traffic Density*: The more traffic which can be carried in a given market, the lower per passenger costs tend to be.

  *Airline Hubs*: Dominant carriers at hubs can channel traffic from a very large number of cities onto a particular hub city pair flight segment. An entrant to the segment would be unable to access this traffic, and thus would be confined to a very small market share.

*Control of the Marketing Distribution Channel*: If another airline controls travel agents and/or the computer reservation system in a market, then other airlines will be at a significant competitive disadvantage.

*Travel Agent Commission Overrides*: Commission rates which increase with sales may favour large airlines, as agents will find it easier to achieve the required sales thresholds, due to their large numbers of destinations and more frequent service.

*Code Sharing*: The representation of the flight of an affiliated feeder carrier as being a flight on a dominant carrier, raises the CRS priority for trips requiring connections. This tends to reduce the market share of small or entrant carriers.

*Airline Frequent Flyer Programs*: These programs are effective in creating customer loyalty to a particular carrier. Their existence may make it difficult for a new carrier to enter a market.

*Vertical Integration*: If a carrier controls the key suppliers to the airline industry (such as ground handlers, caterers, etc., then competitors could be placed at a significant disadvantage in terms of higher costs, lower reliability of service, etc.

*Control of Feeder Carriers*: Another form of vertical integration is controlling feed traffic. For example, if a carrier controls all the domestic traffic in a country, then foreign carriers can be excluded from carrying any "beyond the gateway" traffic, putting them at a disadvantage.



*Access to Public Infrastructure*: Incumbent carriers may have advantages in that they have access to airport facilities (ticketing counters, gates, office space) and to takeoff and landing "slots," when potential competitors are not able to obtain such access.

- Just as mergers resulted in the formation of large air carriers from small carriers in both Canada and the United States, forces are at work which could result in some form of union between carriers of different countries. This phenomena is referred to as *globalization*.

- The airline industry has a strong seasonality characteristic with peak month air traffic roughly double that of the trough month.

- The airline industry is procyclical, meaning that its traffic varies with a higher amplitude than that of the economy as a whole.

- Airlines have high operating leverage, meaning that small traffic increases can result in a large increase in profits, and traffic decreases can result in large losses.

- Airlines have moderately high financial leverage.

- As airlines switch from owning to leasing their aircraft, their finances are changing from strong cash generators to a position where cash in-flows and out-flows must be closely balanced. This could be lessening the ability of carriers to survive a recession in this procyclical industry.

# Chapter 1

# Introduction

Before a firm can develop a market strategy, or a government can design a policy toward a particular industry, it must first understand the basic economics and other characteristics of that industry. Some of the questions which must be addressed in this regard include:

- What are the nature of costs in the industry? Are there economies of scale? If so, what are their source?
- What are the characteristics of the industry's consumers? What factors do they respond to? Which are the most important? Is there more than one type of consumer? If so, how are the consumer segments differentiated?
- How are prices set by the firms in the industry?
- How do firms market their product? What channels or organizations do they use to distribute the product to the consumer? How do firms create loyalty among their customers?
- What is the nature of the production process of the goods or services of this industry?[1]
- What other issues are relevant to the conduct of this industry?

[1] In the case of air transport, production might be viewed in large part as reflecting the route system the airline operates.

This report sets out to answer these questions for the deregualted segments of the world airline industry. The "deregulated" distinction is important. While airlines around the world fly similar aircraft types and follow similar flight rules and procedures, managerial styles differ radically. In many places in the world, airlines continue to be closely regulated by governments and/or an industry cartel. They have limited scope for setting prices, and route changes are done piecemeal over a time span measured in years or even decades. Capacity (the number of seats which can be offered for sale) also requires government approval. Even the size of sandwiches have been determined for the air carriers. Bankruptcy is almost unheard of.

In contrast, the deregulated air carriers have complete freedom to set prices, and often make decisions on an hourly basis. Route decisions are not made piecemeal, but rather are done on a network basis. The network can be radically changed in a short period of time whereas in the regulated era, route changes could take decades to achieve, if at all.[2] The prospect of bankruptcy has been all too real in Canada, the U.S., the U.K. and Australia, keeping airline managers in a constant state of attention to all details of operating a modern, competitive airline service. U.S. airlines have had 16 years of experience starting with effective liberalization of the industry in 1976. In Canada, carriers have had 4, 8 or 13 years of experience with deregulation, depending on where one sets the transition point in the typically Canadian evolution toward regulatory reform. Australia deregulated in 1990, New Zealand in 1984 and Chile in 1979. Since 1987, the European Community has embarked on a program of significant regulatory relaxation, and other nations have injected some elements of competition into their airline industries.

Deregulation has fundamentally changed the airline industry. The carriers' freedom to fly where they wish, and their freedom to make their own pricing decisions has resulted in a fundamental redefining of the airline product and route system. Previously suppressed aspects of consumer demand, such as the need for frequent service, can now be manifested and exploited in the marketplace. New market segments have been tapped for the first time, such as

[2] For example, when Eastern airlines filed for protection under U.S. bankruptcy law, and curtailed services, American Airlines was able to develop a major hub in Miami, a former Eastern base, within two weeks.



that of consumers only willing to fly at low fares. New methods of marketing and controlling the flow of information to and from the consumer have also emerged.

In this book, each of the five key areas of cost, consumer demand, pricing, marketing, and route systems are dealt with in their own chapters. An additional chapter is provided to help put some important issues in context. Specifically, the effective ability for new carriers to enter the marketplace is addressed, along with issues of industry globalization and industry finance. An executive summary is provided at the front of this book in lieu of a summary chapter at the end.

# Chapter 2

# Airline Economics: Costs

## A. Understanding Airline Costs

This chapter begins with a brief discussion of three fundamental aspects of engineering technology which are reflected in airline costs. **Figure 1** begins by showing the relationship between cost per seat and the size of the aircraft. The figure shows that small aircraft have higher costs per seat than larger aircraft. The figure is drawn to show the current maximum aircraft size of roughly 560 seats. This decline in cost per seat with aircraft size is a general representation of technology. Individual aircraft types, especially older ones, may lie above the curve. Nevertheless, the figure captures the essence of aircraft technology.

Another fundamental technological relationship is that between the cost and the distance an aircraft is flown. This distance of a flight *segment* is referred to as *stage length*. Significant amounts of fuel are expended simply in getting an aircraft up to cruising altitude. In addition, there are various flight preparation costs which are largely the same, regardless of the distance the aircraft is flown. The result is that the average cost *per kilometre flown* declines as the number of kilometres flown increases. This is shown graphically in **Figure 2**.

The third relationship is that between cost per passenger and flight load factor. *Load factor* is the industry term for the percent of seats which are filled with revenue-paying passengers. Airlines choose not to fly with 100% of their seats sold on every flight. To do so, would imply that passengers requiring



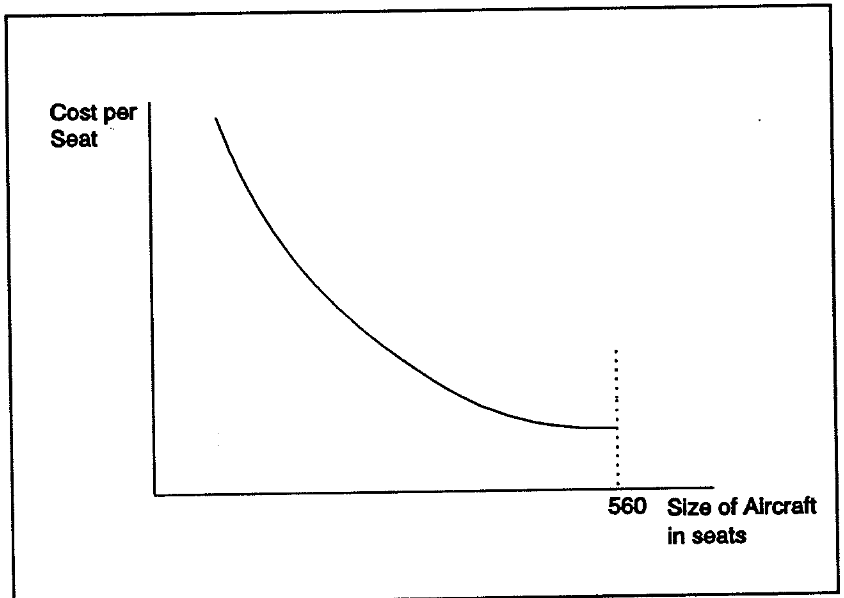


**Figure 1: Relationship Between Cost per Seat and Aircraft Size**

seats at the last minute would not be able to obtain them.[3] Since much of the cost of a flight is fixed, regardless of the number of passengers flown, the cost per passenger will decline as the percent of seats filled increases.[4] This is shown graphically in **Figure 3**. Note that load factors cannot exceed 100%.

[3] A study by Boeing Commercial Aircraft found that when flight load factors average 60%, then 7% of flights will be full and unable to accommodate an additional late-booking passenger. When load factor reaches 70%, this turnaway rate increases to 21%. Most airlines in the world operate with load factors in the 60% range. See *Surplus Seat Management* and *Discount Fare Management*, Boeing Commercial Airplane Company. For a general discussion of airline load factors, see M.A. Brenner (1982).

[4] For example, cockpit crew costs must be incurred whether the flight is full or almost empty. While fuel costs vary somewhat with load, a major portion of them are fixed, being associated with getting the weight of the aircraft itself into the air and along the route.

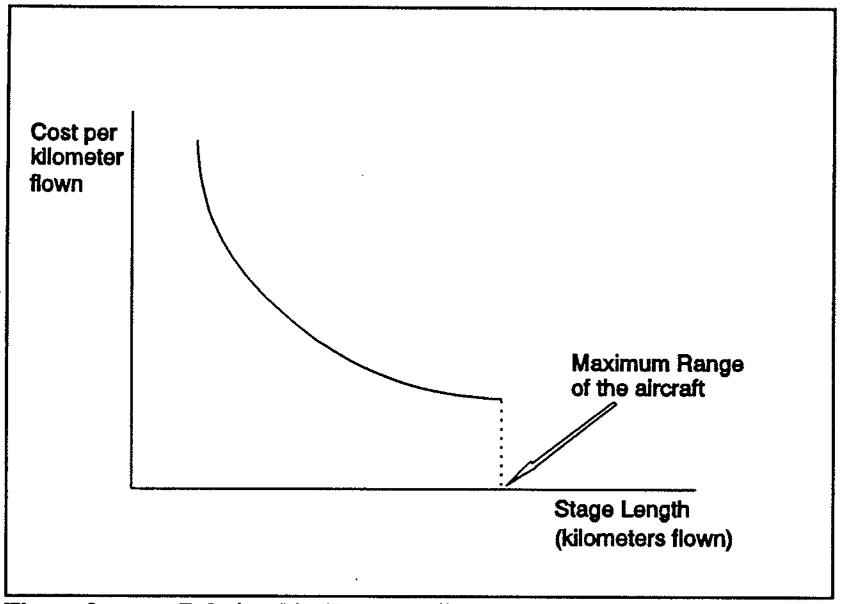


**Figure 2: Relationship Between Cost Per Kilometre and Kilometres Flown**

A final relationship is that between aircraft capacity and range. This is not strictly a cost relationship, but more of a technical constraint on aircraft performance. **Figure 4** shows that different aircraft have different capacity and ranges. Note, however, that at some point, the aircraft's range can only be extended by reducing capacity. In these cases, additional fuel can be carried to extend the range of a flight, but only by reducing other weight on the aircraft. This means, that passenger and/or cargo weight must be reduced in order to safely accommodate the weight of the additional fuel.



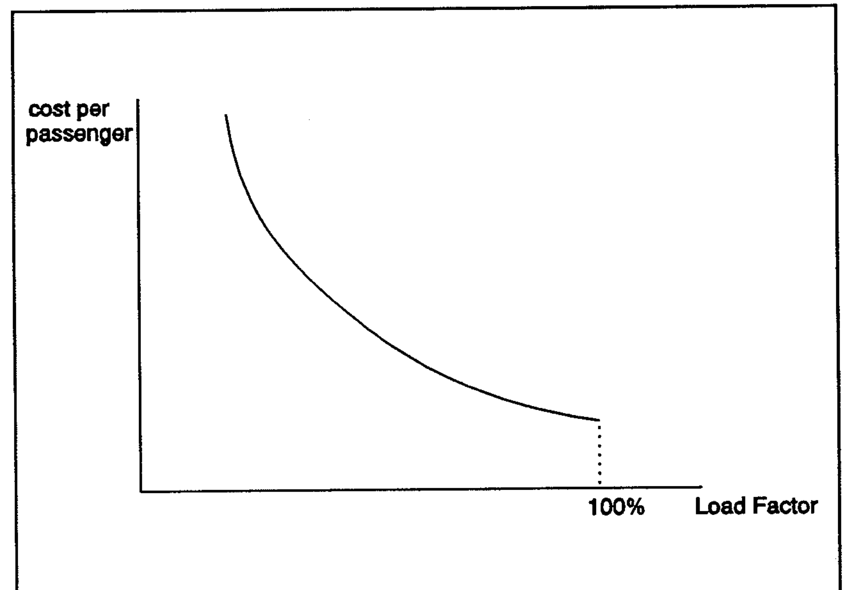


**Figure 3: Relationship of Cost Per Passenger and Load Factor**

## B. Economies of Scale

The cost relationships in the previous section indicate that costs fall as the size of the aircraft increases, as the distance flown by the aircraft increases, or as the percent of seats sold on the aircraft increases. These relationships should not be construed as evidence that there are economies of scale in airline operations. The question of economies of scale addresses the *magnitude* of the carriers operation. Consider, for example, two airlines. Both operate B-737 aircraft with an average 60% load factor on flights which average 500 miles. Airline A has a single aircraft which it uses to operate three round-trip flights per day in a single city pair market. Airline B has a fleet of 20 aircraft which it operates in several city pair markets. Both carriers have the same cost relationships from Section A, given that they are flying the same aircraft type, over the same distance, and with similar average load factors. The question of economies of scale is one of the magnitude of any given type of operation: a

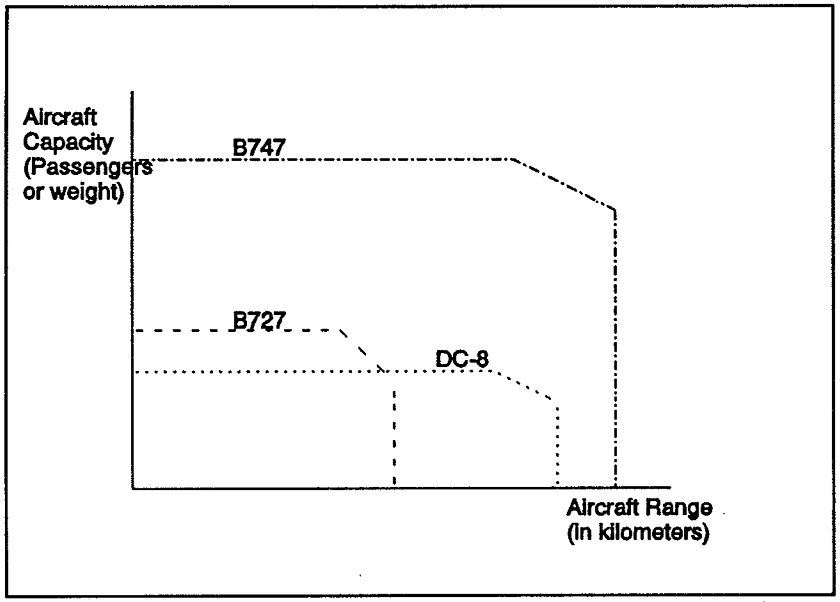


**Figure 4: Relationship Between Aircraft Capacity and Flight Distance**

one versus twenty aircraft operation, in this case. This section addresses the question of economies of scale.

White (1979) surveyed all major studies of the nature of airline costs and concluded that "economies of scale are negligible or non-existent at the overall firm level." Why, then, did the wave of airline mergers occur in both the US and Canada? The first reason is that a simple manufacturing industry concept of economies of scale is inadequate for modelling the relationship between inputs and outputs in this network-oriented service industry. Second, costs alone do not determine market structure. Demand is also relevant, and there are several aspects of demand that favour larger carriers.[5]

[5] These demand aspects are discussed in Section III.A.



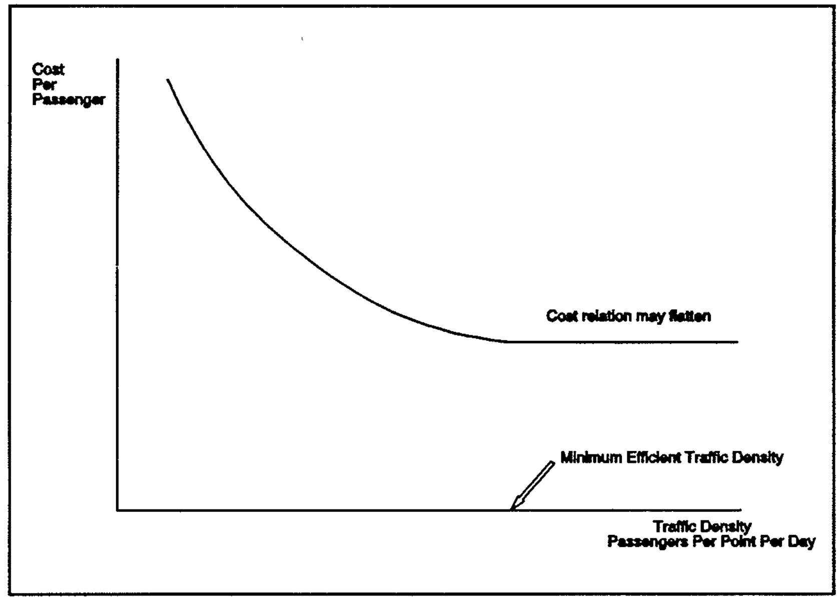


**Figure 5: Economies of Traffic Density**

Caves, Christensen and Tretheway (1984) distinguish between airline *economies of traffic density* and *economies of firm size*. Under the latter, output is expanded by adding points to the network; under the former, output expands by increasing service within a given network (set of points served). Gillen, Oum and Tretheway (1986) applied this concept to Canadian airlines, and developed it further by distinguishing between different types of airline traffic (scheduled, charter, freight). These and studies of other airlines reach a common set of conclusions.[6] Roughly constant returns to firm or network size exist for rather broad ranges of airline traffic. That is, adding or dropping cities from an airline's network does not raise or lower unit cost. In contrast, sizeable economies of traffic density seem to exist up to fairly large volumes of traffic.

[6] See, for example, studies of international airlines in Tretheway (1984), and Caves, Christensen, Tretheway and Windle (1987).

That is, adding more flights or more seats per flight on a given route will result in lower "per seat" costs. However, once the minimum efficient traffic density level is reached, the curve is flat over a wide range, indicating that there are no more gains associated with greater traffic density.

Intuitively, this makes sense. Adding a city to a network involves a set of fixed operation costs: airline counters, station managers, mechanics, ticket offices, advertising, etc. Every time a new city is added, another set of these costs must be incurred. On the other hand, once a set of cities are being served, additional traffic does not require any increases in the fixed operation costs; advertising need not be increased, etc. Thus, the fixed operation costs can be spread out over more traffic, allowing unit costs to fall.

Economies of traffic density are illustrated in **Figure 5**. Here, cost per passenger declines as the number of passengers per station increases. At some point declines in cost per passenger *may* taper off, and the curve may start to flatten. The traffic density where this occurs is referred to as the minimum efficient traffic density level. This is indicated in the figure.



## Chapter 3

# Airline Economics: Consumer Demand

### A. Basic Elements of Demand for Air Service

When economists refer to the "determinants" of consumer demand for air services, they mean the set of factors which influences an individual's decision as to whether or not to travel by air, and how much travel by air they will do in a given year. The main determinants of airline demand are:

- *Price.* Lower airline prices induces people to travel more.

- *Income.* Higher disposable income influences consumers to travel more.

- *Price and convenience of other modes of transport.* An individual living in Kingston, Ontario will be less inclined to fly to Toronto if the automobile is cheaper and/or more convenient.

- *Frequency of service.* More frequent service is more convenient service, increasing the willingness of the consumer to travel by air. A once-a-day flight from London, Ontario to Toronto would not generate as much traffic as a schedule with hourly flights. With the former, several travellers will be induced to either drive or not travel at all.[7]

[7] An hourly service makes it easier to accommodate "quick trips."

- *Timing of service.* In general, consumers prefer to fly first thing in the morning, or late in the afternoon. Flights offered at these times will induce consumers to fly by air, whereas flights at inconvenient times (such as 3 a.m.) tend to discourage consumers from air travel.

- *Day of the week.* Consumers are more likely to fly on certain days of the week than others. Typically, Sunday evenings are very popular, with business travellers leaving home for their first appointment of the week. Similarly, Friday afternoons are also a busy time, as travellers are returning home.

- *Season of the year.* July and August are popular travel times, whereas November and February are unpopular times. There are variations, of course, by market (sun spot destinations are winter peaking) and continent (e.g. Australia, New Zealand).

- *Safety and company goodwill.* A good safety record is good for business. Air travel drops whenever there is a major air disaster.

- *Demographics.* Age is often a factor in the travel decision. College students, for example, are notorious for airline pilgrimages to Europe, popular ski resorts, and holiday trips to home. Individuals raising children tend to travel less, while empty nesters seem to travel more. There are other demographic factors as well. New immigrants tend to travel back to the old country several times.

- *Distance.* The longer the travel distance involved, the fewer trips will be made. Business and leisure travellers make relatively fewer trans-oceanic trips than trips across the



country. At the other end of the scale, few air trips are made over very short distances.[8]

- *In-flight amenities.* Consumers are somewhat influenced by how cramped seats are, the quality of food, the availability of in-flight movies, etc. On average, these factors are less important in the decision of whether or not to fly, but more important in the choice of air carrier.

- *Customer loyalty.* As in any industry, once the consumer has made the decision to purchase a service or product, loyalty factors may come into play in determining which carrier or firm will be chosen. In air transport, frequent flyer reward programs are especially important in fostering customer loyalty.[9]

- *Travel time.* When jets were first introduced, there was a noticeable increase in consumer demand for air travel. The reduction of transcontinental flying time from ten to five hours made air travel far more convenient. It was easier, for example, for businesses to justify meetings which might not have taken place previously. On time performance is also a factor here, especially when the consumer chooses which carrier to use.

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[8] Transportation economists refer to the *gravity law of travel demand.* This indicates that travel demand falls with the square of the distance between origin and destination. Mathematically, this can be expressed as $Q_D = f(1/D^2)$, with D = distance and $Q_D$ = travel demand, a formula which is similar to the gravity law of physics. This law is considered to be relevant for almost all modes of transportation, although not applicable for air transport over short distances.

[9] See Tretheway (1989).

## B. Which Elements of Demand Are Most Important

The previous section listed a number of elements of consumer demand. All of these are, of course, important. Some of the factors are beyond the control of air carriers. Carriers cannot influence the level of income a consumer has, nor the price and convenience of other modes of transport.

Of the elements which the carrier can control, certain are of special importance. Clearly, price is one of the most important determinants of consumer demand. One of the greatest lessons of airline deregulation was that lowering price induces consumers to travel more often. Discount airfares opened a whole new market segment for air travel. In a series of studies of airline demand, Oum and Gillen found that a 10% drop in price would increase demand for air travel in Canada by 11-13%.[10] Another important variable is frequency of service. This is especially important for business travellers, for whom the ability to maximize their time productivity is very important. In a study of U.S. air travel demand, Morrison and Winston found that a doubling of the frequency of air service would lead to a 21% increase in demand for air services by business travellers.[11] For pleasure travellers, who are less sensitive to the availability of frequent flights, the increase would only be 5%. The importance of frequency of service is underscored by the observation that in the top 25 domestic city pair markets in Canada, the number of flights doubled between 1983 and 1989.[12]

While income is a consumer demand determinant outside of the control of the carriers, it is important to comment on its importance. In their study of Canadian airline demand, Oum and Gillen (1983) found an income elasticity in the range of 1.6-2.5. This means, that if the economy were to grow by 10%, then airline demand would increase between 16-25%. Very few goods in the economy are as responsive to income as is air transport. The negative side of this is that in an economic contraction, of say 3%, air travel is likely to fall off

[10] Oum and Gillen (1983), and Gillen, Oum and Noble (1986).

[11] Morrison and Winston (1986), p. 17.

[12] NTA (1990), p. 31. This was intended to measure the impact of regulatory freedom on service offerings by carriers.



somewhere in the range of 5-7%. Air travel is then, not just cyclic but procyclic. This procyclic behaviour has likely been exacerbated by airline deregulation. Gillen, Oum and Noble (1986) in a study of U.S. air travel, were able to distinguish between business travellers and leisure travellers. Business travellers had an income elasticity of only 1.5 whereas leisure travellers had an elasticity of 2.1. As deregulation, with its lower prices, has made the proportion of leisure travellers grow, the average income elasticity for the industry has been creeping more and more toward the leisure traveller extreme. This procyclical behaviour of air travel contributes to the financial challenges the industry faces. These are discussed in Section VII.D.

A recent study in the U.S. focused on four key factors in the consumer's choice of airlines. These are shown in ? Selection factors were determined separately for leisure versus business travellers. As can be seen, price is the key determinant for leisure travellers, although schedule convenience is close behind it. For business travel, schedule convenience is clearly of main importance. Price and frequent flyer programs (to be discussed further in Chapter 5) are virtually tied and have less than half the importance of flight schedules.

## C. Market Segmentation

As has already been alluded to, air travellers are not a homogeneous group. There are at least two broad submarkets. The traditional bread and butter of the industry has been the business traveller. This traveller, whose ticket is typically paid for by an employer, is concerned with maximizing the productivity of his or her time. As a result, this individual is very sensitive to the frequency with which service is offered. This traveller also needs an airline service which is flexible, in the sense of accommodating last minute changes in plans. Thus, high probabilities of being able to obtain a seat at the last minute are essential, as is convenient air service with the shortest possible elapsed trip time. Business travellers are generally willing to pay for the higher quality of service, and thus tend to be less responsive to prices.[13] On time performance and reliability of the airline to its published schedule are also important to this

[13] For example, Gillen, Oum and Noble (1986), found that in the U.S., the price elasticity for business travellers was only 1.15 whereas that for leisure travellers was 1.5.

| Factor | Leisure Travel | Business Travel |
|---|---|---|
| Price | 3.9 | 2.1 |
| Schedule Convenience | 3.2 | 4.5 |
| Frequent Flyer Program | 1.5 | 2.0 |
| Airline Reputation | 1.5 | 1.5 |

Source: P.L. Ostrowski and T.V. O'Brien (1991), "Predicting Customer Loyalty for Airline Passengers," Dept. of Marketing, Northern Illinois University, June.

**Table 1 Airline Selection Factors (mean value on a ten point scale)**

group of consumers.

The second broad segment of airline consumers is generally referred to as the leisure traveller. This traveller is travelling on personal time, and is not quite as concerned with maximizing time productivity. Thus, these individuals are less sensitive with respect to how frequent service is offered, or to the total elapsed time of the air trip. However, these individuals are very sensitive to prices, as already been discussed. Schedule reliability is also less of an issue for these travellers. Another important characteristic of this consumer segment is that they tend to make their travel plans well in advance. As a result, they can be induced to book and pay for their airline tickets weeks before the actual airline flight. In contrast, the business traveller may not know until a few hours prior to the trip that the trip is necessary.



Airlines have been able to exploit this fundamental difference in the two consumer segments by tailoring different types of service for the two groups. Leisure travellers are offered a service at a low price, but which requires advance booking and has limited flexibility for accommodating change in travel plans. The business traveller is offered a service with relatively good seat availability at the last minute, and with no restrictions on the ability to change plans. They are charged a higher price for this more expensive service. They cannot avail themselves of the lower prices offered to leisure travellers, as they cannot abide by the advanced booking requirement, and/or the restriction on changing plans.

There are, of course, various sub-segments of consumers within these two broad groups. Some business travellers need complete flexibility and are willing to pay for it. Other travellers, such as those going to pre-planned business conferences, tend to be somewhat more sensitive to price, and have an ability to accommodate the airline by booking early. Leisure travellers can also be broken into several subgroups. One distinction is between leisure traveller to holiday resorts, versus leisure travellers to visit friends and relatives (VFR). Some leisure travellers, for example retired grandparents, are willing to make their travel plans months in advance and will travel at inconvenient times of the day, week or year in order to get a better bargain. There are also non-business trips which must be booked at the last minute, such as visiting a sick family member or attending a funeral. Like business travellers, these individuals tend to be price insensitive.

## D. Demand Side Forces Favouring Large Carriers

Market equilibrium and therefore market structure is determined by the interaction of both supply (i.e. costs/production) and demand. In airline markets there are demand forces such that consumers prefer large airlines over small ones, all other factors such as prices being the same. In this context, large airlines mean those that serve a large number of points. Some of these forces have been present for some time, while others have been stimulated by marketing practices introduced since U.S. deregulation.

In practice, there are at least three reasons why consumers prefer large airlines. One reason is due to information costs. A traveller knows that a large carrier can get him or her to just about anywhere in the country, while smaller carriers serve only a limited number of communities. Travel agents act as intermediaries for the consumer, but even here large network airlines have an edge, such as when an agent in one region needs to book flights in other regions.

A second reason why consumers favour large airlines is attributable to the higher quality of service these airlines offer. If connections must be made, less of the traveller's time will be required with a single airline than when the trip involves switching airlines because single airline flight connections are more likely to be timed to minimize waiting time at intermediate points (hubs).[14] Consumers are also aware that there is a lower probability of baggage being lost or delayed with a single airline, as well as a higher probability that the same airline's outbound flight would be held for a traveller on a delayed inbound flight.

The third factor causing consumers to favour larger over smaller carriers is the existence of frequent flyer programs. These programs reward the *individual* for patronizing a single carrier (even though the fare for business travellers may be paid by their employers). It is much easier to accumulate points with an airline that flies to a large number of destinations.[15]

In sum, there are natural market forces favouring large airlines in spite of evidence of constant returns to "scale." These are economies of traffic density, and in addition, the demand side factors such as information costs, higher quality travel, and reward programs inducing consumers to favour large over small airlines. It appears that economies of traffic density can be fully exploited by an airline the size of Air Canada and thus further consolidation is unlikely to reduce its cost per seat kilometre by very much.[16,17]

[14] Using the results of Carlton, Landes and Posner (1980), the value of an on-line connection to travellers can be estimated to be about $31 (1989 Canadian dollars). I.e., the average consumer is willing to pay up to $31 to avoid a flight itinerary requiring a change of airline.

[15] See Tretheway (1989) for a discussion of the potential anti-competitive effects of frequent flyer programs.

[16] See Gillen, Oum and Tretheway (1985), especially Chapter 8.



## E. Travel Time and Consumer Demand

One of the consumer demand factors that has been found to be important is the total elapsed time from origin to destination. A carrier which can offer a noticeable reduction in the elapsed time will be more successful in attracting passengers. Airline economists have found it useful to break up total elapsed time into four separate components. The four components are:

- *Schedule wait time.* This is the time from when the consumer desires a departure to the availability of an actual departure.[18]
- *Airport access time.* This is the time for the traveller to get from their home or place of business to the airport, check in at the airport, clear security and customs, etc.
- *Flight time.* This is the actual time from scheduled departure to arrival at destination. This might be broken up into three separate components:
  - Deviation from scheduled times. Flights take longer than published because of late departures and/or arrivals.
  - Actual in-air time. This is the actual time spent flying in the aircraft. It is affected by type of aircraft (jet versus propeller), air traffic control and other delays, and degree of route circuity with hub and spoke systems.[19]

[17] Some would point out that the higher quality of service offered by a larger air carrier can be viewed as reducing quality adjusted cost. Cost per seat kilometre is the same, but the seat kilometre of a larger carrier my be viewed by the consumer as being a higher quality.

[18] For example, a sales manager may conclude negotiations in Toronto at 1:30 and would like to immediately return back to the office in Thunder Bay. However, if the next departure is not until 5:00 pm, then the traveller will incur a "schedule waiting time" of 3.5 hours.

[19] In Europe, flight circuity is a major factor due to air space restricted for military purposes.

- Hub connection time. This is the time spent on the ground at a hub airport making connections from one spoke of a flight to another spoke.

- *Denied boarding time.* Occasionally, a passenger must wait from their originally scheduled departure until the next departure because the original flight was overbooked and they were denied boarding of the aircraft.

The segmentation of total elapsed time allows identification of opportunities for reduction. For example, more frequent flights reduces schedule delay time. Use of a close-in or downtown airport, provision of door to door limousine services, or expedited check in procedures can reduce airport access time. Use of faster aircraft (jets versus turbo props, Concorde versus traditional jets) allows for reductions of actual in-flight time. Procedures asking for volunteers when aircraft are overbooked help shift the denied boarding time component to those travellers less sensitive to total elapsed time. Sometimes, there are trade-offs between the various time components. The next section discusses one of the most important trade-offs: that between frequent air service with a one-stop hub connection versus infrequent but non-stop service.

## F. Effects of Hubs on Passenger Travel Time, Schedule Delay Time, and Passenger Demand

This section discusses the effects of hub and spoke routing networks on passengers' travel time and schedule wait time. A more complete discussion of hub and spoke systems can be found in Chapter VI, Section B.

**Effects on Passenger Travel Time and Schedule Delay Time.** As compared to non-stop flights, a hub and spoke network increases the average passenger's in-flight time because of the need for extra connecting time at the hub and the circuitous routing of the passenger's trip. On the other hand, it can also reduce the passenger's "schedule wait time," in the sense of Douglas and Miller (1974), due to the increased frequency of service on each route.



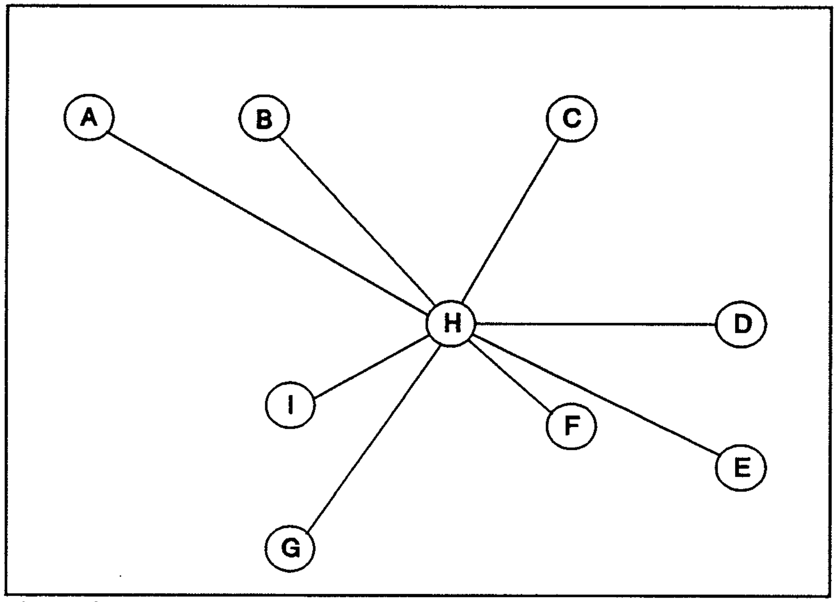



**Figure 6: Hub and Spoke Network**

As compared to a non-stop flight, a passenger flying from city A to city D via hub H (see **Figure 6**) faces an additional time penalty of the following magnitudes:

1) Roughly 30 minutes due to the *additional descent and ascent* at the hub.

2) Perhaps an average of 60 minutes for *time to connect* from one flight to another at the hub (Kanafani and Ghobrial [1985] use 60 minutes).[20]

[20] This is an average. Some passengers may be able to obtain connections of as little as 25 minutes, while at least a few others will need to wait more than an hour. An inspection of Figure 30 reveals that for Delta's Atlanta hub, the start of the arrival bank and the start of the departure bank in a complex are roughly separated by one hour.

3) *Extra cruise time* required for the circuitous routing. This extra cruise time depends on both the angle between the spokes connecting two stations through the hub and the relative distances of the two cities from the hub. This is shown by the law of cosines in **Figure 7**. A large angle (e.g. linking cities B to E through H in Figure 6) adds very little time, whereas a small angle with an equal distance (e.g. linking cities C to D via H in Figure 6) adds a great deal of extra time. As the distance on one spoke shortens, the circuitous routing time penalty will drop (e.g. A to F in Figure 6). Because of the time penalties of circuitous routing, passengers will be unlikely to fly via a hub when the penalty is high. Thus, in Figure 6, routings such as F-H-E and C-H-D may not be "viable."

The total time penalty of a hub versus non-stop flight is thus approximately 90 minutes plus the circuitous routing time. For purposes of exposition, let us assume the average angle through the hub of viable city pairs to be 125°. With spoke lengths equal, on average, this implies a circuitous routing penalty of roughly 25%. Assuming a typical flight through a hub involves two hours of flying time, the circuitous routing penalty is 30 minutes. The total time penalty is thus 120 minutes as compared to a non-stop flight.[21]

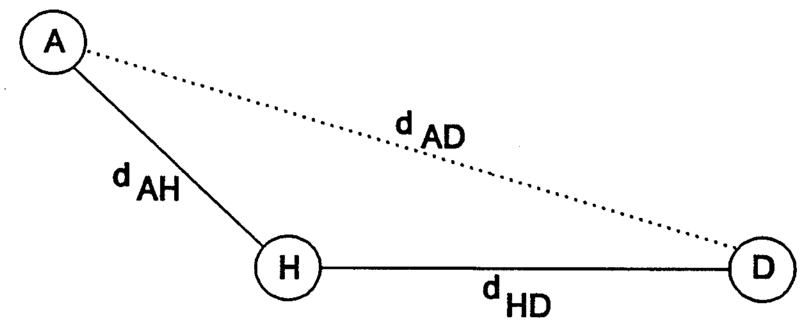
However, a hub and spoke system could allow the airline to increase schedule frequency.[22] The increased frequency reduces the passenger's "schedule wait time," the time between the passenger's desired departure and the actual departure time. The reduction in schedule wait time depends on the increased frequency with the hub and spoke system versus a system of non-stop flights. Assuming consumers' desired departure time are uniformly distributed over 14 hours per day,[23] one flight per day means that the expected frequency

[21] Prior to hubbing, airlines sometimes built up sufficient traffic to justify a flight by making multiple stops. Where this was the case, one stop hubbing may actually reduce travel time.

[22] This is discussed in Section VI.B.

[23] In reality, desired departure times tend to be at the beginning or end of the business day. Airlines try to schedule flights at desired times, but due to limitations to equipment availability not every low traffic point will receive an early morning flight.






$$d_{AD} = \sqrt{d_{AH}^2 + d_{HD}^2 - 2\, d_{AH}\, d_{HD} \cos(H)}$$

where cos(H) = cosine of angle from AH to HD

**Figure 7: Hub and Spoke Networks and the Law of Cosines**

delay is seven hours for an average passenger.[24] As the departure frequency increases to two, three and five flights per day, the schedule wait time decreases to 3.5, 2.3, and 1.4 hours, respectively. For the case when a move to a hub and spoke system increases frequency from one to three flights per day, schedule wait time is reduced from seven to 2.3 hours, a saving of 4.7 hours.

The total effect on travel time is thus the difference between the time penalties (extra ascent/descent, connect time, extra cruise time) and the

[24] Assume the single flight per day is at 11 a.m. Some passengers would prefer a 7 a.m. flight, and thus have a schedule delay of 4 hours. Some would prefer a 10 a.m. flight for a delay of one hour. Some would prefer a 6 p.m. departure and will need to wait 17 hours for the flight the next day. Alternatively, they could take the earlier flight, but nevertheless will experience disutility because of it.

reduction in schedule wait time.[25] For the example worked out above, this comes to a net decrease of 160 minutes: time penalties of 120 minutes offset by a reduction in schedule wait of 280 minutes (4.7 hours). Actual reductions will vary for each route (and passenger), of course.

**Effect on Passenger Demand.** The move to a hub and spoke system will affect passenger demand in several ways. As discussed, the hub system will affect passenger travel times; negatively for routes already with high frequency and those involving backtracking, and positively for routes which previously had infrequent service or involved multiple steps. However, there are other effects as well. These include the disutility of making connections, the effect on price and the effect of allowing the airline to serve many more city pair routes when new stations are added. Each of these are now discussed.

*Hub Disutility.* A hub and spoke system can increase the number of transfers required to get from origins to destinations. This reduces the comfort and convenience of the passenger. We are all familiar with the "joy" of getting off one crowded airplane and boarding another. There is the potential to miss a connection if the inbound flight is late. These factors create "disutility" for the passenger. Disutility can be valued; the passenger is generally willing to pay to avoid these hassles (i.e. willing to pay somewhat more for a non-stop rather than a one-stop flight). The route choice model estimated by Kanafani and Ghobrial (1985) can be used to show that the revealed value of one transfer to a connecting flight is worth about 1.75 hours of transit time. Since the time required for a passenger to make a connection, one hour, was taken into account in Section A, the pure disutility of making a transfer is equivalent to a time delay of about 45 minutes. Assuming that the value of time is $30 per hour, then the value of the hub connection disutility is $22.50.[26]

[25] Typically, "schedule wait time" can be used more productively than other delay times, thus the former should be given a lower weight than the latter in aggregating for the total time effect. With schedule wait time, for example, a businessperson can be productive working in the office, making phone calls, etc. In-flight time cannot always be used to full productivity.

[26] The value of $30 was estimated by Kanafani and Ghobrial (1985). De Vany (1974) estimated a value of $10 per hour. This would translate into roughly $27 in 1987. If these figures for the value of time appear high, recall that the typical airline passenger has a higher income than the population at large.



*Effect on Price.* Passenger demand for travel is highly responsive to price. Oum, Gillen and Noble (1987) as well as De Vany (1974) estimate the air travel price elasticity at about -1.2. Adoption of hub and spoke systems can affect price in several ways.

First are effects on costs. A move from non-stop to hub flights increases flight times, hence fuel and crew costs, etc. These extra costs can be offset in a number of ways. The move to hub and spoke systems can lead to increases in average traffic densities with a resulting drop in unit costs (e.g. spreading fixed station costs over more passengers).[27] The frequent routing of aircraft through the hub could allow more opportunities to increase aircraft utilization, achieve economies in maintenance, etc.

Second, the adoption of hubs and the resulting increase in city pairs served (see Section VI.B) can allow the carrier to better utilize its inventory of unsold seats via modern seat management techniques [see Kraft, Oum and Tretheway (1986)]. This may result in offering deep discounts for lightly travelled segments that can now be connected to popular destinations with a resulting increase in system-wide passenger demand.

*Effect on City Pairs Served.* If a new station (let's call it K) had been added to the non-hub route structure in **Figure 8** via a flight to say F, then only a handful of new city pairs would be viable. If viable city pairs are those involving one stop, then the addition of K to F opens up three new city pairs (KF, KD, and KI). In contrast, adding a new station to a hub already serving (N-1) cities, opens up service to N new origin-destination pairs (including the OD pair from the new station to the hub).[28] Theoretically, a hub system with N stations (including the hub) will provide zero or one stop service to N(N-1)/2 stations. This greatly "levers" the effect of adding stations to an existing hub. For example, by increasing the number of stations connected to a hub from 9 to 14 (total stations including the hub rise 50% from 10 to 15), the number of OD pairs served more than doubles from 45 to 105.

[27] This was discussed in Section II.B.

[28] Of course due to backtracking, not all N new city pairs will be viable. This shows the advantage of adding stations in directional hubs where more OD pairs will, on average, be viable for a given N. See Section VI.B.

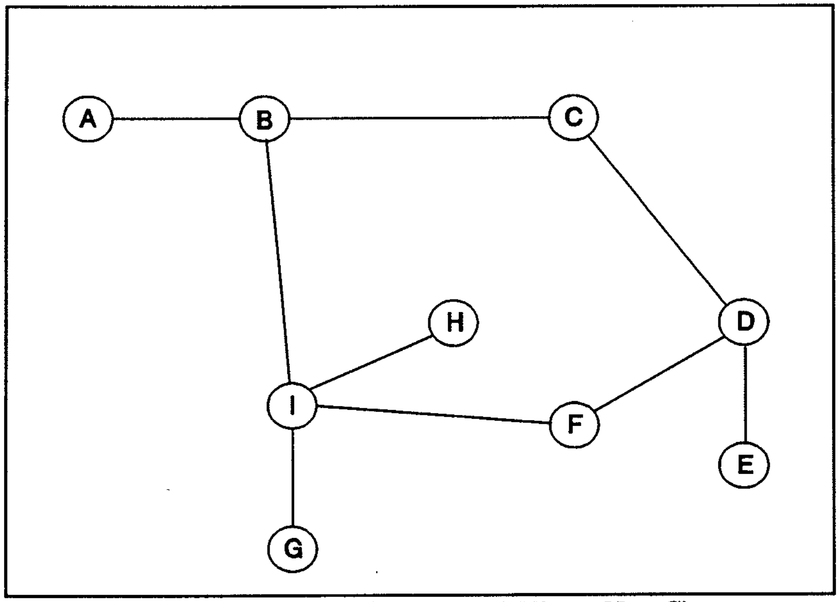



**Figure 8:** **Non-Hub Route Structure: Adding a New City**

One of the important consequences of this leverage is that it can make service to smaller communities viable. A community which generates as few as two passengers per day to each of 30 cities in a network can justify a daily jet flight. If, on average, it can generate six passengers per day in each OD pair, then three jet flights a day may be possible. This seems to have been a major "discovery" for some carriers after deregulation. Immediately after the regulatory reigns were loosened, some of the major carriers dropped service to small communities. As hubs have been established, however, they restarted jet service to small communities by tying them into their hubs.

**Summary of Demand Effects of Hubs.** In summary, hub systems have both positive and negative effects on demand. They involve some important time penalties as well as disutility associated with making a connection rather than flying non-stop. On the other hand, they can significantly reduce the passengers' schedule wait and add many OD pairs to the network. Costs can go down due to higher traffic densities, but these are offset by the circuitous routings sometimes involved in hub operations.



## G. The S-Curve Effect of Flight Frequency

The importance of flight frequency as a key determinant of the consumer's choice of airline has been expressed by aviation economists in an S-curve. **Figure 9** shows this phenomena. It shows that as a carrier adds flights in a market it can gain a disproportionate share of total market traffic. For example, in a two carrier market, the one with 60% of the flights may receive 80% of the passengers.

This phenomena is consistent with the earlier data on the importance of schedule convenience in the consumer's choice of carrier. This is especially important for the business traveller. The power of the S-curve is further enhanced because the business traveller also tends to pay higher airfares. Evidence in Section 5.B suggests that business travellers account for two-thirds of industry revenues.

The S-curve effect may be an important factor in the strategic power of hub and spoke systems. As described in the previous section, hubs have considerable traffic generating power. As a hub carrier adds flights on a spoke, it will likely pick up increasing portions of the traffic on the route, making it more difficult for a competitor to maintain its share of the market. As this effect takes place on an increasing portion of the spokes from a carrier's hub, the carrier's strength in the market becomes formidable. This phenomena is sometimes referred to as *fortress hubs*.

## H. Overbooking

One final aspect of consumer demand is that some travellers do not always show up for flights they have booked. In 1961, it was estimated that 10

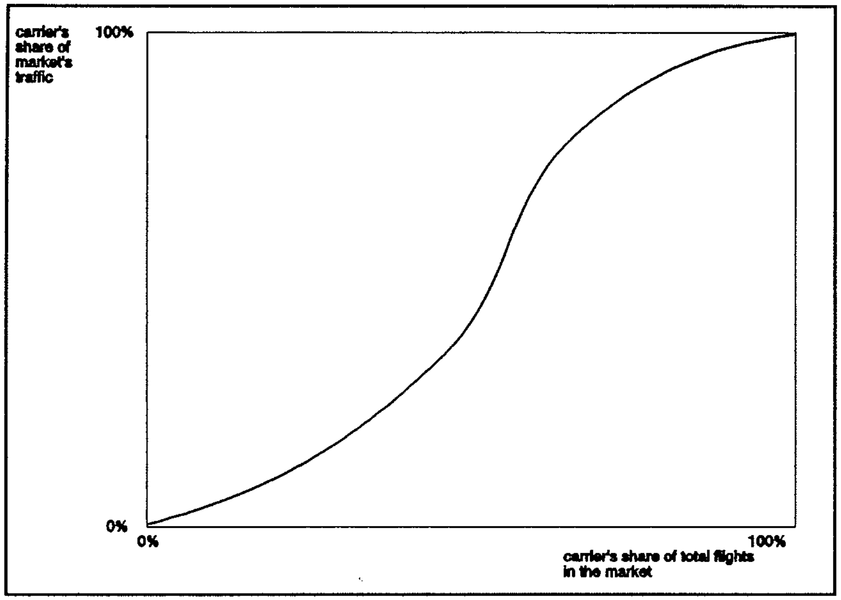



**Figure 9: The Flight Frequency S-Curve**

percent of passengers did not show up for their flights,[29] and in 1982 it was suggested that this figure was 20 percent.[30] Business travellers frequently fail to show up for flights, as their plans change from moment to moment. While leisure travellers flying on discount tickets tend to be more reliable in their travel plans, they too miss flights due to ground traffic, illness, etc.

Because of this stochastic (random) nature of consumer demand, airlines have offset the resulting loss of revenue by the practice of "overbooking"

[29] Economic Regulation Docket 11683, Civil Aeronautics Board, Washington, DC, 20 July 1961. See Discussion in Ruppenthal and Toh (1983).

[30] James (1982), p. 285.



flights.[31] Thus, if experience shows that Flight 147 has an average 15 percent no-show rate on Thursdays, then the airline may actually sell 108 seats even though the aircraft only has 100 seats.[32] This works fine for both airline and consumer if the actual number of "no-shows" is the same or higher than the average. Sometimes, however, all the booked passengers show up, and some must be turned away due to a lack of seats.

Prior to deregulation, carriers dealt with this "denied boarding" situation using a "first come-first served" rule.[33] However, the passengers who show up early tend to be those who are more willing to shift to a later flight. Business travellers, whose time is highly valued, tend to show up at the last minute. Recently, airlines have been given some freedom to change the rule as to which passenger will be denied boarding. While first come-first served remains the ultimate rule of last resort, they first attempt to solicit volunteers to wait for the next flight. As incentives, they may offer volunteers free travel, discounted travel or cash. This approach is generally acknowledged as being superior for all concerned.

## I. Air Cargo

Thus far, the demand for airline services has been discussed only in the context of passenger transportation. Carriers also provide significant amounts of cargo services. Air Canada reported that cargo accounted for 11% of its 1989 revenues while Canadian Airlines International's cargo accounted for 8%.[34] Just as passengers can be broken into two main market segments, cargo is segmented into air freight and air express. Air express generally consists of small size shipments which are very time sensitive. Air freight generally

[31] It should be noted that the loss of revenue is attenuated or eliminated for some discount tickets which attach penalties for change of plans or failure to show up for flights.

[32] The setting of the ratio of allowed oversales to the *average* no-show rate is very complicated. It varies by airline, city pair market, day of the week, hour of the day, etc.

[33] Government regulations in North America stipulated (and this is still the case) minimum compensation levels carriers would have to pay bumped passengers. In much of the rest of the world, there are no such minimum requirements for denied boarding compensation.

[34] Source: 1989 carrier annual reports.

onsists of larger size shipments, which are somewhat less time sensitive. Each f these are discussed.

*Air freight* can be further divided into three submarkets:[35] a domestic rice sensitive market, a domestic service sensitive market, and an international ransoceanic market). The price sensitive market consists of freight which can e easily diverted to other modes, especially truck. This class of freight ypically tolerates delivery times of one to two days. Unutilized belly space in assenger aircraft is well suited to this type of cargo. As freight is typically ndered late in the day, it usually will not fly until the following day's assenger flights, with ultimate delivery between 24 and 48 hours. Such traffic an be priced on an incremental basis, as passengers generally cover all the verhead costs of the flight. Belly space cargo revenues can represent a ibstantial increment to passenger carrier profits. Further, airlines without argo traffic bases, are at an important competitive disadvantage.

The smaller service sensitive domestic cargo market cannot wait for the ext day's passenger flights, and requires dedicated cargo aircraft, generally perating at night. Cargo too large to fit in bellyholds must also travel in edicated cargo aircraft. However, this traffic must be priced to cover the full osts of the flight, and thus is very expensive.

For inter-oceanic movements, longer delivery times are tolerated by the iipper. The only competitive service is liner shipping which has very long ansit times. The large cargo carrying abilities of the typical transoceanic assenger aircraft provide a reasonable amount of "space-available" lift which in be incrementally priced. Dedicated cargo aircraft are also operated for the ore time sensitive shipments. Sea-air combinations, which offer mid-range ice and service option between that of all-air and all-sea, are becoming more mmon.[36]

[35] See Weise (1980), pp. 35-37.

[36] An example of a sea-air service would be movements of fashion apparel from Asia to Europe. sea-air routing puts the goods on a liner ship from Asia to the West Coast of North America (with rival times less than a week). At this point, the goods are trans-shipped to an aircraft destined for ırope, providing total delivery times of less than ten days--which is very attractive relative to a sea-ly routing.



*Air express* was a small and expensive market segment until the debut of Federal Express in 1973. This market is highly service sensitive. The goods cannot wait until the next day's passenger flights. Thus, dedicated cargo aircraft flying overnight are required. While the costs of dedicated freighters is very high, the small size of express packages results in attractive economics. For example, transporting a 90 kilogram passenger (including baggage, carry-on luggage, meal service, etc.) one-way on a transcontinental passenger movement will generate $200-$800 of revenue, depending on whether the passenger is paying a discounted or full fare. The same 90 kilograms of lift could be used to transport 450 parcels of 200 grams each in one direction. At an average revenue of $8.00, the cargo revenue of $3,6000 is 4 to 18 times the passenger revenue. From this, the costs of local pick-up and delivery must be deducted, but the bottom line is still attractive. The key to the air express market is the high willingness to pay for the service, relative to the weight. Air freight (or passengers) generally does not have the same ability to pay per 200 grams.

Hub and spoke systems tend to be conducive to air express operations. Just as Section III.F described the levered effect a hub has for collecting passenger traffic from a new spoke, similar effects occur for cargo. However, cargo is not sensitive to backtracking, and thus a single multi-directional hub works well for air express.[37] Thus, an express package from San Diego to Seattle will likely travel via Memphis. Passengers generally will not tolerate such circuity.

[37] Section VI.B describes directional and other types of hub systems.

## Chapter 4

# Airline Pricing: Yield Management

## A. Introduction

Airline pricing in the deregulated era is significantly different than it was in the regulated era. Under regulation, the government placed severe constraints around an airline's ability to establish prices. In general, regulators in Canada as well as the U.S. followed formulas for establishing coach and first class fares. Any discount fares or other innovative fares were generally not allowed. Fares were set primarily on the basis of mileage. This was unfortunate, as often short distance routes which are operated with small aircraft can end up being more expensive than flying much longer distances when large aircraft filled with revenue paying passengers are used. Also, there was no variation allowed in prices to recognize that certain times of the day or week had higher demands than other times.[38]

When deregulation began, the carriers were freed from these constraints and found they had a blank sheet of paper for setting prices. Fortunately, a pricing technique, variously known as airline yield management, seat management, or revenue management, had been developed and was waiting for them.[39] This technique was developed by Boeing Commercial Airplane

[38] Carriers were sometimes allowed a small peak season surcharge.

[39] See Kraft, Oum and Tretheway (1986) for a discussion of the history of airline yield management.



Company.[40] Airlines, with their enormous computer systems and databases, had long had the ability to predict reasonably well how many seats would go empty for each and every flight. Yield management is simply a technique for selling these seats which have been predicted to go unfilled. The trick is to sell these seats to people who normally would not fly. These people could be induced to fly by offering the airline service at a significant discount. The challenge is to prevent existing customers from taking advantage of the discount. This is accomplished by placing restrictions on discounted tickets. The restrictions must be chosen such that very few of the existing travellers are willing to abide by them in order to access the discount. It has been found that business travellers are typically willing to continue to pay the historically high airfare in order to retain the ability to obtain a seat at the last minute, and to change their plans at will. Discount seats are only made available to those who can commit and pay for the ticket weeks in advance, and who are willing to forego any opportunity to change their plans.

To the airline consumer, airline pricing seems illogical and incomprehensible. Why should two passengers on the same aircraft sitting side by side be paying significantly different airfares? Why are there no "good" seats (i.e., discount seats) available on Wednesday, but a call on Friday reveals the availability of such seats? These seeming paradoxes can be comprehended with a grasp of the fundamentals underlying airline yield management. Section C describes yield management. Most of the concepts which will be used are relatively straightforward. The one concept which might be unfamiliar to some readers is that of a probability distribution. Probability distributions are briefly discussed in Section B.

## B. A Probability Distribution for Airline Demand

An airline forecaster has large amounts of data available. Flight 147 has been operating every day at 9 am for three years. There are almost 1000

[40] It is perhaps not surprising that Boeing actively developed this pricing system. If airlines were to offer seats at discounts, air travel would inevitably increase. This, in turn, would increase the demand for aircraft. Aircraft manufacturers' order books were very lean during the early and mid-1970s. From the late 1970s to the present, their order books have been sizeable, at least in part reflecting traffic stimulation by airline deregulation.

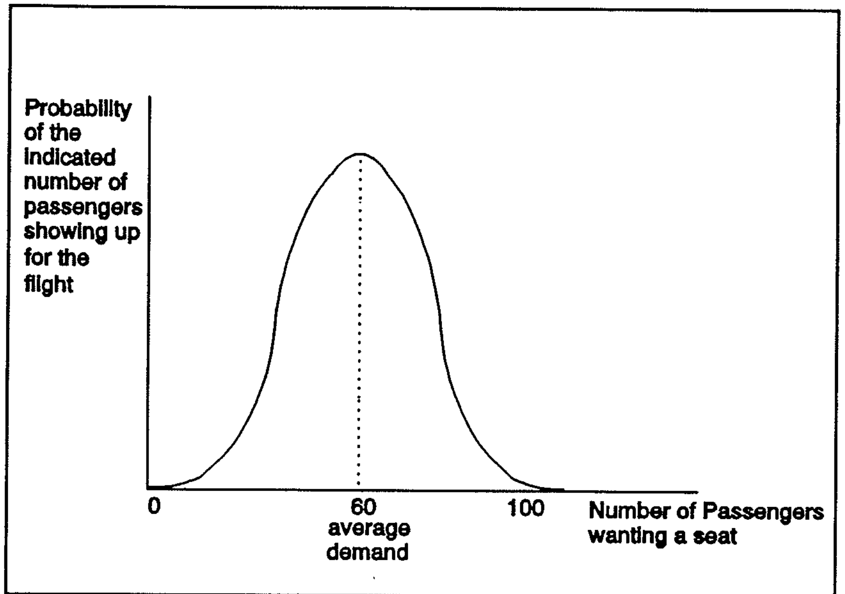



**Figure 10: Probability Graph of Airline Sales of Seats on Flight 147**

observations on how many seats have been sold on that flight. The forecaster can readily determine that, on average, 60 seats are sold on the flight. However, on some days sales will be fewer and some days they will be more. Using statistical techniques, the forecaster might determine that there is a 15% probability of selling 60 seats, a 10% probability of selling between 61-65 seats, an 8% probability of selling between 66-70 seats, etc. While this information can be kept in a cumbersome table known as a probability distribution, statisticians typically display it in a probability graph. An example probability graph for Flight 147 is given in **Figure 10**. This shows that the demand level with the highest probability is 60 seats. The further the deviation from the average of 60, the lower the probability of actually selling that number of seats. There is some probability, although a low one, that 100 seats would be demanded, and similarly a very low priority that no seats will be sold. This probability graph is a convenient representation of the statistical information on the demand for seats on Flight 147. It is used by the airline for determining



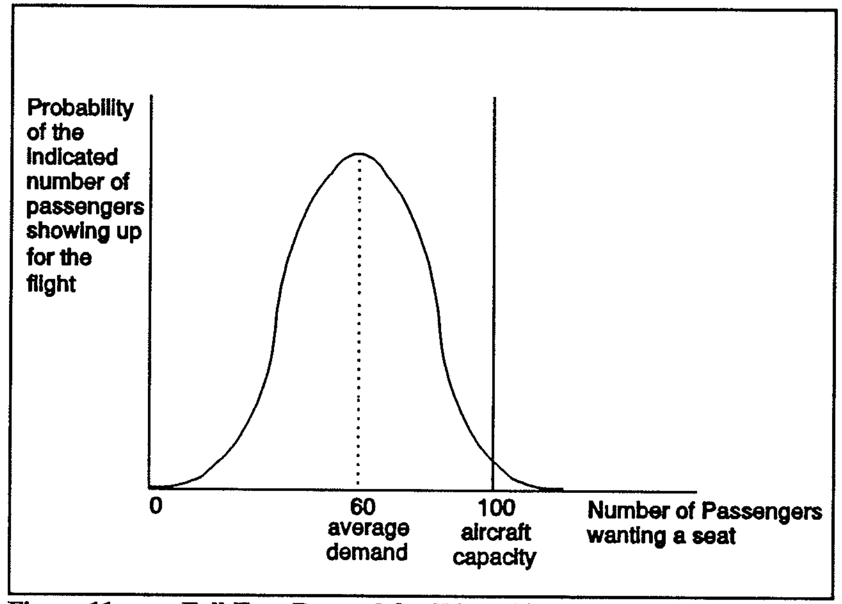



**Figure 11: Full Fare Demand for Flight 147**

how many seats are likely to go unfilled unless new travellers can be tempted by discount fares.

## C. Yield Management Fundamentals

For yield management to work, it is essential that the airline be able to predict, with a reasonable degree of accuracy, demand for each and every one of its flights. The advent of the modern computer reservations system has made this possible. By analyzing the results of perhaps millions of flights, reasonable short-run predictions are possible. Further, these systems also allow the determination of the probability distribution of demand for a flight. This allows the airline to predict not only how many seats *on average* it will sell by the flight's departure, but also how many seats it ought to keep available for existing customers if it wishes to accommodate all full fare passengers, say 95%

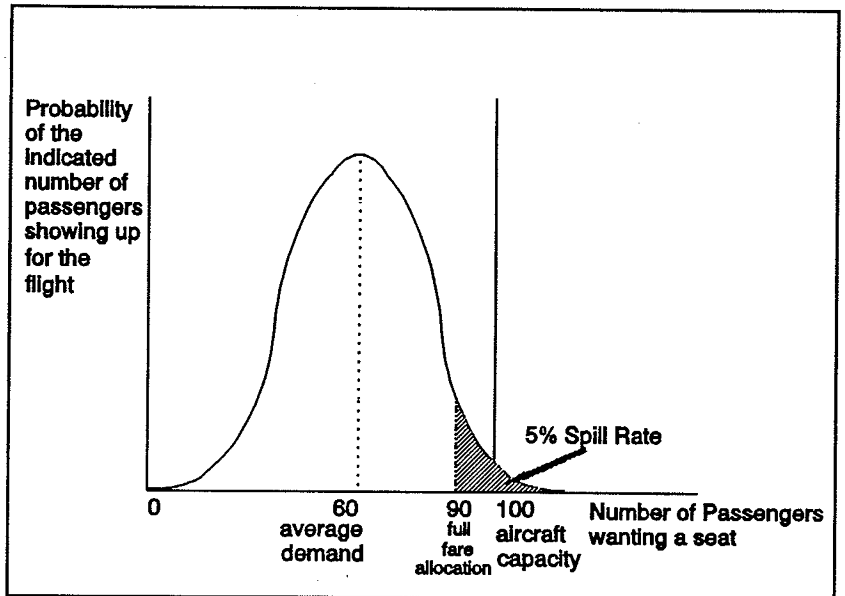



**Figure 12: Full Fare Seat Allocation**

of the time.[41] This information can be utilized to maximize a given flight's expected revenues. This is done by reserving an adequate number of seats to accommodate full fare passengers, and to make any remaining seats available to new customers at a discount.[42] A typical yield management system follows

[41] The probability distribution can be used to indicate things such as "95% of the time, sales will be 90 seats or less--only 5% of the time will sales be 91 seats or greater."

[42] It would be unprofitable to always hold all seats for full fare customers, as much of the time, many seats will be empty. Airlines instead target a certain customer service level of say 95%, and sell the rest of the seats at discount. The 95% figure indicates that 5% of the time, some full fare customers will call and not get on their first choice flight. These "spilled" passengers will shift to other flights, although in a few cases they will shift to a competitor airline. The choice of the customer service level is difficult. It should be high enough to prevent customers from routinely being discouraged, but not so high as to be unprofitable. These choices are faced by most businesses: retail outlets, restaurants, etc. Some days your favourite restaurant runs out of the grilled salmon, and you have to choose something else. It is unprofitable to stock inventory for the rare cases of exceptionally heavy demand.



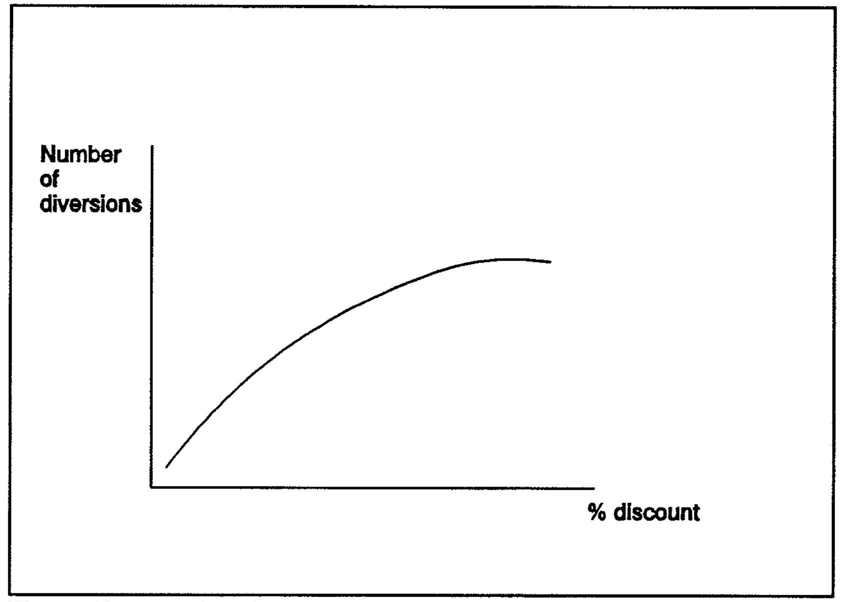



**Figure 13: Diversion From Full Fare Class to Discount Fare Class**

these steps:

**Determine the Capacity of the Flight.** The first step is determining how many seats will actually be available for sale on a specific flight. This is often predetermined. Flight 147, for example, is always flown with a 100 passenger Boeing 737. In some cases, airlines with fleets with varying number of seats per aircraft will attempt to optimize the assignment of aircraft to flights in an attempt to maximize its profits. This optimization of the flight schedule is a very complex process and is not covered here. For simplicity, this discussion assumes that a 100 seat aircraft has been allocated to Flight 147.

**Forecast the Demand by Full Fare Passengers.** The next step is to rely on the airline's historical database of Flight 147 and related flights to forecast (1) the number of *full fare* passengers expected to fly; and (2) the

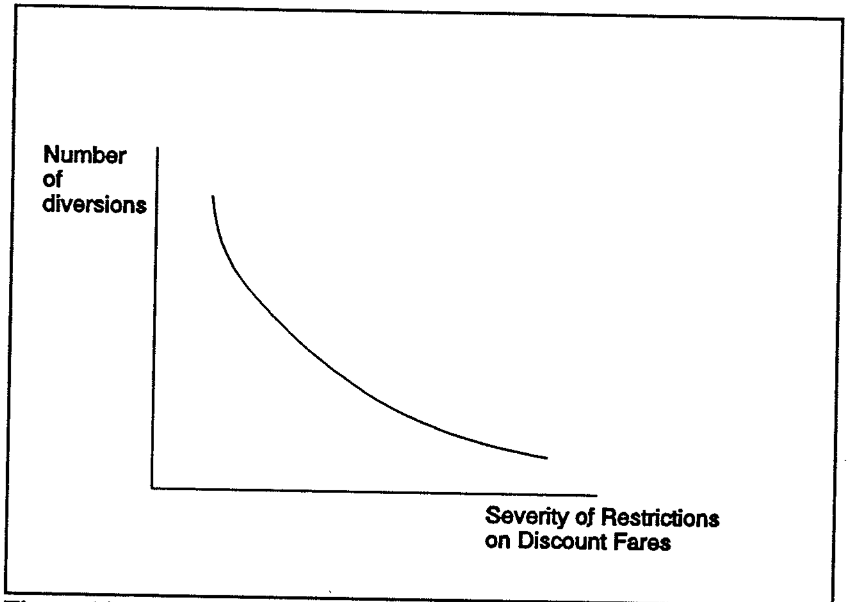



**Figure 14:** **Severity of Restrictions and Diversion from Full Fare Class.**

probability distribution around the expectations. **Figure 11** demonstrates this. Based on experience with this and related flights, Flight 147 has an average demand of 60 full fare passengers.[43] There is a probability associated with the actual realization of 60 as well as with the realization of any other number of seats. It has generally been observed that passenger demands are normally distributed.[44] The capacity of the airplane is indicated in Figure 11 with a solid vertical line at 100 seats. Note that there is a small probability that demand could be greater than the 100 seat capacity of the aircraft.

**Determine a Spill Rate and Reserve Seats for Full Fare Customers.** The next step is to determine how many seats should be allocated

[43] Statisticians use the term "expected" demand for average demand.

[44] See, for example, Brenner (1982).



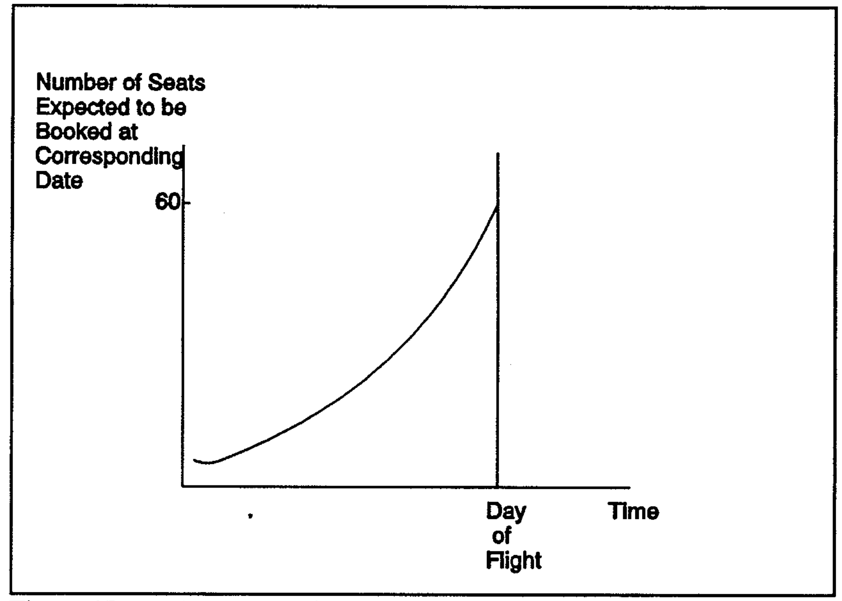



**Figure 15:** **Expected Flight Booking Curve**

on this flight for full fare passengers. This is done by choosing a probability level for seating all full fare passengers. For example, the airline might choose to allocate seats to full fare passengers such that 95% of the time all full fare passengers will be accommodated. The use of a spill rate of 95% is arbitrary. Actual spill rates are closely guarded airline secrets. This is easily determined using the probability distribution of demand for the flight. **Figure 12** shows that if 90 seats on Flight 147 are allocated to full fare passengers, then 95% of the time all full fare passengers will be accommodated. If only these 90 seats were available to the full fare passenger, then 5% of the time some customers will be turned away. This 5% is referred to as the "spill" rate. Not all of the "spill" is actually lost to the airline. Some of these potential customers will be captured

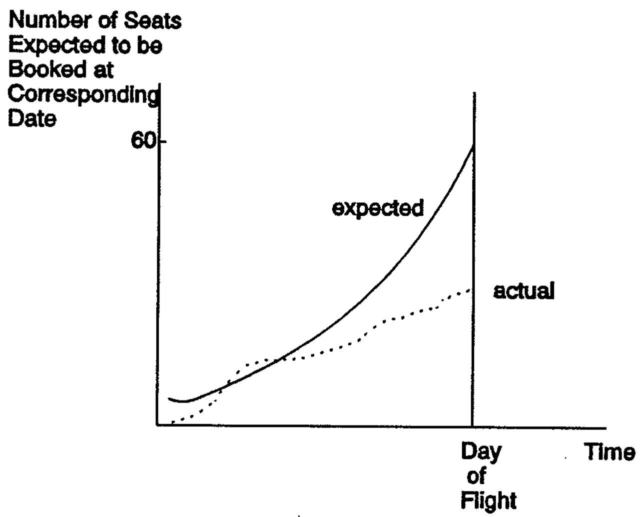



**Figure 16: Actual Versus Expected Bookings**

on other flights of the same airline.[45] A good yield management system accounts for this.

**Assign Remaining Seats to Discount Fare Classes.** Figure 12 indicates that ten seats are now available on Flight 147 for a discount fare class. This is the difference between the 100 seat capacity of the aircraft, and the 90 seats reserved for full fare passengers.

**Determine Discount Fare Level and Restrictions.** The airline must now sell the remaining ten seats to new customers. This requires choosing the level of the discount fare and associated restrictions. Restrictions

[45] Flight 147 is a 1 p.m. flight. Some of the spill will be recaptured by Flights 145 (10:45 am) and 149 (3:15 pm).



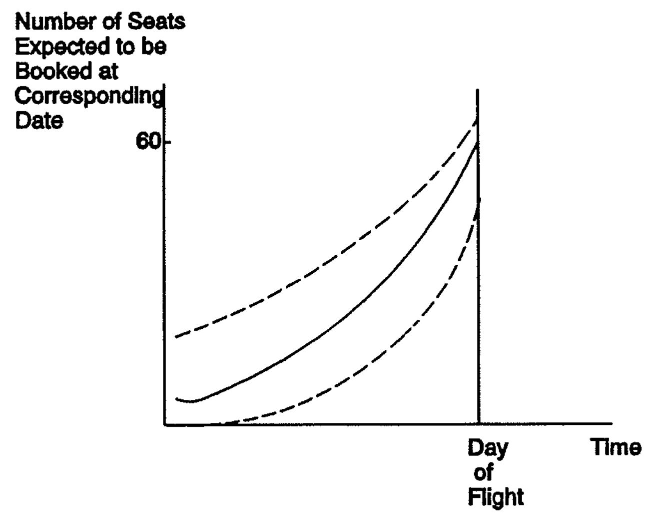



**Figure 17: Threshold Range**

are essential if the airline is to limit the full fare passengers from availing themselves of the discount fare. The discount level and associated restrictions should be chosen to maximize the amount of revenue the airline can get for these seats. If demand for these seats is high, the airline will only offer a modest discount. If demand is low, the airline might offer deep discounts.

A discount has two effects. The first effect is "stimulation." That is, the discount fare attracts those who would not have flown. The second effect is "diversion." Some of those who would have flown at the full fare, will divert to the discount fare.[46] Luckily, with modern yield management systems, the

[46] Economists would say that there is a positive cross elasticity of demand between the two products: unrestricted full fare seats versus restricted discount seats. See, for example, Oum, Gillen and Noble (1984). "Demand for Fareclasses and Pricing in Airline Markets," (Working Paper No. (continued...)

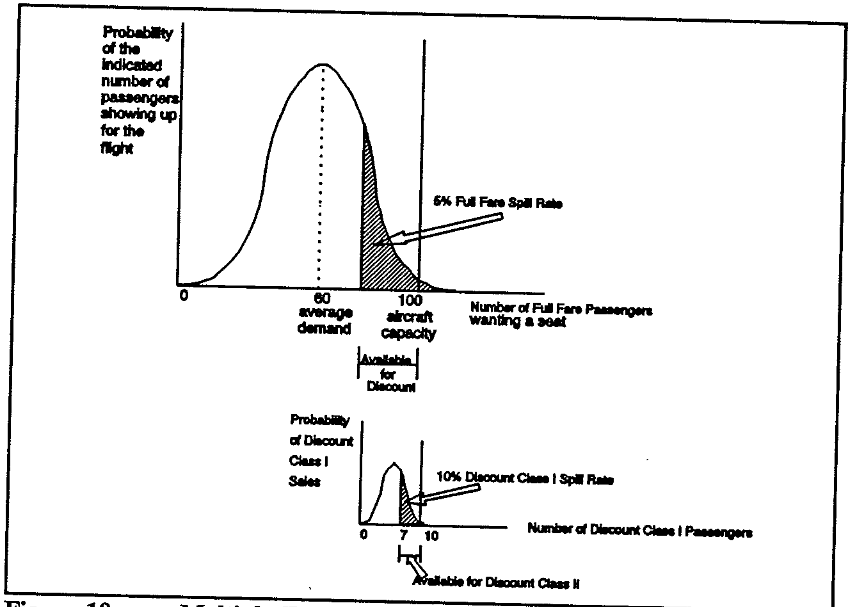



**Figure 18: Multiple Fare Classes**

amount of this diversion can be predicted. It has been found that the amount of diversion is positively related to the size of the fare reduction. See **Figure 13.** Airlines have found in recent years that with large fare reductions, they get substantial stimulation and diversion of traffic. With smaller fare reductions, the amount of diversion is considerably reduced.

The airlines have also observed that the number of diversions is inversely related to the severity of the restrictions on the discount fares. See **Figure 14.** For example, there will be fewer diversions to a 60% discount fare when the restrictions include 90 day advanced booking, 60 day advanced purchase, 14 day minimum stay, 31 day maximum stay, and no cancellation

[46](...continued)
1000, Faculty of Commerce, U.B.C.) for estimates of our own and cross-price elasticities on various major U.S. routes.



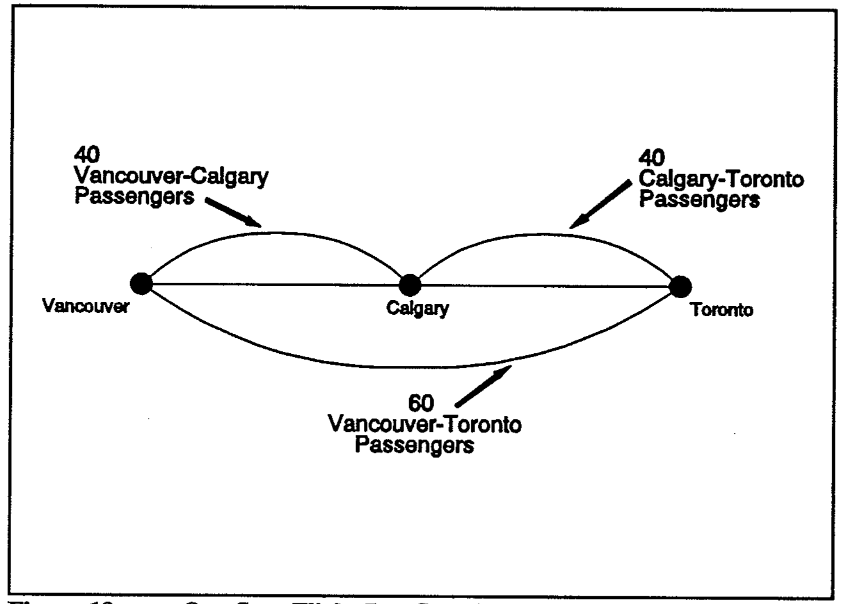



**Figure 19: One-Stop Flight Leg Seat Allocations**

privileges; than to a 60% discount fare where the only restriction is three day advanced purchase and staying over a Saturday night. **Table 2** gives a list of some typical restrictions used by airlines.

## D. Other Yield management Issues

Three other issues associated with yield management programs are now discussed.

**Dynamic Adjustment of Seat Allocations.** The above discussion was for a one time "static" allocation of seats between full fare and discount classes. This is typically done three to six months before the actual date of the flight. In practice, most airlines revise their expectations of the demand for the flight as they gather information on actual sales for the flight. This is typically done using a "booking curve." **Figure 15** is an example of this.

| | |
|---|---|
| **Advanced booking** | Book seat at least $N_1$ days in advance of flight |
| **Advanced purchase** | Pay for ticket at least $N_2$ days in advance |
| **Minimum** | Time between originating flight and return flight must be at least $N_3$ days |
| **Maximum stay** | Maximum of $N_4$ days are allowed between the originating flight and return flight |
| **Return (or round trip) ticket** | Ticket must be round trip to qualify for discount. This excludes one way, triangular or complex itineraries |
| **Saturday night stayover** | There must be a Saturday night between the originating and return flights |
| **Refund penalty or no refund** | If booking cancelled before flight, traveller forfeits all or part of airfare |
| **Rebooking fee or no rebooking privilege** | If traveller wishes to change to another flight for originating and/or return flights |
| **Limited or no stopover privileges** | On a flight from Toronto to Rome via London, traveller cannot spend time in London |
| **Limited or reduced service** | Reduced service depending on fare type, e.g., reduced in-flight service |
| **Limited to specific time of day** | e.g., Nighthawk or Redeye service |
| **Class of service restrictions** | If flight full, no upgrade privilege to a higher class which might have empty seats |
| **No interline privilege** | Tickets cannot be endorsed to another carrier |

**Table 2: List of Fare Restrictions Typically Used by Air Carriers**



As the day of the flight approaches, more and more of the full fare seats should be booked. In the example, the expectation is that on the day of the flight, 60 full fare seats should have been booked. The shape of the curve is drawn intentionally to reflect the fact that most full fare passengers book close to the day of the flight.

The airline compares actual bookings against this expected booking curve. **Figure 16** is an example. Here we see that actual bookings are falling below expectations as the day of the flight approaches. In this case, the airline may choose to increase the number of seats it has available in the discount fare categories or decrease the discount fare. If bookings run ahead of expectations, then the carrier might choose to reduce the number of discount seats available on this flight or increase the discount fare. By tracking actual versus expected bookings, the airline obtains better predictions of the number of seats that will be flown empty as the flight date approaches.

Since airlines may have to track thousands of flights on any given day, it is not feasible to manually compare actual versus expected bookings for all flights. Instead the computer will be instructed to make the comparison itself. Flights which seriously deviate from expected bookings are flagged by the computer and brought to the attention of management for a decision. This is generally done by a daily "exception report" indicating all flights that have exceeded or fallen short of a "threshold" level. **Figure 17** illustrates this. Here upper and lower bounds are given for the threshold range. When actual bookings fall outside of the threshold range, then the flight is added to the exception report list. Flights whose bookings fall below the threshold range may be cancelled, the number of discount seats increased or the discount fare can be decreased. If a flight rises above the threshold range, the number of discount seats can be reduced, larger equipment might be substituted, an extra section might be flown or the discount fare may be increased.

**More Than One Discount Class Can Be Offered.** The case of a flight with a full fare class and a single discount fare class has been described. In fact, air carriers will apply the same yield management concept to the discount fare class and offer additional discount fare classes. **Figure 18** illustrates this. The top part of the figure is a duplication of Figure 12. Here a 5% full fare spill rate was chosen for the full fare seats, making 10 seats available for discount classes. Discount fare class 1 is offered with some restrictions and a modest discount. Just as for the full fare class, there is a probability distribution of actually selling the 10 discount seats. This is plotted in the lower part of Figure 18. A spill rate can be specified for this class, 10% in the case of Figure 18, indicating that 7 seats are to be allocated to discount fare class 1.[47] This leaves 3 seats available for a second discount fare class, usually with a deeper discount, but more stringent restrictions. The multiple fare class system is effective in allowing the airline to fine tune its price discrimination so as to maximize revenues.

**Route Assignment.** The discussion thus far concerned itself with a non-stop flight. Consider the one-stop flight depicted in **Figure 19**. Here the plane flies from Vancouver to Toronto making a stop in Calgary. There are 100 seats available on the Vancouver/Calgary "leg" and 100 seats on the Calgary/Toronto leg. The question now becomes how many seats on the Vancouver/Calgary leg should be allocated to Vancouver to Calgary passengers and how many should be allocated to Vancouver to Toronto passengers. The profit-maximizing solution will be a function of the demand on the Calgary to Toronto leg as well. This problem is very difficult to solve. In general, short passenger trips reap higher fares per mile. This is offset by the fact that it may not be possible to fill all of the short haul seats on both flight legs. There can be severe traffic imbalances. A flight from Vancouver to Kamloops to Prince George might stimulate significant amounts Vancouver to Kamloops traffic during the ski season with little ability to sell the Kamloops to Prince George seats.

Again, a modern yield management system with a sophisticated optimization program can determine the optimum "blocking" of seats between the various route legs. The program accounts for different demand elasticities (and cross elasticities) and traffic bases on different flight legs.

[47] Typically, carriers are less concerned with not having a discount seat available on their first choice of flight. These consumers are not very time sensitive and generally will be willing to shift to another flight. Thus, the spill rate for a discount fare-class is higher than for full fare tickets.



## Chapter 5

# Airline Marketing

## A. Distribution/Marketing Channels

**Figure 20** depicts the typical airline marketing channel. A channel is the set of organizations which sells a firm's product or services. As can be seen, carriers can and do sell direct to their customers. They can also authorize other carriers (affiliates and/or competitors) to sell tickets for their flights. This requires an "interline" agreement of some form between the carriers.[48,49]

Airline tickets may also be sold by independent travel agents. Agents must be authorized by carriers to sell tickets.[50] Another outlet for airline services is the tour wholesaler. This independent operator purchases airline seats (typically in large, discounted quantities) and may combine these with hotel services, ground transportation, local tourist attractions, etc., in order to sell the traveller a complete vacation/conference/etc. package. The tour wholesaler differs in an important way from the travel agent. Agents merely *facilitate* the sale of airline services, and receive a fee/commission from the airline for doing so. They bear relatively little risk. On the other hand, the tour operator buys

[48] In interline agreements, the ticketing carrier collects the revenues from the customer. These are paid to the carrier providing the service when the latter presents the former with the customer's used ticket coupon. The International Air Transport Association operates a ticket clearinghouse service, similar to bank clearinghouse services, to facilitate such payments.

[49] Some interline agreements make provision for joint fares between carriers. With a joint fare, a consumer travelling from A to B on Airline 1, and then B to C on Airline 2, pays a fare which is less than the combination or sum of the A-B and B-C fares. How the joint fare is shared between the two airlines is a matter of considerable negotiation between the carriers.

[50] IATA also provides a travel agent approval service for carriers.

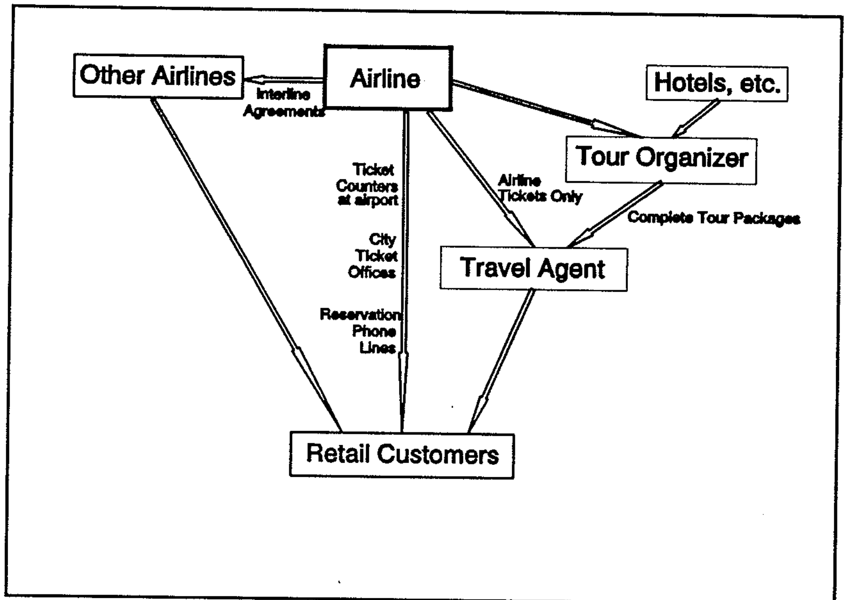



**Figure 20: Airline Marketing Channel**

airline services on his/her own account, and *resells* these to the consumer. The tour wholesaler bears considerable risk of not being able to resell what it has purchased from the carrier. While the wholesaler can and does sell to the consumer, more typically, sales are made via travel agents, to whom the wholesaler pays a commission. The two largest tour operators in Canada are Touram and Canadian Holidays, each of which are wholly owned subsidiaries of Air Canada and Canadian Airlines International, respectively.[51,52]

[51] Canadian Holidays was formerly known as Treasure Tours, which in turn consolidated CP Air Holidays, and Wardair Holidays.

[52] In the U.S., airlines typically do not own tour wholesalers, as there is no equivalent to the Canadian regulation that charter tickets cannot be sold directly to the public by an air carrier.



Even though airlines have the ability to sell tickets directly to consumers, 70% of airline tickets in Canada are sold by travel agents.[53] While the agents are supposedly independent and impartial, they are agents of and paid by the airlines, not the consumers. Airlines have two methods of influencing agents choices. The first of these is by paying higher than normal commissions on airline tickets sold by the agent. This gives the agent an incentive to steer the consumer to the services offered by the airline paying the "override." To a certain extent, consumers have preferences as to which carrier they use, and this restricts the agents' abuse of overrides. Nevertheless, the U.S. D.O.T. (1990) study observed that "some industry participants believe that agencies can choose the carrier for half of their leisure customers and one-fourth of their business travellers. Agencies have a greater ability to control the leisure passengers' choice of carrier because fewer leisure travellers will have a carrier preference."[54]

Since overrides are hidden to the consumer and sometimes to competing airlines, the effect can be anti-competitive. A recent survey in the U.S. indicated that 24% of travel agency locations "usually" chose a specific carrier in order to get an override commission, and an additional 27% "sometimes" made such a choice, for a total of 51%.[55] Typically, override commissions increase as the ticketing share of a particular carrier increases at the agency.

The second avenue airlines have for controlling decisions of agents is via ***computer reservation systems (CRSs)***. CRSs were originally designed as an internal tool to improve airline efficiency. In the late 1960s, a few airlines experimented with putting CRS terminals in travel agent offices. However, these efforts were put on hold as carriers tried to develop a common industry CRS for travel agent use. When this effort broke down in 1976, United, American and TWA started to market their own CRS systems in a major way to travel agents. By the early 1980s, they were joined by Delta and Eastern. Other airlines without their own CRS services to sell to travel agents eventually

[53] For a discussion of the role of travel agents in the marketing of airline services, see U.S. D.O.T. (1990), pp. 7-30.

[54] U.S. D.O.T. (1990), p. 29.

[55] "1988 Louis Harris Survey," *Travel Weekly*, p. 4.

were forced by the market to either buy into an existing airline's CRS system, or to pay substantial fees to their competitor's CRS subsidiary in order to access the market.

To date, all CRS systems used by travel agents have been developed by airlines. Development costs of a new CRS have been estimated to be as high as $500 million. There appear to be such significant synergies between airlines providing CRS services to travel agents and the revenues they receive for selling airlines seats, that it is unlikely an independent CRS system will ever be developed. Because of this, airlines without their own CRS have attempted to buy into the CRS subsidiaries of rival airlines. Lack of a CRS system may also have been an important factor in the 1986 wave of mergers in the U.S. industry.

Ninety-five percent of U.S. travel agents are now automated.[56] Studies in the United States have found that the way the information is displayed in a computer reservation system has enormous influence on consumer choices. American Airlines, for example, testified to Congress that 92% of all ticket sales come from the first computer screen displaying information on a given market. 54% of sales come from the first line on the first screen! This creates an overwhelming incentive for the carriers to bias CRS displays of flight information to favour the flights of the airline owner of the CRS. Even if CRS displays are unbiased, a "halo" exists which results in the agents favouring booking on the airline which owns the CRS.[57]

In 1982, the U.S. Civil Aeronautic Board launched an investigation into the anti-competitive implications of biased CRS displays, as well as other CRS abuses, such as manipulation of information provided by competing airlines. A set of rules were adapted in 1984 which *prohibited* certain practices, including bias of displays and discriminatory pricing. The elimination of (or, more accurately, reduction of) display bias reduced carrier incremental revenues of

[56] U.S. Department of Transportation, "Study of Computer Reservation Systems," May 1988, p.70.

[57] For example, the agent will have greater confidence that the information in the CRS is most up to date for the owner airline than for other airlines. This is especially important when booking last minute tickets, which are usually full fare.



extra traffic induced by the bias, but these were replaced with higher direct fees charged to other airlines.

In Europe, *prescriptive* rules for CRS conduct were adopted in 1989. Two large CRS systems are being developed there, as partnerships of two separate groups of European airlines. Both use U.S. CRS technology. In addition, American Airlines is directly marketing its Sabre system to European airlines (and railroads).

Eighty percent of travel agents in Canada now use a CRS.[58] In the 1960s Air Canada developed the world's first airline computer reservation system. This system eventually came to be known as Reservec. Until 1984, it was the only CRS system available in Canada. In January 1984, CP Air, recognizing the problem that it was facing with its primary competitor controlling the travel agent portion of the distribution channel, launched a competing CRS system, Pegasus. However, CP Air quickly discovered that penetrating the market would be difficult at best. Air Canada had already locked up the major travel agents with its Reservec system. CP Air found that it could successfully market its Pegasus system only to the smaller agents. Further, while CP Air paid Air Canada a fee for every CP Air ticket sold on Reservec, Air Canada refused to make any payments to CP Air when an Air Canada flight would be booked on a Pegasus system. CP Air claimed that its Pegasus effort was failing, and approached Air Canada about merging the systems. Apparently Air Canada refused.

CP Air then opened negotiations with American Airlines to bring its Sabre system into Canada as a replacement for Pegasus.[59] Sabre dominated the U.S. and was making significant penetrations elsewhere in the world. This threat appears to have been sufficient to get Air Canada to come to the bargaining table. Effective June 1, 1987 Air Canada and CAI (the successor of CP Air) agreed to merge their two CRSs into a single system, Gemini. Gemini was then owned 50/50 by the two airlines. Gemini decided to abandon both

[58] The 20% of agents who are not automated account for a very small proportion of airline ticket sales.

[59] See Hine (1990), p. 82.

carriers' home grown systems, and to replace them with a U.S. system. An initial agreement was arrived at with TWA/Northwest's PARS, but this was eventually replaced with Gemini adopting United Airlines' Apollo/Covia technology. Covia became a one-third owner of Gemini.

The Gemini merger resulted in a consolidation of the CRS market in Canada. Gemini's Canadian market share was 90% at the time of the merger, compared with a 10% share for Sabre.[60] Although the merger was contested by the Bureau of Competition Policy under the *Competition Act*,[61] the case was settled with a Consent Order under which CAI and Air Canada are required to provide complete, timely and accurate information on the information in its CRS to all other CRSs operating in Canada on the same basis as it is given to Gemini. Air Canada and CAI were ordered to participate in all CRSs operating in Canada on commercially reasonable terms. They were ordered to make available to other CRSs in Canada the same advance seat selection and boarding pass capability which has been provided to Gemini. Further, Air Canada and CAI were ordered to provide a "look but not book" link (effective January 31, 1990) and a "look and book" link to other CRSs (effective June 30, 1991). In addition, the Consent Order specified a set of rules for the operation of CRSs.

Before closing this section, a few other comments ought to be made about the travel agent industry. A recent U.S. study observed that "agencies generally operate on narrow profit margins, and some surveys suggest that a large proportion of agencies are at best barely profitable."[62] While there are a large number of agencies, and the industry is quite competitive, there are a handful of mega-agencies with large market shares. Data for the Canadian industry is not available, but in the U.S., two agencies have a combined 10%

[60] See Competition Tribunal, *Statement of Grounds and Material Facts for the Application by the Director of Investigation and Research under Section 64 of the Competition Act*, Ottawa, 7 December 1988, pp. 6-7. It is believed that in the two years after the statement, Gemini's market share has been reduced somewhat by Sabre.

[61] Competition Tribunal, *Consent Order* and *Reasons for Consent Order* (Ottawa, July 17, 1989) re Director of Investigation and Research and Air Canada, PWA Corporation et al.

[62] U.S.D.O.T. (1990), p. 16.



market share and the top ten agencies sold $8.5 billion of airline tickets in 1988.[63] The trend is toward greater concentration in the industry.

## B. Creating Brand Loyalty: Frequent Flyer Programs

As deregulation began in the United States, air transport could largely be viewed as a commodity. That is, consumers had little loyalty to particular producers. Some airlines, such as People Express, followed the appropriate strategy for a commodity: follow a cost leadership strategy (i.e., low costs) and compete on the basis of price. A few other airlines, notably American Airlines, decided to pursue strategies to create brand loyalty where it did not exist and thus undermine the commodity nature of the service. The most notable of these strategies was the introduction of frequent flyer programs by American Airlines in 1981.[64]

Because large carriers can offer frequent flyer rewards at lower costs, these programs create a significant barrier to entry.[65] Frequent flyer programs came to Canada in July 1984 only a few months after they were permitted under the *New Canadian Air Policy*. Prior to this they were not allowed by the government. The Canadian carriers introduced these largely in order to maintain market share on trans-border routes to the U.S. as they were losing customers to the U.S. carriers offering these reward systems. Elsewhere in the world, frequent flyer programs are non-existent, although some carriers have responded with programs on routes to/from North America.

A trunk carrier awards points for travel on its affiliated feeder carriers. However, it never allows a competing carrier to join its frequent flyer plan. Non-aligned smaller carriers are also generally excluded from these plans.

[63] American Society of Travel Agents, "Outlook: Travel Agency Industry in 1989."

[64] Economists would describe this process as one of putting some slope in the carrier's demand curve.

[65] It is easier to build points with a carrier that flies to all destinationsthe consumer is interested in. Thus the large carrier may choose to offer one free trip for every thirty paid trips. To offset the difficulty of accruing points since it only flies to a few destinations, the smaller airline may have to provide rewards at a one to fifteen or a one to ten ratio. Tretheway (1989) discusses the nature of these programs and their success in building brand loyalty.

Because of their attractiveness to consumers, membership by an air carrier in the frequent flyer plan of a large carrier is almost required these days in North America. Both PSA in the U.S. and Wardair in Canada cited frequent flyer programs as a problem and as a major reason for their mergers into larger airline systems.

Some observers claim that programs such as American Airlines' AAdvantage have resulted in an increase in an individual carrier's business by 20-35%.[66] The programs have been so successful that every North American significant air carrier has been forced to either offer its own program or to join the program of another major carrier.

Stephenson and Fox (1987), in their article on frequent flyer programs, gathered the following facts:

- 54,000,000 adults in the U.S. took at least one airline trip in 1986.
- 32% were classified as business travellers (i.e., the employer paid for the trip).
- 46% of all airlines trips were business trips.
- Business trips accounted for 68% of industry revenues.
- 3% of air travellers were frequent flyers (i.e., take more than 12 trips per year).
- These frequent flyers accounted for 27% of the airline industry trips.
- From these facts, it can be determined that frequent flyers accounted for a minimum of 40% of the industry's revenues.

[66] Does the Frequent Flyer Game Pay Off for Airlines?", *Business Week*, August 27, 1984.



- In 1985, 10,000,000 individuals were members of U.S. frequent flyer programs.
- 70-75% of all business travellers were members of at least one program.
- These members received $1 billion worth of free travel and accrued an additional $2 billion in free travel.
- The value of the frequent flyer awards represent approximately 7.5% of the industry's revenues, and the liability for 1985 alone represented 5% of 1985's revenues.
- In 1986, frequent flyers sold $75 million in awards to brokers.[67]
- 3% of passengers on any given flight are likely to be frequent flyers cashing in a free ticket.[68]

The airlines consumer is likely to view frequent flyer programs as a real bonanza. Even customers who pay for their own fares see the frequent flyer reward as some form of rebate from the airline.

As the facts above show, two-thirds of airline revenues come from business travellers (i.e., travellers for whom the ticket is paid for by the employer). These passengers may well view the frequent flyer bonus as something for nothing. However, the purchaser of the ticket, the employer, is not receiving the rebate. The benefit, the free air pass, accrues to the individual traveller. This is a case which economists refer to as the principal-agent problem. Agents, employees travelling on tickets paid for by their employers, make the decision as to the quantity, price and choice of carrier, and receive the benefits of the frequent flyer program. The principal, the employer paying for

[67] "Frequent Flyer Awards Tougher to Sell as Airlines Tighten Rules, Press Brokers" (1988), *Wall Street Journal*, 6 September, p.31.

[68] J. Ibbiteson, "Fight for Frequent Flyers", *Vancouver Sun*, 14 November 1988, p.D2.

the ticket, pays the cost but is unable to optimize air travel purchases since the decision is being made by the agent.

It might be argued that the frequent flyers are confined to seats which the airline can predict would otherwise fly empty. If the airline was successful in confining the frequent flyer to these otherwise empty seats and if these seats could be filled with no incremental cost to the airline, then perhaps there is some form of social benefit accruing here. Of course, these two assumptions are not likely to be true. Many of us have personal experiences unable to get onto a fully booked flight, only to later learn that many seats were occupied by airline employees or frequent flyer award users. Statistically, it is known that when airline load factors average only 60%, 6% of flights will be fully booked. When the average passenger load factor rises to 70%, this jumps to 21% of flights that are fully booked, and at an 80% load factor the percent of fully booked flights jumps dramatically to 64%.[69] Thus, at the very least, a certain proportion of the time, airline frequent flyer award users are likely to displace paying passengers. When this happens, an opportunity cost is created in terms of foregone revenues.

When the employer pays for an airline ticket, frequent flyer programs should not be viewed as a rebate for quantity purchases. This is because the recipient of the frequent flyer benefit is not the same person or entity which made the payment for the original flights. A true quantity discount would be one where the employer would receive the frequent flyer benefit. The employee will make his or her decision so as to optimize his or her own utility. An employee may make sub-optimal decisions because there is no cost for him in taking a flight that may cost more than necessary. Instead the cost goes directly to the employer.[70]

The magnitude of overpayment for and overuse of airline services can be quite large. In Canada, it has been estimated that 13-20% of business travel

[69] See M.A. Brenner (1982), "The Significance of Airline Passenger Load Factors" in G.W. James, *Airline Economics*, Lexington Books, Lexington, MA.

[70] See C. French (1989), "Will Frequent Flyers Still Get the Point?", *Globe and Mail*, 4 February, p.11, for a discussion of how business travellers are spending 13-20% more than necessary on airline services in an attempt to maximize their frequent flyer benefits.



is unnecessary.[71] In the United States, it has been estimated that there is $4.2 billion in frequent flyer cost overruns annually.[72] This is almost 10% of the total revenues received by the airline industry. Stephenson and Fox point out that "the U.S. Internal Revenue Service has estimated the value of unnecessary travel accumulated by frequent flyers to be $9.5 billion."[73]

In addition to the dollar cost of this unnecessary air travel, airline frequent flyer programs also cost the employer in terms of squandered work time. When an employee travels New York-Dallas-Los Angeles in order to earn additional frequent flyer points rather than New York-Los Angeles, the employer is losing a minimum of one hour of work time. In addition, there is a chance that the Dallas-New York leg of the flight could be delayed or even cancelled. There is also the possibility that totally unnecessary trips would be taken. Perhaps in the absence of frequent flyer programs an employee would choose not to go to a particular convention. The employee may be only a few thousand miles short of that coveted trip to someplace warm and sunny, so he or she chooses to go to the convention, costing the employer in travel expenses and foregone work time.

Another issue to be considered is whether or not airline ticket prices have been inflated in order to cover the cost of frequent flyer programs. Certainly, there are some costs for the airlines to manage these programs. *Business Week* estimated that the startup expenditures to establish a frequent flyer program were between $2 and $12 million in 1984.[74] In addition to the annual program administrative cost, the airlines incur some costs in servicing the awards. As discussed, there is a potential opportunity cost for the airlines when frequent flyer passengers fill seats that could have been sold to revenue paying customers. Even when seats would have otherwise been empty, the airline needs to provide an additional meal, expend additional fuel for the roughly 200 lbs. of passenger and luggage, and incur additional passenger service cost. The latter

[71] Ibid.

[72] See Stephenson and Fox (1987), p.18.

[73] Stephenson and Fox (1987), p.1. The authors cite as a basis for this observation L.K. Jereski (1985),. "High Times for Marketers," *Marketing and Media Decisions*, April, p.143.

[74] "Does the Frequent Flyer Game Payoff for Airlines", *Business Week*, 27 August 1974, p.75.

are costs involved in handling the passenger's reservation and in processing the passenger at the airport. *Frequent Flyer* estimates that ticket prices are 10-15% higher than they would be without frequent flyer programs.[75] Layer and Reid estimate that frequent flyer programs "may be costing American business as much as $7 billion a year in added travel costs."[76]

These programs have definitely been successful in building product loyalty in airline consumers.[77] The first airlines to introduce these programs undoubtedly experienced an increase in traffic and revenues. Eventually the other airlines had to offer similar programs in order to stem the losses of traffic to those airlines offering the programs.

Now that just about every airline of any importance in North America offers a program, one might ask whether or not there is any residual advantage for the industry in their maintenance. Once all firms in any market offer a particular innovation to their product or service, its marketing effect has essentially been neutralized. The question then becomes whether the industry as a whole has been stimulated by frequent flyer programs. In the discussion above, statistics have been cited indicating that indeed this is the case. One of the reasons that corporations have higher travel budgets due to frequent flyer programs is due to extra travelling in the form of unnecessary trips and circuitous routings.

Another market advantage of frequent flyer programs for an air carrier is the ability to build information on its customers. The frequent flyer program gives the carrier information on the customer's name, address, employer, number of flights flown and destinations, preferences for meals, seating, etc. In the past, airlines had information on the total travel taken by their customers

[75] "Will the Airlines and Corporations Fight it Out?" (1986), *Frequent Flyer*, November, p.79.

[76] See R. Layer and D.R. Reid (1988), "Have the Frequent Flyer Programs Defeated the Purpose of Deregulation and How Much are they Costing Your Firm?", *Business Travel Review*, June, p.16.

[77] It should be pointed out that the brand "loyalty" induced by frequent flyer reward programs is a peculiar type of brand loyalty. Some would argue that it is not necessarily a loyalty won from providing a differentiated product which the consumer highly values. Rather it might be viewed as a grudging type of loyalty due to high costs of switching to another brand. The high cost is that of forgoing reward benefits by having to restart collecting points.



but little, if any, on the patterns of individual customer. As this database accumulates, the airlines will be able to take advantage of it in terms of market research, specialized promotions, differentiating its product by automatically booking a certain customer's favorite seat, etc. Airlines with this information definitely will have advantages over their rivals.

A final question is whether or not frequent flyer programs can be used by one airline to harm another. One way this could happen is if the cost of a frequent flyer program is higher for one's competitors. If this is the case, then introducing such a program will raise their cost relative to yours, thereby lowering their profitability and/or increasing your market share.

One way in which frequent flyer programs can be less costly to some airlines than others is via the payout ratio. This ratio indicates how many miles a customer must fly in order to achieve a frequent flyer reward of a given value. An airline who awards a transcontinental return ticket upon accumulation of 45,000 miles of travel will have lower costs than one who must award such a ticket after only 14,000 miles of travel. This relationship between cost and the payout ratio is obvious. What is not obvious is whether in equilibrium consumers will require one airline to have a more generous payout ratio than another. In our view, this is likely to be the case. Consider an airline customer located in Toronto. This business traveller makes trips to various destinations in North America during the year. If Airline A flies to most of these destinations, then it will be easy for that customer to accumulate frequent flyer points. Airline B, on the other hand, might only fly to a limited number of the customer's destinations. Even if the customer always chose Airline B for those destinations, it would be choosing between Airline A and Airline B for a trip to a destination served by both, the customer is likely to choose Airline A if the payout ratio is the same for both carriers. A marginal trip on A is more likely to bring the customer to a given mileage level necessary for a particular reward. This is especially important given the accelerating nature of rewards as mileage accrues. To counter this disadvantage, Airline B must offer a more generous reward payout, thus raising Airline B's cost.

## Chapter 6

# Airline Route Systems

One of the strategic decisions of any business is defining the product it will produce and sell. In the case of air transport, perhaps the key decision an air carrier makes in this regard is the determination of its route structure. Which cities will be served? How will the cities be linked? This chapter deals with these issues. It starts with a discussion of viewing air transport as a logistical system for moving people. However, there is not one unique route system, but a wide range of alternatives which can satisfy passenger needs. The chapter then discusses the hub and spoke concept, the role of feeder traffic, and the role of international traffic.

## A. Viewing Air Transport as a Logistical System

**Logistics.** Logistics is the management discipline which deals with systems for moving goods from source to use. It is referred to in some contexts as "physical distribution management" (the movement of finished goods from manufacturer to consumer), or as "materials management" (when the focus is on the movement and procurement of raw materials to be transported to the factory). Logistics covers the movement of good in both space and time. The geographical characteristic is obvious: goods are produced at a single location, but are consumed by individuals at many locations. There is also a temporal link: goods (like apples) are produced at a particular point in time, but are consumed later. Transportation solves the problem of the geographical movement of goods from source to use. Inventories provide the temporal links.

Logistical systems for moving goods through time and space consist of nodes and links. Nodes are the places where inventory is held: at the factory, regional warehouses, and retail outlets. Links are the connections between the nodes. A link might use truck, pipeline, rail, water or air transport. There are



trade-offs in logistical systems between links and nodes. A system using slow, unreliable rail transport would require inventory stored at regional warehouse nodes. In contrast, a system using more expensive but speedy and reliable air transport, may be able to ship from factory to customer, thus eliminating the need for intermediate nodes and inventories.

**Passenger Logistics.** While logistics is normally thought of in terms of freight, it also applies to moving passengers. Passengers move from origin to destination. In doing so, they will travel along links (air routes) and between nodes (airports). Note that generally there are several alternative routings for moving passengers. The alternatives increase as the distance between origin and destination increase. There can be trade-offs between nodes and links. Non-stop routes are possible, but they may not have enough volume to economically justify frequent service. Hub and spoke systems add a node in the passenger's journey, but their traffic pooling ability may allow increased service frequency (reducing the temporal dimension of the passenger's journey).

Business passengers are especially concerned with getting from origin to destination *on a timely basis*. Before deregulation, much of the U.S. was served by non-stop, but often infrequent, air service. Since deregulation, airlines are providing (and travellers seem to be preferring)[78] more frequent, but one stop routing through major hubs.[79] Most travellers feel that the "cost" of increased time spent in flight is more than offset by the "benefit" of more frequent service.

Tourists can also be viewed as purchasing complete logistical packages. For example, tourists from Japan may wish to see the Rockies and spend some

[78] See Morrision and Winston (1986) for evidence that passengers vote with their dollars for frequent hub service over infrequent direct service.

[79] Gordon (1990) provides evidence that since deregulation *more* non-stop service is available. He criticizes Dempsey (1990) and Good, Nadiri and Sickles (1989) for perpetuating the "myth" that deregulation has required passengers to travel extra miles due to the circuity of hubbing. Gordon points out that hubbing has resulted in more non-stops to hubs, and since markets to and from hubs dominate passenger volumes, this has led to an overall improvement. He substantiates this with evidence from the top 300 markets in the U.S. showing a roughly 10% increase in markets with non-stop services. He further points out that many prederegulation non-stop markets had single or few daily flights, whereas after deregulation flight frequency has increased. (See pp. 38-41.)

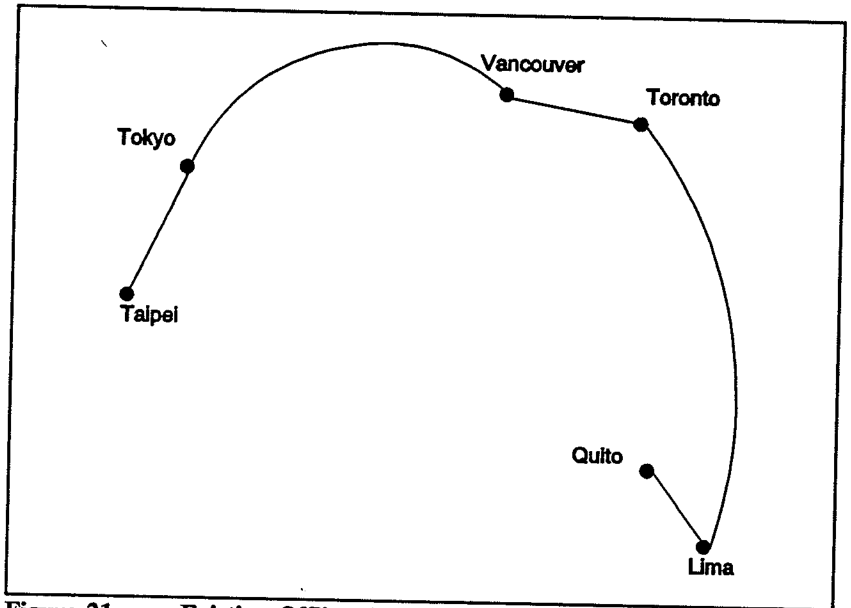



Figure 21: Existing Offline Asia to Offline South America

time shopping in a large city. They may be indifferent between a package which routes through Vancouver and one that routes through Seattle.

**Airports as Nodes in Logistical Systems.** An airport, as part of a logistical system, facilitates the flow of goods and people into and out of a region. It can also act as a transfer node (an in-transit node) between two very distant regions. An airport is also an intermodal facility, transferring passengers or freight from one mode of transport, air, to another, usually motor transport. A particular airport competes with other logistical systems. For example, air freight can fly to Seattle and then be trucked to Vancouver as an alternative to flying into Vancouver and using a local truck for delivery. Depending on frequency and reliability of service, relative customs clearance times, etc., one system may give the customer superior performance.



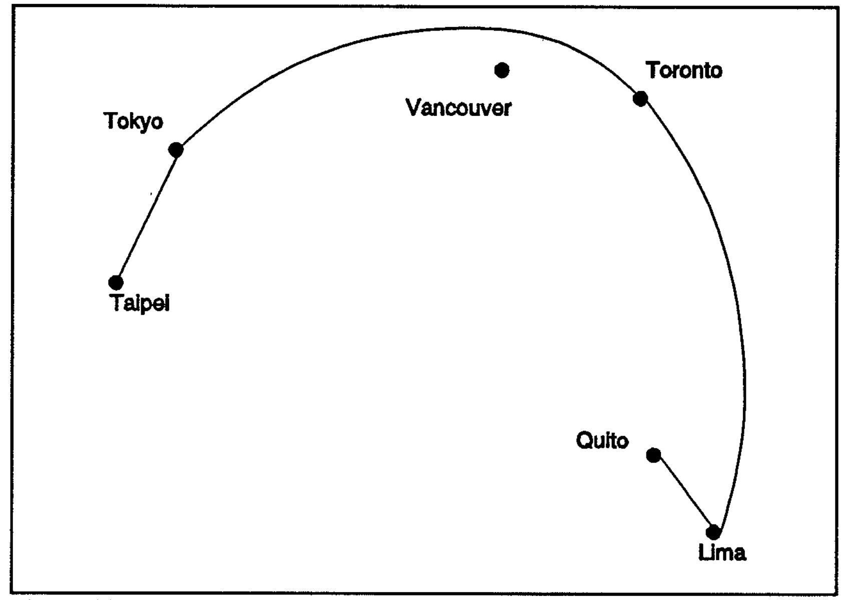



Figure 22: Alternative Route System: Overfly Vancouver

To illustrate how one country's air transport system fits into a broader logistical system, consider the traffic routing in **Figure 21**. A traveller from an "off-line: (i.e. non hub) point, such as Taipei in Asia, wishes to travel to an off-line point in South America, such as Quito. The historical routing pattern using Vancouver requires no fewer than five stops, a minimum of three airlines and, depending on the day of the week, 2-4 days travel. It is now technically possible to fly directly from Tokyo to Toronto (see **Figure 22**). This eliminates one stop and hours of flying and in-transit time. Alternative methods of improving the traveller's utility of routing through Canada exist; off-line points in Asia can be connected to Vancouver (**Figure 23**), and Vancouver could be more directly connected to hubs with access to off-line South American points (**Figure 24**), or directly to South America (**Figure 25**).

The main point of this section is that air transport routing must now be thought of in terms of global networks, not just as country-to-country origin-

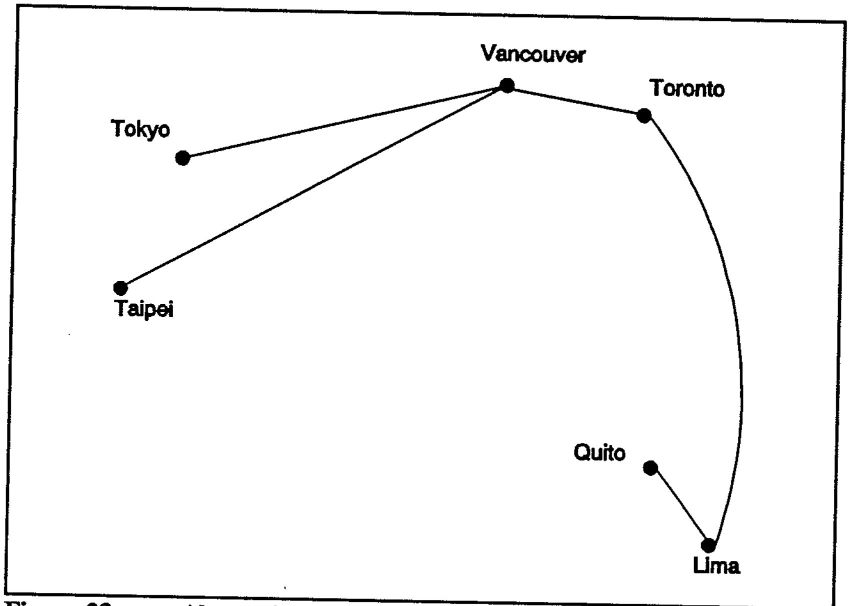



**Figure 23:** **Alternative Routing System: Connect Vancouver to Off-line Asia**

destination statistics. Canadian traffic can be routed indirectly through the U.S. Similarly, Canada's airlines can enjoy some non-Canadian global traffic flows by proper design of their route networks. As Canada becomes better connected to the globe, it becomes a more attractive place for doing business. Better network connections for Canada will result in lower costs for moving goods and people into/out of Canada.

## B. Airline Hub and Spoke Systems

With the background of how airline route systems should be viewed as logistical systems for moving people (and goods), the rest of the chapter discusses three important elements of post-deregulation airline route systems: hub and spoke systems, feeder carrier connections and international connections.



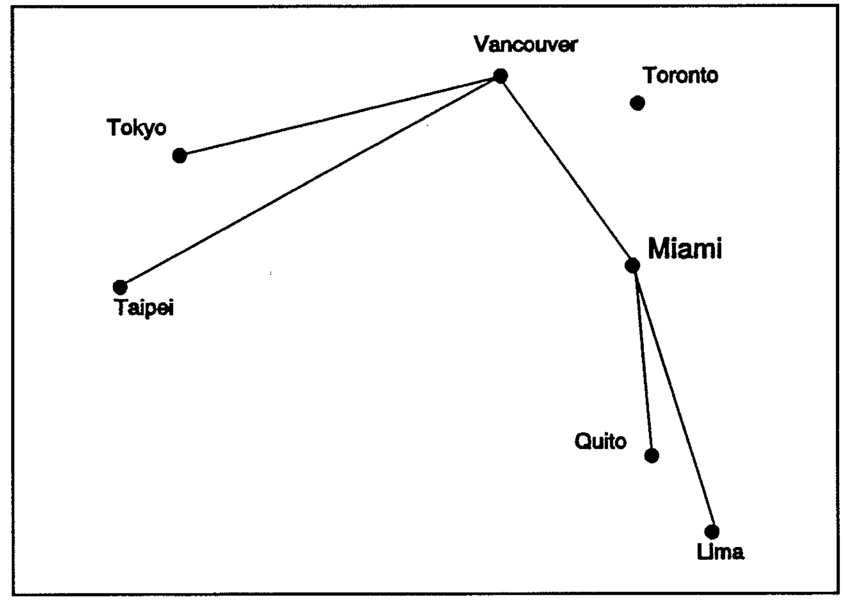



**Figure 24:** **Alternative Routing System: Connect to Gateway to South America**

**Introduction.** During the era of economic regulation of air transport, U.S. and Canadian carriers were constrained in their choices of routes. With the new freedoms of deregulation, there has been a dramatic restructuring of airline routes. In the U.S., with many major population centres scattered throughout its geography, the carriers' new route networks almost invariably follow a hub and spoke pattern. Canada, with less opportunity to rationalize its route networks around hubs,[80] has nevertheless also witnessed development of hub and spoke networks at both the trunk and feeder carrier levels. This section describes the nature of hub and spoke systems.[81]

[80] Canada's strong East-West travel pattern, confined to a narrow band along the U.S. border, is less conducive to hub routing than the more geographically dispersed U.S.

[81] The impact of hub and spoke systems on consumer demand was described in Section III.E.

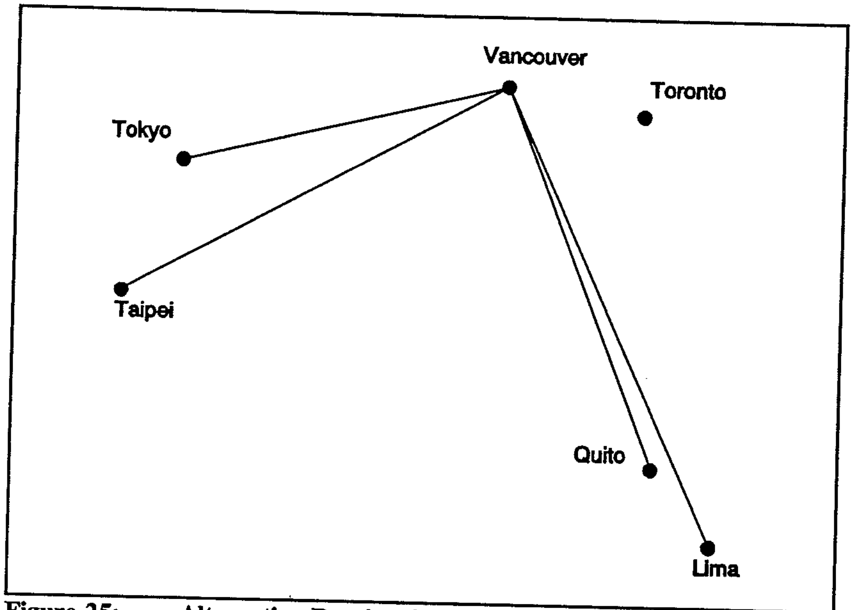



**Figure 25:** **Alternative Routing System: Vancouver Direct to Asia and South America**

**Hub and Spoke versus Linear Networks.** **Figure 26** shows a typical pattern of an air carrier's routes before airline deregulation. This example shows that the route system does not have any dominant focus. Station I has four direct routes emanating from it, while Stations B and D have three each. Some noticeable gaps exist in the route structure. Passengers travelling from H to E, for example, must make four stops if they choose to use this airline. Because this pre-deregulation route structure is not a hub and spoke type, it is sometimes referred to as a "linear" route system. This is because the original government awards of the components of the route system tended to be straight line routes. For example, the airline may originally have been awarded "Route 1" for service from A to B to C to D to E. "Route 2" may have been awarded some time later for the D-F-I-G sequence. The remaining routes (B-I, H-I) were probably awarded by the government regulator one at a time, on a piecemeal basis, over a span of twenty years.



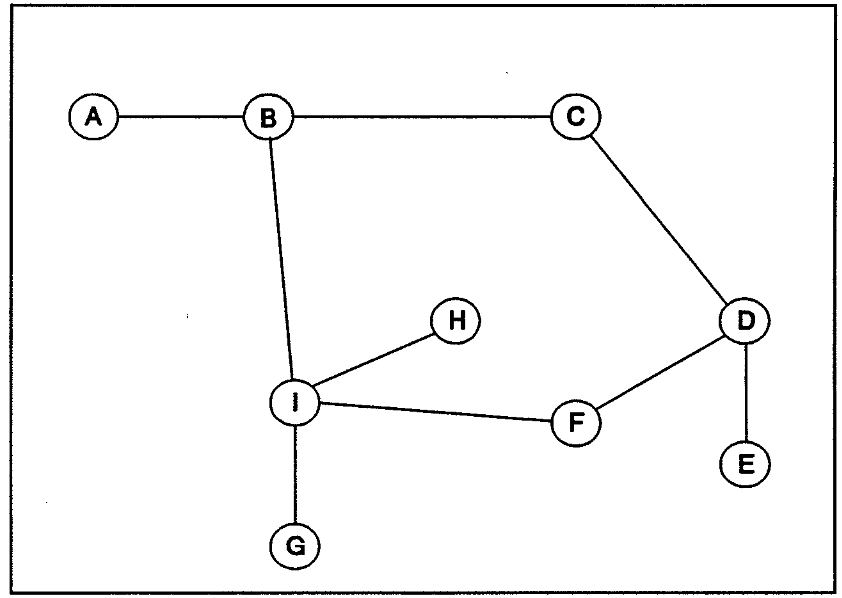



**Figure 26:** **"Linear" Route Structure**

It should be pointed out that this airlines' route system was likely not of its own choosing. It may have put in applications with the government regulator to serve the B-H and H-F-E routes several times; but due to politics or a failure to conclusively prove public convenience and necessity for their proposed service, it was consistently denied an award.

**Figure 27** shows ABC Airlines' route system after deregulation. The same cities are served, but now all cities are connected to city H. This route network resembles the hub and spokes of a bicycle wheel thus giving rise to the term "hub and spoke" route structure. City H, which before deregulation was only linked to a single station, has become the focus of the system and now connects with all other stations. Notice that city H was chosen as the hub station due to its central geographic location, even though city I had the most service before deregulation. Any station on the system is now at most one stop away from all other stations. This is of course, an idealized hub and spoke network.

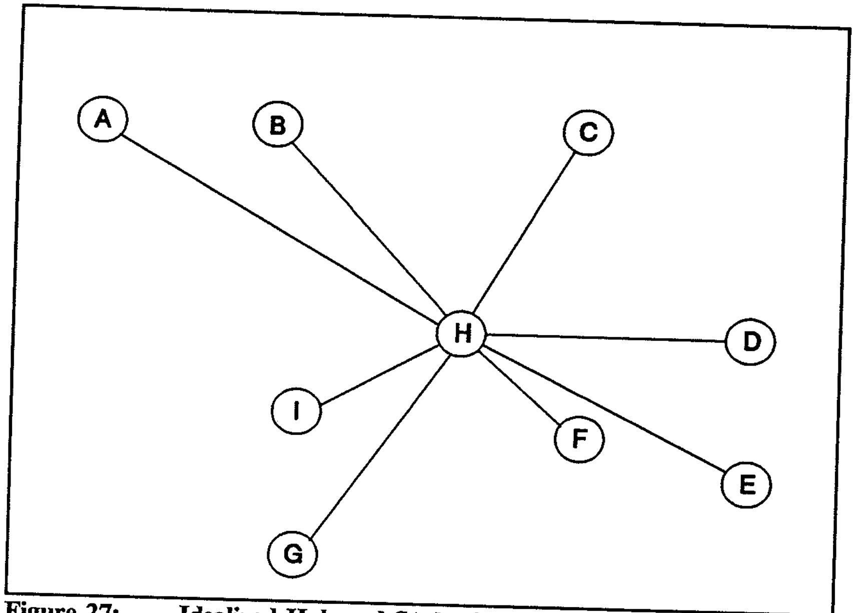



**Figure 27:** **Idealized Hub and Spoke System**

**Figure 28** shows a somewhat more typical pattern, with a few stations being one stop away from the hub (perhaps due to low traffic generating ability), a high traffic route overflying the hub (CK), and a few more stations which were not served during the regulation era (J,K) added to the network.

**Simple Versus Complexing Hubs.** The idealized hub shown in Figure 27 can be of either simple or complexing types. Simple hubs are ones where the flights on various spokes operate independently of each other. In contrast, in a complexing hub operation, flights on all spokes are timed to arrive and depart from the hub within a short period of time. As will be discussed below, this allows passengers travelling beyond the hub to make quick connections between flights on various spokes, and thus reduces their travel time.



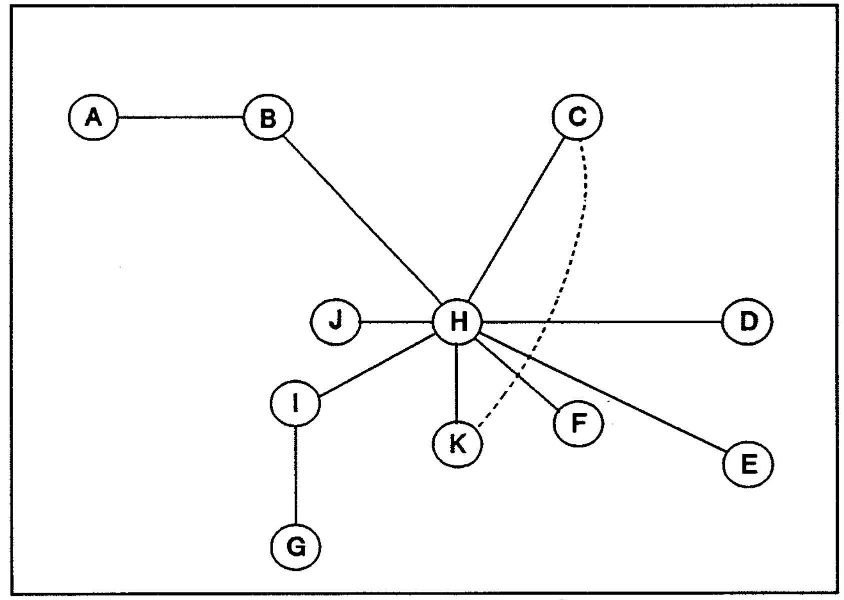



**Figure 28:** **"Typical" Hub and Spoke Route System**

**Figure 29** and **Figure 30**, taken from Gillen, Oum and Tretheway (1985), show the pattern of arrivals for a simple hub, that of People Express in Newark, and for a complexing hub, that of Delta airlines in Atlanta. Notice that the People Express operation had flights arriving and departing on a continual basis, while Delta's flights arrived in batches and departed in batches. The coordinated arrival of a series of flights followed by a rapid series of departures is referred to as a "complex" or a "bank." Delta operates several complexes each day as can be seen in Figure 30. For example, there is a complex that begins with arrivals around 8 AM, followed by 9 AM departures.

Complexing hub operations offer better connections for passengers, but they can be much more expensive for the air carrier to operate. Since flights arrive in large batches and must all be serviced quickly, the hub station will require more service vehicles, airport gates, personnel, etc. than if the flights were more spread out. Both capital and personnel will be poorly utilized

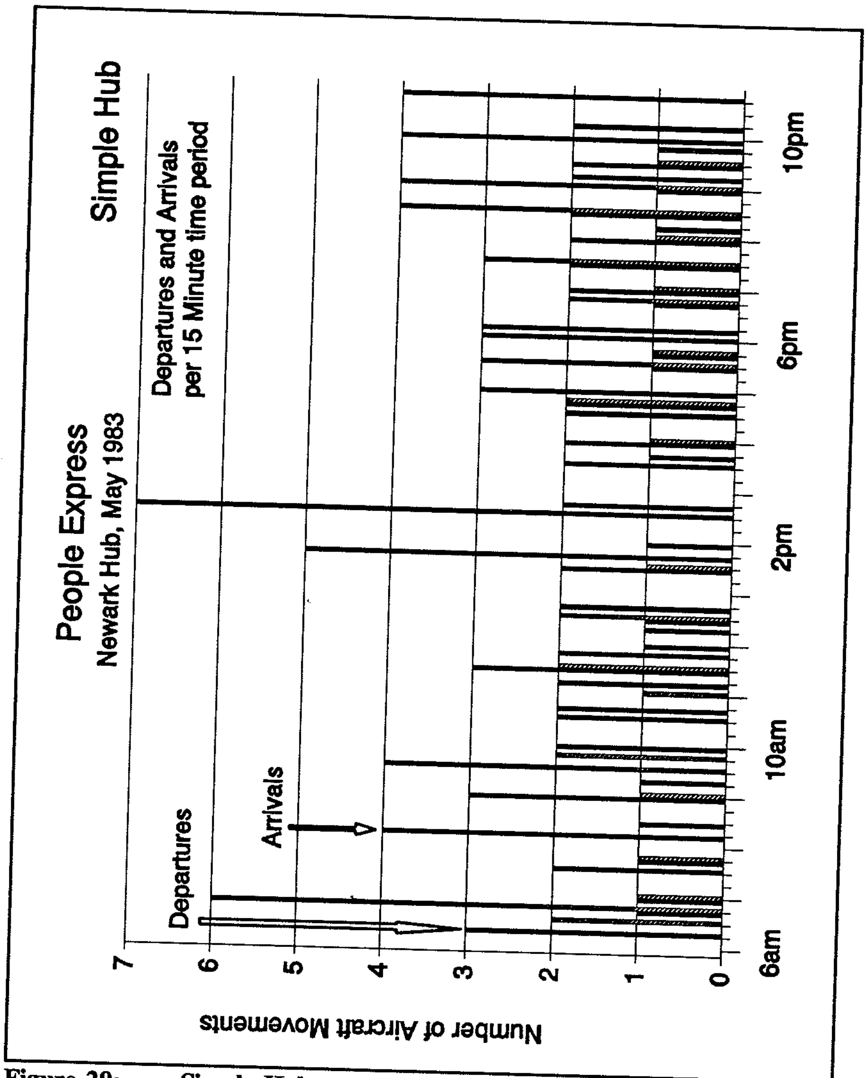



**Figure 29:** **Simple Hub and Spoke Scheduling Pattern**



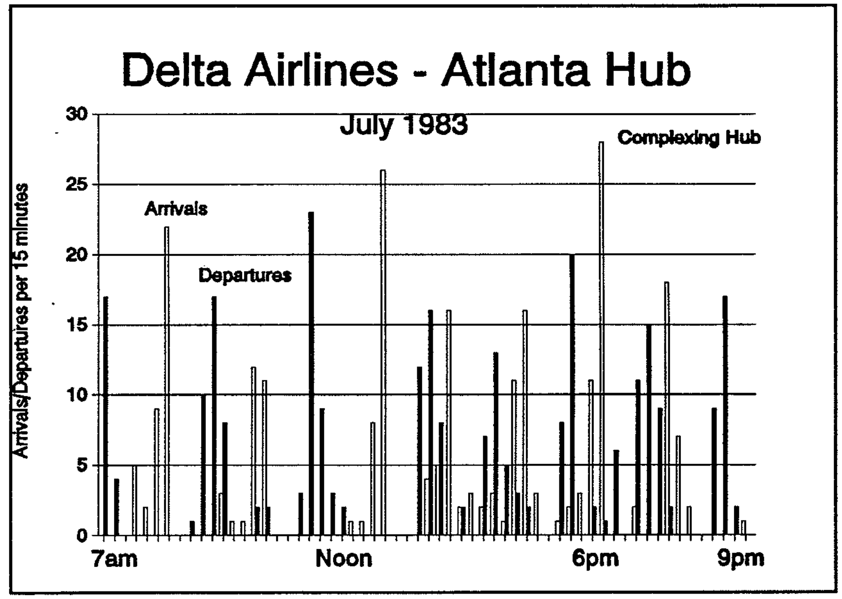



**Figure 30:** **Complexing Hub and Spoke Scheduling Pattern**

between complexes. If the airport is congested, the timing and performance of the complex can be affected. This in turn can ripple down the system, especially if the carrier operates multiple hubs.

**Directional Hubs.** The hub and spoke network in Figure 27 shows that it would be possible for a passenger to fly from City E to City F via the hub, H. This would require much backtracking, and if competing service is available (and since deregulation it probably is) passengers are not likely to choose ABC Airlines. Theoretically, passengers boarding in city E can travel via the hub to 8 other cities (including the hub), and thus 8 city pairs are served from E. In reality, because of the backtracking problem, only subset of these will be "viable" city pairs. Recognizing this, some airlines operate "directional" hubs. Such carriers choose to operate only that set of routes which generates a large amount of connecting traffic at the hub. These tend to be routes which operate in east-west or north-south orientations, but not both. Routes in a

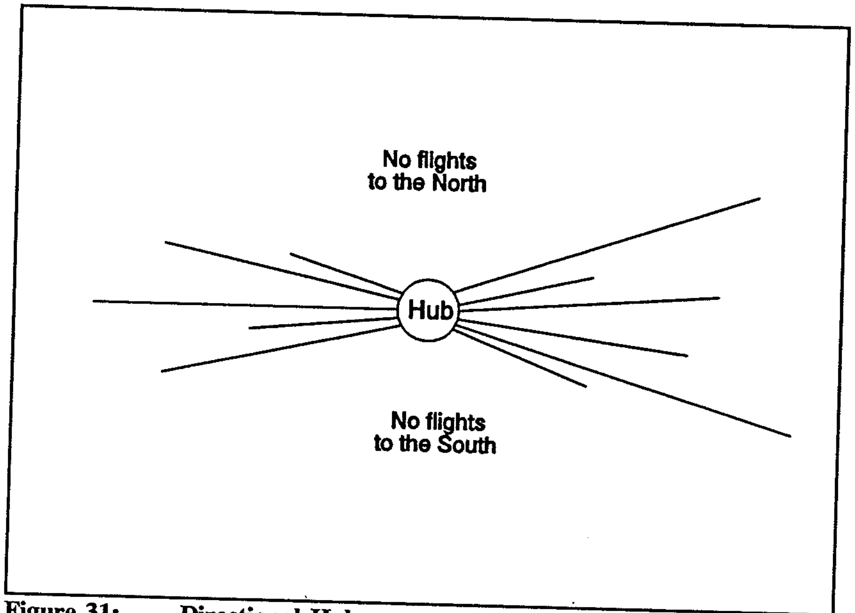



**Figure 31: Directional Hub**

perpendicular direction tend not to be viable. For example, a passenger travelling from Kansas City to Seattle is not likely to hub through Chicago, but may be willing to travel via Denver.

**Figure 31** shows an example of a directional hub, east-west in this case. In this example it is assumed that the airline only has six gates at the hub airport. If a carrier is constrained to a given number of gates at the hub, a directional orientation is likely to maximize the number of potential connections between flights, and thus increase the carrier's revenues.[82] Stations North or South of the hub either are not served by this airline or, alternatively, are served via another hub operated by the airline. American Airlines operates

[82] A complex in a directional hub is directional as well. E.g., flights are timed so that a bank of inbound flights from the east converge in a complex, with the departure sequence being to the west.



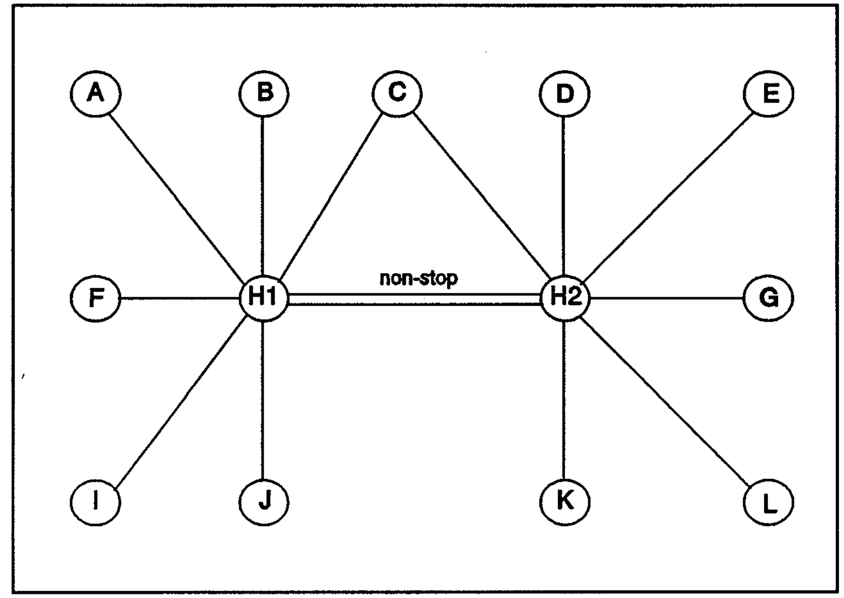



**Figure 32: Multiple Hub System**

predominantly east-west hub operations in Chicago and Dallas/Fort Worth, and North-South oriented hubs at Nashville and Raleigh/Durham. Of course, at a coastal hub like Raleigh/Durham it is not possible to operate with an East-West orientation, but Nashville could have been oriented in either direction.

**Multiple Hubs.** The discussion in the previous paragraphs indicated that some airlines will operate more than one hub. Typically, these are serving different regions. As in the previous section, these could also be directionally oriented. In the American Airlines example, Raleigh/Durham serves north-south markets on the east coast, while Nashville serves north to south in the midwest. **Figure 33** shows one type of multiple hub network. Notice that the hubs are linked by frequent non-stop flights, and that a few spoke stations will be linked to each hub. **Figure 32** shows another example of multiple hubs; this one linking stations in the north east quadrant with both an east-west hub at H1 and a north south hub at H2. This arrangement is common for the large network

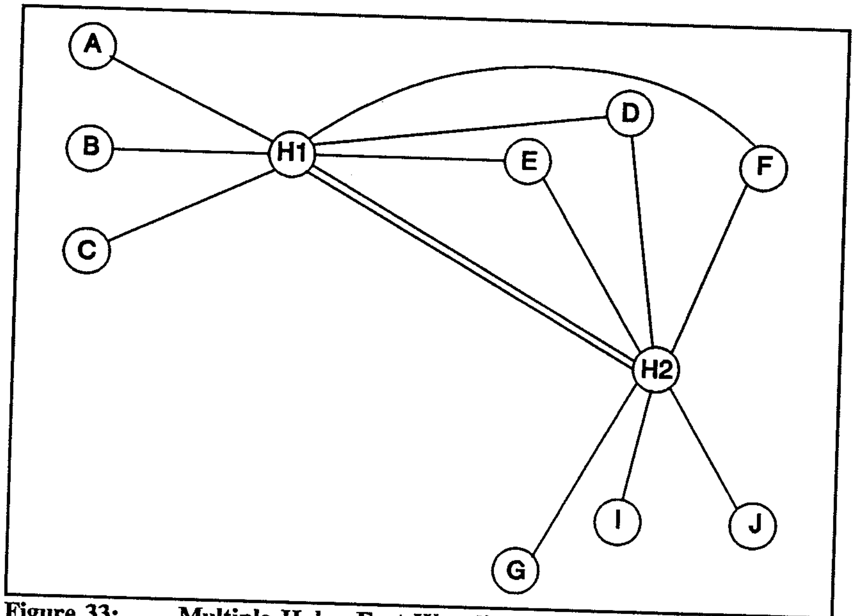



**Figure 33:** **Multiple Hubs: East-West linked to North-South carriers.**

## C. Feeder Traffic and Its Importance

**Extending Market Coverage.** Section III.D discussed how consumers prefer to patronize carriers offering service to a large number of communities. There were three reasons for this. First, it is easier for consumers to gather information from a single large airline than from many small airlines. Second, the consumer often perceives the large airline as providing a higher quality of service in the sense that connecting flights are better timed, there is a lower probability of baggage being lost, etc. Third, carriers have created marketing incentive programs, such as frequent flyer award plans, which create artificial incentives for the consumer to favour large carriers over small.



In order to extend the number of communities which they service, North American trunk carriers have developed "families" of feeder airlines. A feeder airline is one which operates small capacity, limited range aircraft. Typically, these aircraft are turbo-prop. They are ideally suited to serving low traffic points, and/or points which are less than 45 minutes flying time in jets. With these properly sized aircraft, services to smaller communities are more economic. The improved economics allows for the provision of frequent air service. Thus, under deregulation, many communities may have witnessed a twice-daily jet service being replaced by a much more frequent service in small turbo-prop aircraft. The slightly longer flight times and noisier ride in smaller turbo-prop aircraft is more than compensated for by the convenience of frequent air service. The experience of both Canada and the United States has been that smaller communities have benefited greatly from the advent of the feeder carrier. Services which had been previously dropped by trunk carriers are now once again viable. A community which previously had a sole air carrier serving it may now find competing air services are available.[83]

While it would be possible for a trunk carrier to operate such turbo-prop aircraft itself, in practice this is not done. One reason is that turbo-prop operations are significantly different from jet operations. Maintenance needs are quite distinct. Different types of training are required for pilots, flight crews and mechanics. Second, wage scales typically differ between turbo-prop operations and jet operations. Bringing turbo-prop operations into a unionized jet carrier could result, through the collective bargaining process, in relatively high wage rates being paid to turbo-prop crews. This, in turn, reduces the economic viability of many feeder routes. Third, trunk carriers appear to prefer that a feeder operation be managed by a local entrepreneur who closely monitors developments in local markets. The typical executive rotation in large trunk air carriers could make it difficult to maintain the consistency required for good market intelligence.

**Importance to Trunk Carriers.** These feeder operations are of great importance to trunk air carriers. On the surface, it may appear that feeder

[83] NTA (1989) reports that "in Canada, the proportion (of city pair markets) served by two or more competing carriers rose from 44 percent to 77 percent between 1983 and 1987." (p. 30). For example, see Vellenga and Vellenga (1986) for evidence from the U.S.

traffic is of minor importance to the trunk carrier. For example, a feeder flight (with a 40-passenger aircraft and 30 arriving passengers) might hand over only 20 passengers for connections to its affiliated trunk air carrier. These 20 connecting passengers might be spread over 10 flights for an average of only two each. Considering that the trunk flights may be operated on aircraft of 100-400 seats, this traffic may seem to be of minor importance. However, this is not the case. The trunk carrier has already committed to operating the jet flights, and the addition of the few feeder passengers will not motivate it to offer any additional flights. Thus, the cost of operating the trunk flights should be viewed as sunk (or fixed) from the point of view of the incremental traffic from the feeder air carrier. Any revenues it gets from connecting feeder passengers are almost pure profit.[84] If two trunks are competing in a market, operating the same number of flights with identical-sized aircraft, the one which gets an additional two passengers per flight from a feeder carrier will experience higher profits. Revenues from feeder passengers translate almost directly to the bottom line.

In addition, there is a greater tendency for feeder airline passengers to be paying full fares. Consider the Kingston, Ontario to Toronto market. A Kingston family planning a vacation trip to Vancouver are unlikely to fly from Kingston to Toronto, but rather will drive to Toronto and pick up a flight to Vancouver. This family would undoubtedly be flying on a heavily discounted airfare. In contrast, the person most likely to use the Kingston to Toronto air service is the business flyer, who is likely to be paying a full airfare. Thus, not only do feeder passengers contribute directly to the trunk air carrier's bottom line, but they are more likely to be high fare paying passengers as well. Thus, there is a double leveraging of the impact of the feeder passenger on the profitability of the trunk air carrier.

Airlines have attested to the importance of feeder traffic. One U.S. jet airline president stated that the traffic from its feeder airlines provides only 5 percent of its total jet traffic, but that this traffic accounted for all of its profits. In Canada, Wardair's experience provides a further illustration of its importance.

[84] The trunk carrier will incur minor costs for an additional meal, some additional flight cruising fuel, etc.



Wardair only operated services between the major Canadian cities. Since it had no feeder carrier affiliates, it was essentially locked out of the feeder traffic market. In its last month of operation, Wardair proposed paying the entire cost of a feeder airline flight to any passenger who connected to an ongoing transcontinental Wardair flight. As Wardair had to pay the full retail price of the ticket to the feeder carriers of its competitors, this shows how important the incremental profits from feeder passengers can be.

**Ownership.** It was in the U.S. (where deregulation occurred first), that the first formal alliances between feeder and trunk carriers were developed. Typically, a trunk carrier contracts with only one feeder airline in each region it serves. The trunk carrier can be viewed as having a family of feeder carriers, one for each region. In the early days of deregulation, the trunk carriers used various marketing agreements to formalize the links with the independent feeder carriers. However, several trunks experienced their feeder carriers changing loyalty to a rival trunk carrier. This left them with no feed traffic in a particular region, and given the limited number of feeder carriers which any given market can support, the trunk carrier would have little prospect of finding a new source of feed traffic. Subsequently, the trunk carriers began to forge more stable links with the feeder carriers by taking equity positions in their affiliates. At first, minority rather than majority positions were considered to be ideal. With a minority position, airline unions would not be able to petition for common employer status and thus gain access to the more generous collective bargaining agreements of the trunk carriers. In addition, it was felt that a local entrepreneur, with a majority ownership of the feeder carrier, would be more vigilant in keeping costs under control, staying abreast of changing market conditions, etc. Over time, however a few carriers started to develop majority and eventually complete ownership positions in their feeder carriers.[85] In Canada, Canadian Airlines International Limited (CAI) found that one of its minority-owned feeder carriers, InterCanadian (formerly Quebecair and Nordair Metro) could defect, in spite of a minority ownership stake, and set itself up as an independent, rival carrier. Following the InterCanadian defection, both Air Canada and CAI have moved to take majority equity positions in many of their feeder carriers.

[85] For example, the American Eagle carriers are almost wholly owned by American Airlines.

**Summary.** In summary, although a small proportion of a trunk air carrier's total operation is represented by feed traffic, it has a highly levered impact and has thus become of vital importance to the modern trunk airline. Feeder traffic contributes directly to revenues and little, if at all, to trunk airline costs. Thus, feeder traffic represents incremental profit to the trunk airline. Furthermore, feed traffic has a tendency to be full-fare. Today, every major trunk air carrier in North America has a family of feeder carriers extending its reach into the smaller communities.

## D. International Carrier Alliances: Another Form of Feed Traffic

Just as feed traffic from small local airlines is important to a trunk carrier's mainline profitability, traffic obtained from international flights is also important to the profitability of the domestic system. International flights arriving in Toronto, for example, will have a certain number of passengers who will connect to domestic flights segments. The number of such connections is usually not sufficient to justify additional domestic flights. Thus, any incremental revenues from the international feed traffic will accrue to the domestic trunk carrier as incremental profit. Because of this, and because consumers prefer to do business with a single airline, carriers have been increasingly attempting to forge alliances with international airlines in order to feed their domestic networks.

In general, carriers will strike alliances with international carriers who complement their services. For example, Air Canada, which does not fly to Hong Kong, has a marketing agreement with Cathay Pacific. This agreement benefits both carriers. Cathay receives traffic which Air Canada collects on its domestic system, some of which might have gone via Cathay's rival CAI, or via a rival U.S. carrier. Air Canada benefits from receiving overseas traffic in Vancouver, some of which normally would have gone to its rival, CAI.

Sometimes, a carrier will strike an alliance with an international airline who would appear to be its competitor. For example, CAI has an agreement with Lufthansa Airlines. While both compete for traffic from Western Canada to Germany, CAI is able to feed traffic to destinations beyond Germany to



Lufthansa, and similarly use Lufthansa to gather traffic from other countries it does not serve to its flights from Frankfurt to Western Canada.[86]

There are a number of different forms which international carrier alliances can take. These are discussed in Sections VII.C below. Before finishing this section, it is appropriate to point out a major difference between international feed traffic versus domestic, small community feed traffic. The latter tends to have a high portion of travellers paying high airfares, thus leveraging the impact on the trunk carrier's profitability. In the case of international feed alliances, there tends to be no disproportionate amount of traffic flying at full fares.[87]

## E. Technology

Air traffic route patterns are highly dependent on aircraft technology. Perhaps the two most important aspects of technology in this regard are the range and capacity of aircraft. In the past few years, a number of new aircraft have appeared which are starting to change airline routings, and additional aircraft are on the drawing boards. On the distant horizon, some major breakthroughs in technology may be possible.[88]

**Recent Aircraft.** Prior to the 1980s, aircraft travelling overseas were required to have a minimum of three engines. For this and other reasons, most overseas markets were served by one of the following long-range aircraft types:[89]

- Very high capacity aircraft, such as the 747-200

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[86] In this particular case, CAI and Lufthansa codeshare. Since neither airline is able to offer daily service, they alternate days, and list the other's flights as being their own.

[87] International feed traffic is sometimes referred to as flow traffic.

[88] This section does not consider aircraft developments such as advanced turbo-prop aircraft, which are not expected to be used in intercontinental service. Nor does it cover technological developments for ground services (such as electronic scanning baggage flow systems) or air traffic control.

[89] Source: *Aviation Week and Space Technology*, 20 March 1989, pp. 137-191.

(Typical Range: 11,000km/7,000miles; typical payload: 350-450 passengers)

- High capacity aircraft, such as the DC-10-30 and L-1011 (Typical Range: 9,700km/6,000miles; typical payload: 300 passengers)

- Medium capacity older aircraft types, such as the DC-8-63 (Typical Range: 8,000km/5,000miles; typical payload: 250 passengers)

- Small capacity supersonic aircraft (Concorde) (Typical Range: 6,100km/3,800miles; typical payload: 100 passengers)

In the 1980s, a series of decisions by ICAO, the U.S. FAA, Transport Canada, etc., enabled the use of new design twin engine aircraft for overseas markets. The importance of these decisions is that aircraft of smaller capacity could now be used. This, in turn, allowed the provision of frequent service (such as daily service) in what were formerly considered to be thin markets. Thus, many medium-sized communities are now receiving direct air service to foreign destinations. Previously, these communities were serviced indirectly, via the major gateway hubs. A typical aircraft in this category is the B767-200-ER (extended range), with its 9,500km/5,900mile range, capacity around 170 seats, and attractive operating costs.

Another new aircraft is the B747-400. This aircraft increases both the range (to just under 13,300km/8,000miles) and capacity (to 500) of the very high capacity aircraft. The 747-400 is now capable of stages such as Toronto-Tokyo, with very high loads.[90] The extra range is making new non-stop services viable. As with the new small capacity aircraft, a consequence is that former gateway airports are seeing diversion of their traffic base.

[90] An earlier aircraft, the 747-SP had a longer range than the 747-200 (12,300km/7,600 miles), but also a smaller capacity (275-350 seats).



Finally, there are a number of new long range aircraft in the medium to high capacity range. Foremost among these are the MD-11, Airbus 340, and Boeing 777. To a certain extent, these are replacements for older versions of existing high and medium capacity aircraft, although the improved engine economics are extending their ranges and/or capacities. The MD-11 is a replacement for the older DC-10 and L-1011. It has an operating range of 12,900km/8,000miles and a capacity of around 370 seats. The A340 (290 seats, 11,300km/7,000miles) and the A330 (350 seats, 8,000km/5,000miles) are replacements for the older medium range DC-8 type aircraft, or the high capacity aircraft such as the L-1011/DC-10.

**Speculative Aircraft.** Aircraft manufacturers are contemplating new "stretches" of existing aircraft, such as the 747 and DC-10/MD-11. McDonell-Douglas already has a proposal for a full length double deck aircraft dubbed the MD-12. Boeing believes a full-length double-deck 747 is possible. This aircraft could carry in excess of 600 passengers, with very attractive operating costs. Airbus is considering an "A-350" design which would have very large capacity.[91] All of these aircraft are considered to be possible with existing technology.

Another potential aircraft is a replacement for the now aging Concorde. Most replacement strategies would increase capacity to a minimum of 200. The low capacity of the existing Concorde (just over 100 seats) has resulted in poor economics for this aircraft. Noise will continue to be a concern for aircraft of this type at supersonic speeds.

More speculatively, two radically new types of aircraft are being considered. One would be of very high capacity, perhaps 1000 passengers per flight. Flying wing designs have been suggested for it. The other would be a hypersonic aircraft. This aircraft would likely achieve suborbital flight. Flying times of one hour Toronto-Tokyo could be possible.[92] The suborbital nature of the aircraft could eliminate the supersonic noise problem. For both of these

[91] 700 Passengers with 11,200 km range. *Vancouver Sun,* 24 December 1990, P. E11.

[92] "A Long Wait at the Spaceport," *The Economist,* 3 September 1988, p. 26-27.

radical types, existing airports would not likely be able to accommodate the new services. Runway length and parking space at gates are both a factor here.

## F. Airline Scheduling

Airline scheduling can be broken up into two components. The *flight schedule* indicates the times that flights are offered to airline consumers. A number of factors go into determination of the flight schedule and these are discussed below. *Aircraft assignment* is a second phase of scheduling.[92] This is the process of assigning specific aircraft to specific flights on a given day. This is a difficult process as time must be allowed for required aircraft maintenance, yet full productivity of the aircraft is desired.

Airline scheduling is of critical importance to the airline for both marketing as well as cost reasons. On the cost side, improper scheduling can result in the need for more aircraft and groundside crews, more gates at airports, and low fleet utilization resulting in high capital costs. On the marketing side, improper scheduling can result in a competitor taking market share with more attractively scheduled airline services. Scheduling which is too tight can result in flight delays and missed connections, lowering the marketing power of the carrier. On the other hand schedules with too much slack in them result in higher costs. The airline scheduler has a challenging problem in finding the optimum way to operate the airline.

**Flight Schedule.** Perhaps the most important factor in determining the airline's flight schedule is customer preferences. **Figure 34** shows that consumers have preferences for early morning and early evening flights. These are convenient times as they maximize productivity of individuals. The morning peak is at 8 a.m. with an evening peak running from 5-7 p.m. There is a "shoulder" during the middle of the day, and after 10 p.m. traffic drops off rapidly, almost disappearing during the late night.[93,94]

[92] In practice, there is interaction between aircraft assignment and flight schedule development.

[93] An important exception to this are the so-called *redeye* flights which generally consist of departures from the west coast around midnight with arrivals in the midwest and east coast around 7-8 a.m.



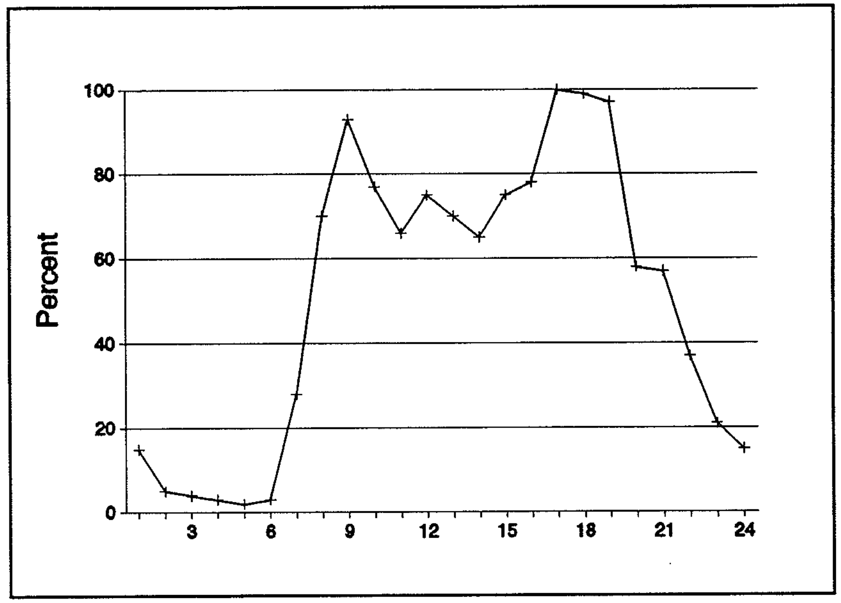


**Figure 34: Hourly Traffic Pattern**
**U.S. Airlines, 1969 Survey**
**Hourly Traffic as % of Peak Hour Traffic**

**Figure 35** shows that consumers also have a preference for flights on certain days of the week. Thursday and Friday are attractive flight times, as they allow the business traveller to return to home and office at the end of the week, or to allow leisure travellers to depart at the end of their work week. Sunday is also a popular time as it allows business travellers to leave home to be ready for business appointments the first thing Monday morning, and to allow leisure travellers to return home prior to the commencement of a new work week.

[95] Data for the figure were obtained from 1969, a period prior to deregulation, and thus are more likely to reveal actual consumer preferences. Data taken after deregulation would distort preferred travel patterns as some consumers are induced by discount air fares to travel during an off-peak period.

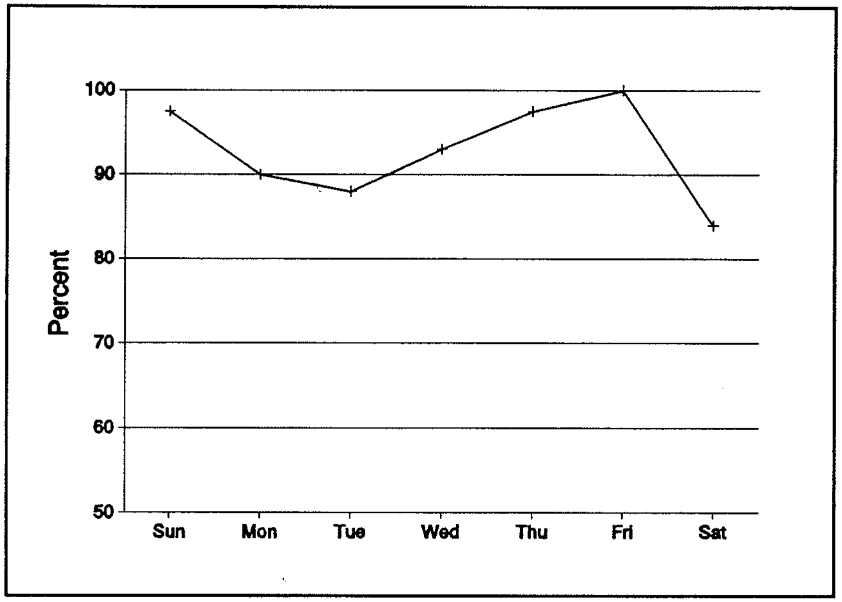


**Figure 35: Weekly Traffic Pattern**
**U.S. Airlines, 1969 Survey**
**Daily Traffic as % of Peak Day Traffic**

**Figure 36** shows traffic patterns for a particular airline during the months of the year. This pattern is fairly typical of many carriers. July and August are peak travel times, primarily due to an influx of leisure travellers. There is a sub-peak some time in the March to April period reflecting a slight increase in travel during the Easter period.[96] Traffic at many airlines drops dramatically during the winter period, although there is often an increase during the December-January period for those travelling for Christmas and the western New Year.

[96] Travel patterns will vary of course by continent, culture combination and airline. As an example, carriers in Islamic nations do not experience an Easter uptake in traffic, but have noticeable increases in traffic during the Hadj season.



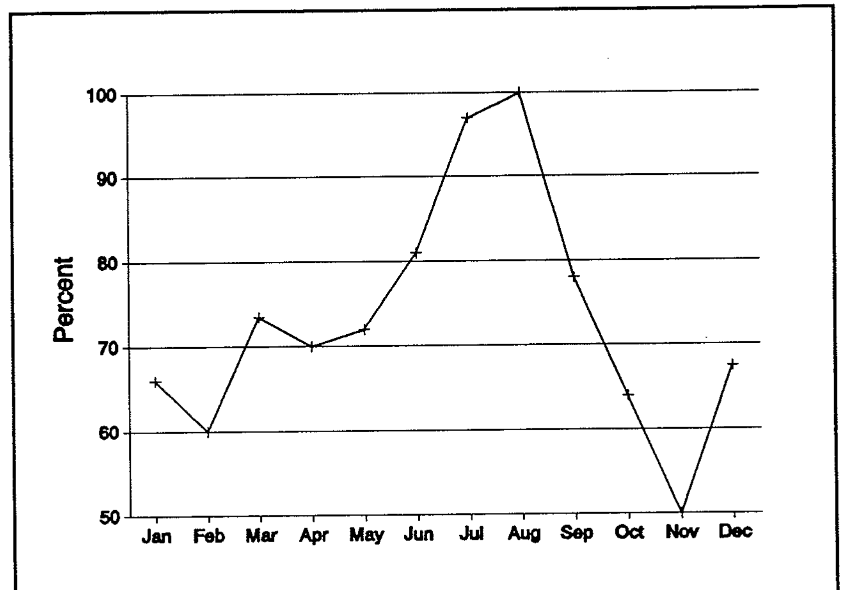


**Figure 36: Monthly Traffic Patterns**
**Air Canada, 1982**
**Monthly Traffic as % of Peak Month Traffic**

Passengers are not the only consumers of airline services. Air cargo is also an important source of revenue for carriers. Unfortunately, the schedule preferences of cargo shippers differ from those of passengers. Cargo shippers prefer to have nighttime services, as that allows them to spend an entire day preparing the shipment. They want to offer the shipment to the airline for transportation at the end of the day, and wish that their customer will receive it first thing in the morning. Because of this, dedicated cargo carriers such as Federal Express, have emerged. These cargo carriers operate flights in the late afternoon and early evening to meet the needs of shippers. While attempts have been made to schedule night passenger services to coincide with express air cargo traffic, it is rare.

**Traffic Imbalance.** It is safe to say that most airline passengers purchase round-trip tickets.[97] This means that there will roughly be an equal number of people flying to a particular destination as will be flying from it. Nevertheless, there can be day-to-day imbalances in traffic flows. Years ago, when transatlantic traffic was dominated by North Americans travelling to Europe, flights would be full in the early summer carrying passengers from North America to Europe, but the return flights would be relatively empty. At the end of the summer, just the opposite would take place, with flights in August returning to North America full and departures from North America empty. Imbalances can also exist on travel to and from conventions, special sporting events such as the Super Bowl, etc.

Another form of traffic imbalance is due to particular legs of a flight being more popular than others. Consider the example of an airline flying from Vancouver to Kamloops to Prince George in British Columbia in **Figure 37.** Vancouver is a city with a large traffic base. Both Kamloops and Prince George are much smaller communities, but Kamloops has popular ski hills. The aircraft flies from Vancouver to Prince George with a stop in Kamloops. The carrier may find it easy to fill up the aircraft with Vancouver-Kamloops passengers, but the consequence may be that the Kamloops-Prince George section of the flight would be empty. While it might be suggested that the airline should operate a different aircraft on the Kamloops-Prince George sector, this may not be possible, because of the lack of such an aircraft in the carrier's fleet, the inability to position such an aircraft at the right place, the low utilization of the plane, etc.

Finally, there can often be advantages to moving a flight schedule by just a few minutes relative to the competition. One U.S. airline, for example, has a policy of "sweeping the clock" by moving its flights five minutes prior to departures of a competitor. This airline has found that in its air markets,

[97] Cargo is uni-directional and significant cargo traffic imbalances exist. One consequence is that it is difficult to build an international all-cargo service under the existing bilateral air treaty system. While there may be sizeable traffic flows from country A to country B, the backhauls may be empty. A viable service may be to fly A to B, B to C, then C back to A. However, an airline of country A would not in general be allowed to fly from B to C.



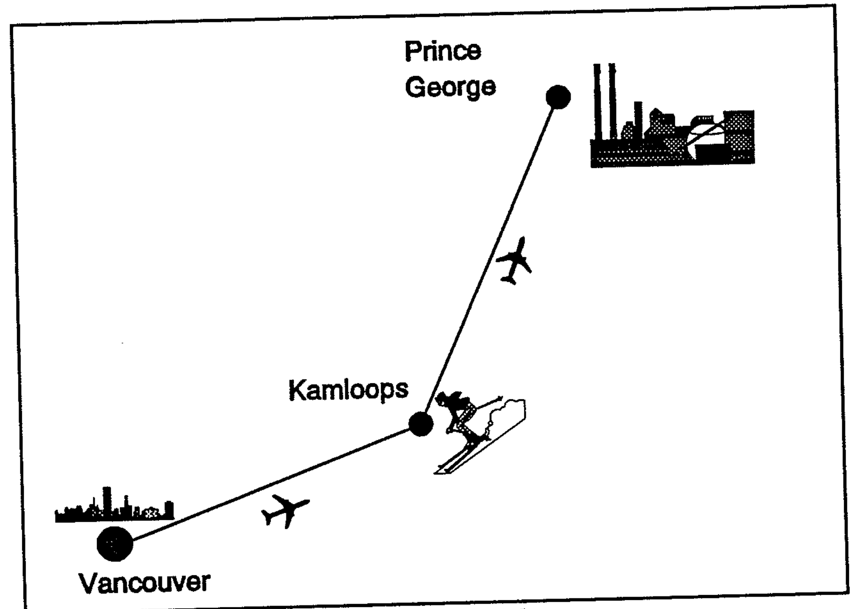


**Figure 37: Flight Leg Imbalance Example**

consumers have a preference for the slightly earlier flight.[98]

**Time Zones.** Another important aspect of airline scheduling is that of *time zones*. We have seen that evening departures are generally preferred by airline consumers. In the case of a flight from New York to Los Angeles, a 6 p.m. departure would arrive at 8 p.m. in Los Angeles. This is a 5 hour flight, but the 3 hour gain from crossing three time zones creates an arrival at an attractive time. However, in the opposite direction, a 6 p.m. departure would be highly undesirable. In this case, a 6 p.m. departure with a 5 hour flight

[98] The reader is cautioned that this effect can vary by market and time of day. For example, at the end of the day flights leaving five minutes after another airline's may be desirable as it allows the passenger a little more flexibility in the case of rush hour traffic delays, etc.

results in an arrival at 2 a.m. in New York (because of the gain of three time zones).[99]

To illustrate the effect of time zone differences, and to give a simple example of an airline scheduling problem, consider the Vancouver-Toronto market. Passengers in Vancouver, a city on the west coast of Canada, would likely prefer departures at 9 a.m, 1 p.m, 4 p.m. and midnight. The 9 a.m. departure would arrive in Toronto at roughly 4 p.m.,[100] giving the business traveller time for an evening appointment or the leisure traveller time to reach their destination and settle in. The 1 p.m. Vancouver departure would arrive at 8 p.m. This is attractive as it allows the traveller to spend half a day in the office the morning before her departure. The arrival is at a convenient time, allowing the passenger to relax. The 4 p.m. departure allows the individual to work most of the day. It arrives at 11 p.m., somewhat late in the day, but still allowing time for an adequate night's rest. The midnight, *redeye* flight is attractive in that it allows a full day in Vancouver and a complete evening with family prior to departure. This flight arrives at 7 a.m., in time for a full day of work in Toronto.

At the other end of this market is Toronto.[101] Popular departure times in this market are 9 a.m., 1 p.m., 5 p.m. and 7 p.m. The 9 a.m. departure arrives in Vancouver at 11 in the morning, allowing a lunch meeting plus a full afternoon. The 1 p.m. departure allows a full morning's work in Toronto, and a late afternoon appointment after the 3 p.m. Vancouver arrival. A 5 p.m. flight arrives in Vancouver at 7 p.m., allowing most of the day in Toronto. A 7 p.m. departure arrives in Vancouver at 9 p.m. allowing a full day in Toronto.

Having determined the desirable departure times at each end of this route, the challenge for the scheduler becomes one of making the schedule work with as few aircraft as possible. **Figure 38** shows the various departure and

[99] Note that because of the prevailing winds at certain times of the year flights from east to west can be up to 1 hour shorter than flights from west to east.

[100] In the winter, an eastbound Vancouver-Toronto flight requires 4 flight hours, plus 3 hours due to time zone loss.

[101] In the winter the flying time westbound from Toronto to Vancouver is 5 hours less 3 hour gain from time zone differences.



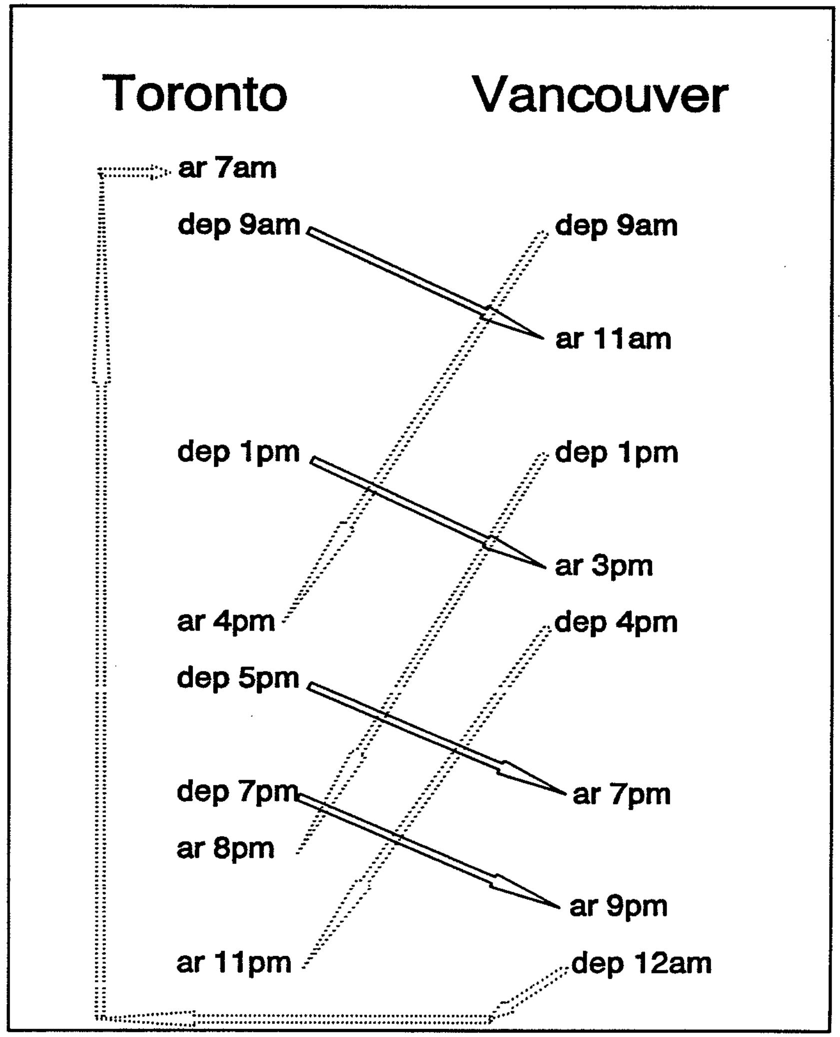


**Figure 38:** **Initial Schedule: Toronto-Vancouver Marked 4 Flights/Day/Direction**

arrival times in each of Toronto and Vancouver. The arrows show how a departure in Vancouver is linked to an arrival in Toronto and vice versa. The solution to this problem is in part the solution to the aircraft assignment problem. Altogether there are eight flight segments to be flown. This schedule can be operated with eight aircraft, one for each of the flight segments, but it is also clear that the schedule could be operated with four aircraft. For example, the departure from Vancouver at 9 a.m. arrives in Toronto at 4 p.m. This aircraft then can be used for the 5 p.m. Toronto departure arriving in Vancouver at 7 p.m.[102]

However, upon closer inspection, it is almost possible to operate this schedule with three aircraft. **Table 3** shows how three aircraft can be used to come close to operating the schedule. Aircraft 1, for example, is able to fly three flight segments during the day. The only major problem in the Table is that aircraft number three arrives from Toronto at 8 p.m. but is needed for a departure at 7 p.m. This problem would be resolvable if it is possible to adjust a) the 1 p.m. Vancouver departure to an earlier time, perhaps at noon; and/or b) adjust the Toronto departure time perhaps to 8 p.m. If this is possible, only three aircraft are needed to fly the schedule.

This example shows how the requirements of aircraft assignment need to interact with the desired flight schedule (developed by the marketing department) in order to balance cost and realities of what can be done with a given fleet.

**Airport Constraints.** Another aspect of scheduling is to recognize various constraints at airports. Some airports, such as Toronto, have restrictions between 11 p.m. and 7 a.m. During these hours, aircraft operations are generally not allowed.[103]

[102] One problem with this particular routing is that it may not provide adequate "turn-around" time in Toronto between the arriving flight and the departing flight. Time is needed to service the aircraft (refuel, restock food supplies, clean the aircraft, etc.), as well as to allow time to deboard and reboard the aircraft, in time for a contingency in case bad weather or other circumstances delay the inbound flight from Vancouver.

[103] In some cases, arrivals with the very quiet Stage 3 aircraft are allowed during curfew periods.



| Aircraft | Flight Segments | | | Notes |
|---|---|---|---|---|
| 1 | dep | Van | 9 a.m | |
| | arr | Tor | 4 p.m. | |
| | dep | Tor | 5 p.m. | |
| | arr | Van | 7 p.m. | |
| | dep | Van | 12 a.m. | A/C #1 positioned for A/C #2 or #3 sked next day |
| | arr | Tor | 7 a.m. | |
| 2 | dep | Tor | 1 p.m. | |
| | arr | Van | 3 p.m. | |
| | dep | Van | 4 p.m. | A/C #2 positioned for A/C #3 or #2 next day |
| | arr | Tor | 11 p.m. | |
| 3 | dep | Tor | 9 a.m. | |
| | arr | Van | 11 a.m. | |
| | dep | Van | 1 p.m. | |
| | arr | Tor | 8 p.m. | } sked must be changed |
| | dep | Tor | 7 p.m. | |
| | arr | Van | 9 p.m. | this A/C positioned for A/C #1 sked |

**Table 3: 3 Aircraft Solution to Toronto-Vancouver Schedule**

Another set of airport restrictions affecting airline schedules is due to chronic congestion at airports. Four U.S. airports are slot constrained in the sense that slots, a particular time when an airline can perform a takeoff or landing operation, have been assigned to airlines via a lottery or auction. For example, Airline A may operate a flight into Chicago's O'Hare at 9:05 a.m., and wishes to move this flight to 9:20. But this may not be possible, if it does not have a 9:20 a.m. slot.

In addition to the slot congestion costraint, many airlines face problems with availability of gates for loading and disembarking passengers. The section on hub and spoke systems discussed the concept of operating banks or complexes of flights. A carrier may wish to add flights to a complex, but be unable to do so because additional gates for accommodating the aircraft are not available.

**Aircraft Assignment.** Once the flight schedule has been developed, the next step for the airline is to assign a particular aircraft to fly a particular flight in the schedule. This process is referred to as aircraft assignment. The previous subsection discussed the problem of time zones and used the example of four flights per day in the Vancouver-Toronto market. An initial flight schedule was developed and a solution was found requiring only three aircraft to perform the set of four daily round-trip flights. As is typical in the real world of airline scheduling, the solution with three aircraft required some adjustment in the original flight schedule.

When assigning aircraft flights, an important consideration is the scheduling of adequate "downtime," (time when the aircraft is not available for flight) to perform required heavy or light maintenance. Typically, maintenance requirements are stated in terms of maximum times between maintenance.[104] However, waiting until the last moment to do the maintenance is not always possible, as the aircraft might not be at a maintenance base. A solution to this scheduling problem is to perform the maintenance earlier than necessary, utilizing time when the aircraft would not have been useful for scheduled flights. For example, aircraft whose four year heavy maintenance is due in August,

[104] Time must also be available for refurbishment or reconfiguration of the aircraft.



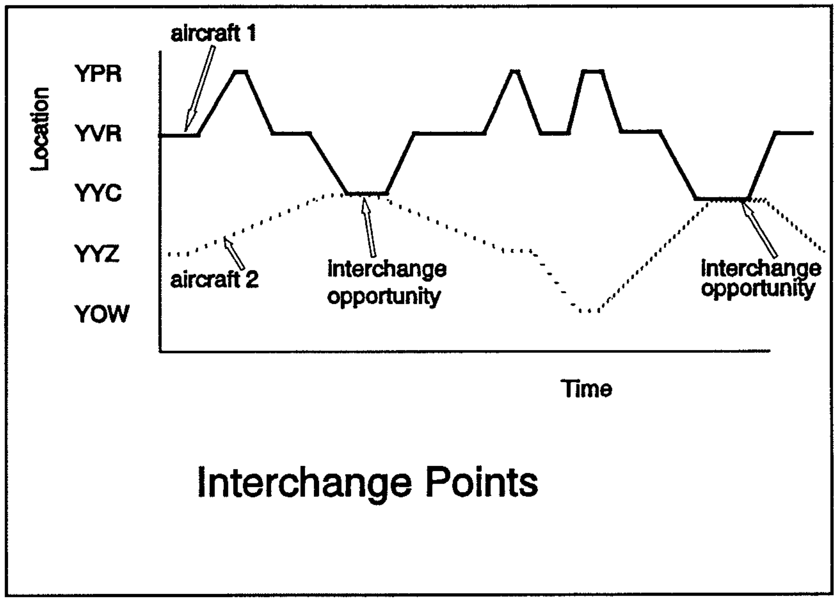


**Figure 39: Interchange Points**

might have that maintenance done at a slow period in March. This is an attractive solution in the sense that the aircraft is available during the peak months. In another sense it is unattractive since the costs of the heavy maintenance are being incurred earlier than would be required, and as a result the total number of flight hours over which the maintenance cost can be amortized is reduced.

In scheduling aircraft assignment, airlines often attempt to develop frequent "interchange" points. An interchange point is a time and place where two aircraft of an identical configuration cross paths. This creates an opportunity for one of the aircraft to be substituted on to the other's schedule. **Figure 39** gives an example of an interchange point. Here there are two aircraft. Aircraft 1 starts at Vancouver (YVR) and flies to Airport YPR, then cycles back to Vancouver, then down to Calgary (YYC). The dashed line represents Aircraft 2, which starts in Toronto (YYZ) and flies to Calgary. As can be seen by the time and location plot, both Aircraft 1 and Aircraft 2 share time in Calgary. If Aircraft 2 requires servicing, and if the service is normally done at YVR, then Aircraft 2 can be switched in Calgary to follow Aircraft 1's schedule and vice versa. The next time Aircraft 2 (now flying Aircraft 1's schedule) arrives in YVR, the service can be done. Aircraft 2 continues on Aircraft 1's originally assigned route until the two aircraft again interchange in Calgary. At this point the two aircraft can return to their regular cycle.



## Chapter 7

# Other Issues

### A. Infrastructure Problems in Air Traffic Control and Airports

**Public Infrastructure.** Among the various modes of transportation, economists distinguish between those which provide all of their own infrastructure versus those which make use of public infrastructure. Railroads, in addition to providing their own vehicles (locomotives and cars), also provide and maintain their own right-of-way infrastructure--the roadbed, rails and accompanying signalling and communications systems. The same is true for pipelines.

Airlines, buses and trucks use publicly provided infrastructure. In the case of buses and trucks, they make use of the public road system. The trucking and bus companies do not own the road system themselves; they are provided and maintained by various levels of government. Both trucks and buses do provide their own *terminal* facilities for the exchange of passengers or freight.

Airlines also use public infrastructure. Just as trucks and buses make use of publicly provided high*ways*, air carriers make use of publicly provided air*way* systems.[105] In addition, they also make use of publicly provided terminal facilities--airports. Carriers do not construct, own and operate their

[105] These are the navigation and communication systems used to regulate the flow of all types of air traffic.

own airports. Rather, various levels of government own and operate airports, which are shared by many airlines and other air transport users.

Because airlines make use of publicly provided facilities (at a fee, of course), the public infrastructure can often be a constraint on their own operations. An airline may wish to open a service to a particular community. However, if there is no space available at that community's airport, the entrant could be locked out of the market, either temporarily or for extended periods of time. Because of the public nature of the decision-making process at airports, expansion of facilities can often encounter significant delays. In addition, just as highways become congested, airways can become congested as well. When this happens, airlines can be restricted in their ability to operate, and the operations they are able to perform will be at a higher cost because of the congestion.

**Congestion and Shortage.** In general, throughout North America, there is a shortage of airport facilities, and a growing problem of congestion in the airways. At certain key airports in the United States and Canada, carriers' ability to take-off and land are severely restricted. The busy times of the day are divided into "slots," the period of time required to perform a single take-off or landing. Since carriers desire more slots than are available, they are rationed. Rationing mechanisms include lotteries (often used in the U.S.), scheduling committees (used in Canada),[106] and pricing (used in the U.K.).[107] The first two methods have been criticized for a number of reasons, among which are the difficulty of new airlines to get access to peak hour slots on a timely basis.

**Competitive Implications.** The shortage of adequate airport and airway capacity is not just an engineering operational issue. It also has important implications for competition among air carriers. Incumbent carriers have large advantages over new entrants in being able to launch new services.

[106] A scheduling committee consists of representatives of the airlines and other users of an airport. They try to work out among themselves who gets which slots.

[107] The U.K. charges significantly higher landing fees at peak times, giving incentives to carriers to move some operations to off-peak times.



Because they have already been allocated a large number of take-off or landing slots, or have historically been able to acquire adequate airport ticketing and boarding gate facilities, they have an advantage in mounting competitive responses to developments by rivals.

The issue of infrastructure constraints is very important for international air transportation. For example, a new bilateral treaty with Japan might give Canada the right to designate an additional airline. However, if that airline is unable to obtain a slot at the Japanese airport (or ticketing and gate facilities), it can be effectively prevented from competing in the market. As Canada discusses the issue of a more open-skies arrangement with the United States, the ability of Canadian air carriers to obtain access to slots, gates and ticket space is very important in determining whether or not the Canadian carriers will be effective in their ability to compete for their fair share of the traffic. Airport congestion is also a factor when carriers choose which airport they will serve.

## B. Entry Barriers

"Entry Barriers" is a term economists use to denote frictions which prevent new firms from commencing operations in a given market. This section discusses various types of entry barriers which might exist in the airline industry. Understanding them is important both for appreciating whether or not Canadian carriers will be able to compete with foreign carriers, and for understanding what types of service and access conditions it may be necessary to negotiate with foreign governments.

*Economies of scale* have often been considered a potential barrier to entry to small firms into an industry. Gillen, Oum and Tretheway (1986) measured economies in the Canadian airline industry.[108] They distinguished between cost economies of network size and cost economies of traffic density. Network economies would occur if adding additional cities to an airline network allowed cost per passenger to fall.[109] The evidence suggests that in the range

[108] Gillen, Oum and Tretheway (1986).

[109] This assumes that the amount of traffic per city is unchanged after the addition.

of carriers the size of Air Canada or Canadian Airlines International Limited (CAI), such economies do not exist.

*Economies of traffic density* would occur if cost per passenger drops when a carrier experiences an increase in traffic in a network of a given size.[110] Smaller carriers are likely to operate with higher unit costs, unless they can confine their service to a handful of cities and provide very large volumes of service between these cities.

*Airline hubs* are alleged to be barriers to entry.[111] Section II.F already discussed how hubs lever the effect of adding new stations. The example was given of how increasing the number of stations by 50%, from 9 to 14, increases the number of city pairs served by more than 100%, from 45 to 105. When applied to U.S. hubs, such as American's 100 city hub at Dallas-Fort Worth, the traffic generating potential of an additional city can be awesome. Relatively small amounts of traffic can justify frequent daily services. A new entrant to a city pair market connected to a major hub would be unable to replicate the network of the hub carrier, and thus would be confined to a small portion of the market. Air Canada has cited this as a problem it faces in competing with U.S. carriers in the transborder market.[112] On a route such as Toronto-Chicago, Air Canada is largely confined to Chicago originating/destining traffic. In contrast, its competitors, United and American, can access traffic from other cities connected to the Chicago hub and carry them through Chicago to Toronto.

An important potential barrier to entry is *control of the distribution channel.* If incumbent firms have complete control over the marketing channel, then new entrants could be excluded from the channel and thus, not be able to effectively sell their services. In some countries, there may be a single travel agent network, controlled by the national airline, and this control and market power could significantly hinder the ability of Canadian carriers to make sales.

[110] This would be because fixed station costs can be spread out over more passengers, larger sized aircraft could be used, etc.

[111] See Levine (1987), pp. 412-413.

[112] "Air Canada Submission to House of Commons Special Committee on Canada-United States Air Transport Services," Montreal, 6 December 1990. See especially pp. 9-14.



*Travel agent commission overrides*, when used by dominant carriers, may be a barrier to entry. A recent study by the U.S. Department of Transportation found that agencies will tend to look favourably on a small override commission from a dominant airline, which accounts for say one-third of its total bookings, than on a high override commission paid by a small, entrant carrier.[113]

In Canada, there are a large number (4,300) of travel agents who act as intermediaries in selling airline services to retail customers.[114] On the surface, this might suggest that the two dominant air carriers would not be able to control the marketing channel. However, travel agents are strongly influenced in their choices by the *computer reservation systems* (CRS) which they use. The fact that travel agents rely on a single CRS service to provide information on airlines,[115] combined with the fact that the two dominant Canadian carriers control the dominant CRS system in Canada, suggest that there may be potential for these two carriers to prevent or hinder access to the distribution channel for new entrants. While the issue of CRS dominance in Canada was resolved by a consent order between the Bureau of Competition Policy and Gemini (the CRS vender jointly owned by Air Canada, CAI and the U.S. Covia Corporation - which owns the Appolo CRS system[116]), the potential for such abuse must be recognized when contemplating how Canadian carriers will fare in other countries.

*Code sharing* can also be a barrier to a new entrant. With code sharing, a flight from A to B on Carrier 1 is shown in the CRS as a flight on Carrier 2.

[113] U.S. D.O.T. (1990), p. 28.

[114] In Canada, 70% of airline tickets are sold by travel agents. Source: "Statement of Grounds and Material Facts for the Application by the Director of Investigation and Research under Section 64 of the Competition Act," 3 March 1987, application between Director and Gemini Group Automated Distribution Systems Inc., et al.

[115] It is too expensive for any but the largest travel agencies to have more than one CRS system.

[116] For example, schedule A of the 7 July 1989 Consent Order stipulates that Gemini "shall not discriminate in providing access to the system to any carrier willing to pay the non-discriminatory fee and comply with the system vendor's customary terms" (p. 9). There are many other additional pro-competitive provisions in the consent order.

This can be important when that flight is combined with a Carrier 2 flight from B to C. The code sharing arrangement shows the A-B-C flight as being a "single carrier" service, which gets a higher priority on the CRS display than an "interline" service. As was revealed in Section V.A, the higher priority is quite significant in influencing the consumer's choice.

Tretheway (1989) describes how *airline frequent flyer programs* can act as a *powerful* entry barrier. This is because it is much easier and cheaper for the large network airlines to provide these programs than it is for entrants. Here in Canada, Wardair had great difficulty offering a frequent flyer program which could compete with those of Air Canada and Canadian Airlines International. Their original attempt in 1988 was terminated, as Wardair found it too expensive to operate. Following this, they made repeated statements to the financial community that they were going to produce a new frequent flyer program. The program which they eventually introduced in October 1988, offered awards at roughly twice the frequency of Air Canada and CAI, and rewards were of greater value.[117] As an example of the latter, with the Wardair program popular flights and travel times were not blocked out from frequent flyer award usage. Gillen, Stanbury and Tretheway (1988) point out that frequent flyer programs are not quantity discounts but rather loyalty inducing incentives. They thus conclude that these programs are anti-competitive and should be terminated if competition is to be encouraged.

Another potential barrier to entry is sometimes referred to as *vertical integration*. In the case of air transport, this would involve acquiring supplies (and distributors) of services needed by a carrier and its rivals. By controlling up and downstream markets, a carrier could exclude a rival from a market, raise its costs,[118] or indirectly control its actions.[119] There are may up/downstream

[117] One problem Wardair faced was that there were no partners left to join their program. With the exception of City Express, all Canadian airlines of any importance had already been affiliated with either CAI or Air Canada.

[118] By setting up high prices for wholly owned suppliers, a carrier can raise costs of a rival who must use that supplier. The offending carrier is simply transferring money from one wholly owned entity (the airline) to another (the supplier).

[119] For example, a carrier which owns a monopoly ground handling services firm can cause a rival to reschedule a flight by instructing the handler to say it is not able to provide the service at the desired time.



firms which a carrier (or its shareholder government, in some cases) could seek to control for anticompetitive purposes. These include travel agents and computer reservation systems on the distribution side; and fuelling firms, caterers, ground handling services, etc, on the supplier side.

One controversial type of vertical integration is *control of feeder carriers*.[120] In an important sense, feeder carriers supply passengers to trunk carriers. If an airline (or group of airlines) obtains exclusive access to feed passengers in a region, then it will have a larger traffic base than a rival carrier. The latter would be confined only to origin/destination passengers at the city.

A variation of this "control" of feed traffic has been put forward as an argument as to why simply liberalizing cross border traffic between Canada and the U.S. would harm Canadian carriers. Because they control all domestic feed to U.S. hubs (either via feeder carriers or via their own flights), the U.S. carriers can confine Canadian airlines to only origin/destination traffic at the gateway U.S. cities. While Canadian carriers could do the same in their own home market, the impact is much smaller. This is because Canada is both smaller and more concentrated than the U.S.[121] The largest seven cities in Canada account for 42% of the nation's population, whereas the seven largest U.S. cities account for only 19%. A U.S. carrier would only need to serve a handful of Canadian cities to be able to access much of the total traffic. In contrast, a Canadian carrier would need to serve scores of U.S. cities in order to have a similar access. A U.S. carrier can bring large portions of the U.S.

[120] Air Canada and CAI have been successful in purchasing most of the feeder carriers in Canada. (City Express is aligned with U.S. carrier Continental, while Intair is unaligned. Both of the "free agent" Canadian carriers are in precarious financial positions.) By preventing their feeder subsidiaries from signing interlining agreements or putting in joint fares with other carriers, CAI and Air Canada could be excluding new Canadian entrants from the domestic trunk airline routes for important segments of trunkline markets. Just prior to Wardair's demise, it announced that it was going to pay feeder airline fares for its passengers, at great expense, in order to get access to this important segment of the scheduled airline market. See "Wardair to Pay Commuter Fares for some Connecting Passengers," Globe and Mail, 18 January 1989, p.B10.

[121] The share of total population accounted for by the largest metropolitan area is 14% for Canada versus 5% for the U.S. The proportions accounted for by the largest 2, 3 and 7 cities are:

| | largest | largest 2 | largest 3 | largest 7 |
|---|---|---|---|---|
| Canada | 14% | 25% | 30% | 42% |
| U.S. | 5% | 8% | 12% | 19% |

market to its hub and then on to Canada. The Canadian carrier has no equivalent access to this vast U.S. market. In contrast, the U.S. carrier can access much of the total Canadian traffic from a handful of Canada's concentrated points.

A similar type of entry barrier involves *access to public infrastructure: airports and airways*. In some nations, airport facilities might not be available to new carriers, and takeoff/landing slots may be restricted. A hypothetical example could involve negotiating the ability for a Canadian carrier to fly to a new Japanese city, in exchange for the Japanese right to operate to a new Canadian city. The Japanese carrier might launch service immediately, while its rival Canadian carrier, although authorized, finds itself unable to obtain ticketing, gate or office space in the Japanese airport, and/or unable to obtain takeoff/landing authorization at the desired time. The Japanese carrier, due to its large presence at the Japanese airport, has no similar trouble. It already has gate, office and ticketing space. It may be able to get an additional slot, or in the worst case, simply reallocate a slot from a low profit route.

While not exhaustive, this list of entry barriers is illustrative of the problems a Canadian carrier could face when entering a new foreign market.[122] Individually, each of these can be quite serious. What is more important, however, is the cumulative height of the entry barriers. When designing a new bilateral negotiating policy, care must be given to negotiating the conditions under which our carriers will operate. This section closes with a comment, which although unsubstantiated and potentially a figment of its author's prejudices, illustrates the type of problems a carrier can face when entering a new foreign market:

> "Not only would Braniff face incredible governmental harassment in places like Hong Kong and Singapore, but in Seoul, South Korea, it would be fighting a rear-guard action against an unfriendly government that thought little of threatening the government-monopoly travel agency system in South Korea with dire action if they booked passengers on Braniff instead of Korean Air Lines, and directing a campaign of outright thievery against Braniff operations at Seoul's Kimpo Airport. For instance, Braniff's 747's, when cleaned by ground crews contracted from Korean Air Lines, would regularly be stripped of all the paper products (including toilet paper) from the aircraft."[123]

[122] It also may apply to a new carrier attempting to enter domestic Canadian markets.



## C. Globalization

In the mid-1980s, a wave of mergers swept the U.S. airline industry, resulting in the formation of roughly eight "mega-carriers".[124] Shortly thereafter, consolidation came to Canada resulting in the duopoly consisting of Air Canada and Canadian Airlines International Limited (CAI). Some consolidation is also taking place in Europe, with the merger of British Caledonian into British Airways, and the proposed acquisition of Air Inter and UTA by Air France. BA and Air France have joined what had been an exclusively American $7 billion club.[125] The question now is whether this consolidation movement will cross international borders. Will truly global carrier systems emerge? If globalization does come, what form will it take? Will there be outright mergers, or will the consolidation take the form of strong or weak carrier alliances?

Section 3.D discussed why consumers prefer to patronize large, rather than small, carriers. Carriers with large networks make it easier for the consumer to gather information on available flights and fares. Large network carriers are perceived by many consumers as providing a higher quality of

[123] Nance (1984), p. 127.

[124] These are United (US$8.8 billion), American (US$8.6), Texas Air - now Continental Holdings Inc. (US$8.4), Delta (US$7.4), Northwest (US$5.6), Federal Express (US$5.8), USAir (US$5.2), and TWA (US$4.4). Pan Am (US$3.6) might also be included. Figures are 1988 revenues. Source is ATA (1989).

[125] In 1990 Canadian dollars, this would be roughly $9.5 billion.

service due to better timing of connecting flights, less opportunity for baggage to be lost, etc. In addition, artificial marketing incentives, such as frequent flyer programs induce the consumer to patronize large carriers. Section 6.C discussed the basic economics of the impact of feed traffic on air carrier profitability, and Section 6.D put this into the context of international air traffic. The net result of all of this is that carriers throughout the world are experiencing market forces inducing them to extend their reach to larger and larger portions of the globe. To some, this implies that the industry may eventually "globalize," just as a number of other industries such as energy, automobile production, etc., have switched from national to global orientation and operations. Here, the globalization concept is discussed further.

**What is a "Global" Carrier?** Before one can discuss globalization of the airline industry, the concept of a global carrier must be defined. Some carriers provide services on many continents, and might even completely circumnavigate the globe. Most of these are *international carriers*. They carry passengers between countries, but most of their customers originate from the carrier's home base. Some carriers, Pan Am for example, had fifth freedom rights allowing it to transport passengers between "foreign" countries. But again, if the passengers they carry are largely from the home country, perhaps it should not be considered as a global carrier. In this paper, the term international carrier will be used.

A few carriers go a step beyond in that they may primarily transport patrons from countries other than their home base. These are the *sixth freedom carriers*. They fly passengers from one "foreign" country to another, but via their home base. The Netherland's KLM is a good example. Its' home population is small, but by developing sixth freedom routes, it has been able to build a formidable traffic base. An example from the Asia Pacific region is Singapore Airlines.

The operation of a sixth freedom carrier is hub and spoke. However, the operation is of a single hub. Single hubs have a good ability to provide feed traffic into the system from medium and sometimes small communities which are short air distances from the hub. However, the further one gets from the hub,



the more likely it is that the carrier is transporting O-D passengers only:[126] they do not have the ability to collect "feed" traffic from the small and medium size communities around one of their spoke stations. British Airways may be effective in obtaining a share of Toronto originating passengers going to Europe (or beyond) on its own system. But it is not likely to pick up feed traffic in Toronto. Thus, sixth freedom carriers will tend to rely on O-D traffic the further a station is from its home base hub. BA's Toronto competitor, Air Canada, is more likely to pick up feed (from say Windsor or Timmins, ON), bring it to Toronto, and keep it on-line for the long haul to the European destination. Passengers going beyond an Air Canada European station would then connect to another carrier, with no particular carrier having a pronounced advantage in obtaining Air Canada's "feed."

The term *global carrier* should be reserved for an airline which can gather feed traffic from many widely separated points throughout the world, and channel that feed onto its long haul routes. Such a carrier would have the ability to carry on-line a passenger from origin to destination for a large portion of the world. An analogy with the U.S. domestic market may help clarify the concepts. A single hub carrier would be the domestic equivalent of a sixth freedom carrier. US Air's pre-merger single hub (Pittsburgh) operation would be an example.[127] (See **Figure 40.**) A full coverage multiple hub carrier, like American Airlines, would be the domestic equivalent of a global carrier.[128] (See **Figure 41.**) American has the ability to take a passenger from an awesome number of places in the U.S. and keep him/her on-line to the ultimate U.S. destination. The single hub carrier can serve a large number of major cities, but as shown in Figure 40, it is not likely to get traffic from the small and medium

[126] O-D stands for origin-destination. O-D traffic differs from "connecting" traffic which travels through a station/airport, but originates/destineselsewhere. A Toronto resident travelling to London England would be a Toronto O-D passenger. A Timmins resident travelling to London via Toronto is not a Toronto O-D passenger.

[127] US Air subsequently developed other hubs and acquired hubs via acquisition of Piedmont and PSA.

[128] American operator hubs in Chicago (East-West northern tier), Dallas-Fort Worth (East-West southern tier), Raleigh-Durham (North-South east coast), Nashville (North-South midwest), and San Jose (North-South west coast). In addition it has a Caribbean hub in San Juan, and a developing hub in Miami which could feed the South American route system it hopes to purchase from Eastern Airlines.

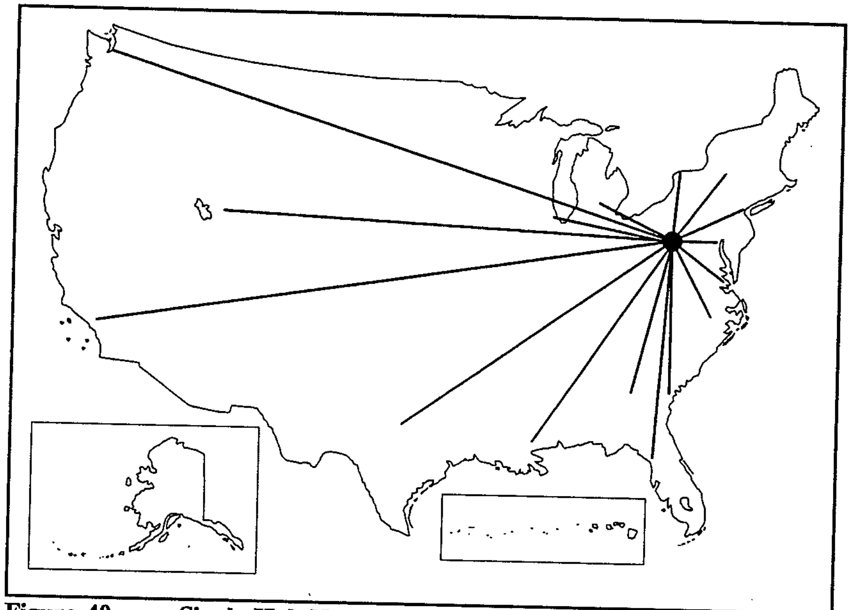

Figure 40: Single Hub Network

sized communities in the West. In contrast, the multiple hub carrier of Figure 41 has great potential to collect feed traffic from smaller communities near to its many hubs. In addition, it can carry traffic up and down the west coast, something which the single hub carrier of Figure 40 is not able to do.

A global carrier is one which operates hubs in several countries. It can gather short/medium haul traffic to each of these hubs, and connect them to other hubs where they can connect to outlying destinations. The global carrier reaches beyond the major cities of the world to access a much larger market -- and keep it all on-line. At present, no true global carriers exist in the world, although much talk has been heard recently about their potential emergence.

**Three Levels of Global Network Building.** What form would global consolidation take in this industry? This paper identifies three potential strategies. At one extreme carriers from different countries merge outright with



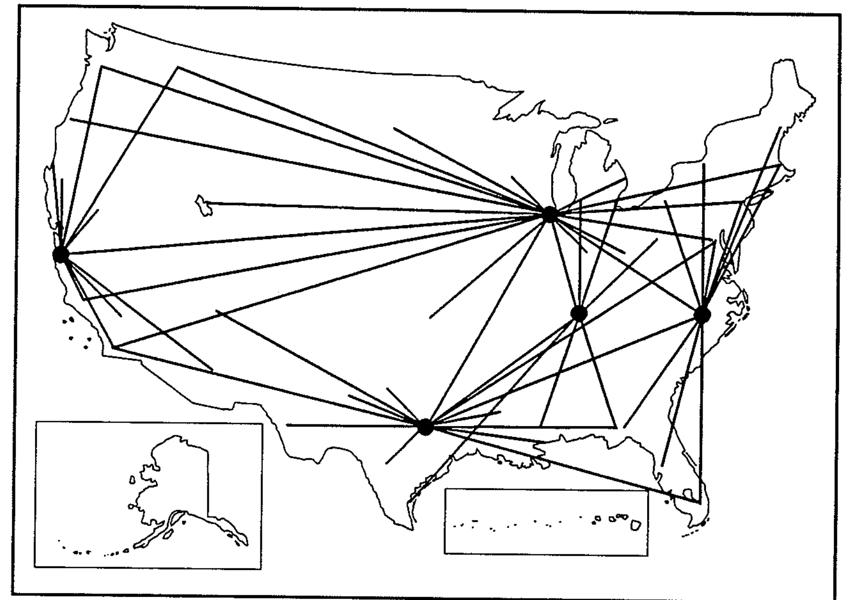

Figure 41: Mutliple Hub Network

a single surviving corporate identity. At the other extreme, carriers keep their unique identities but use simple marketing agreements to coordinate traffic flows. In between, there is a stronger form of marketing agreement, one which is solidified with an equity position but is not a merger. Each of these is discussed in turn.

***Corporate Merger.*** The most obvious way to build a global network is to buy airlines in various countries, and merge them into a single corporate entity. Some precedent exists for such multinational airlines. SAS is owned by government and private interests in Denmark, Norway and Sweden.[129] Air Afrique services 12 countries in Western Africa. While a few other examples can be found, all involve pooling the traffic generating ability of small countries

[129] Each country also has its own domestic carrier.

within a close geographic region. Some attempt has been made by airlines to purchase airlines of other countries. SAS, for example, bid for British Caledonian as well as Aerolineas Argentinas, but was unsuccessful in both attempts.

From an operational point of view, outright merger is the most desirable form of consolidation. It allows full advantage to be taken of fleet and crew utilization possibilities, amasses purchasing and borrowing power, allows the adoption of a single consumer identity, etc. International mergers, however, meet with many political obstacles. For example, Canada and the United States have laws limiting foreign ownership of their respective carriers to 25%.[130] For many countries, national identity is tied to the existence of a "flag" carrier. Many high skill managerial and technical jobs are linked to the city with the corporate headquarters. A merger could transfer such jobs from one country to another. For these and similar reasons, it is hard to envision outright mergers taking place, at least at present. Would the French (or any other) government allow Air France to disappear by being swallowed up by AMR Corp,[131] Lufthansa, or Japan Air Lines? While global merger may be attractive from the airline managers' point of view, it seems to be an idea whose time has not yet come.

***Simple Carrier Alliances.*** Simple carrier alliances involve "marketing agreements" between carriers of different countries for preferential exchange of traffic. Air Canada, for example, may sign an agreement with Cathay Pacific whereby it books Canadian travellers going to various Asia Pacific destinations on Cathay. Similarly, Cathay books passengers going to destinations east of Vancouver on Air Canada flights. Both carriers gain traffic which would have gone to rival Canadian Airlines International Ltd. (CAI) who serves both domestic Canada and the Asia-Pacific region, or to rival U.S. carriers serving both Asia and Canada.

[130] The U.S. is reviewing this policy. See "DOT Rules to Review Foreign Investment for Airlines," *Journal of Commerce*, 19 November 1990, p. 5B.

[131] AMR Corp. is the parent of American Airlines.



Marketing agreements may go further than this, specifying frequent flyer participation or code sharing. A travel agent in Seattle, for example, will see a British Airways flight to London listed on the Computer Reservation System (CRS). In fact it consists of a United Airlines flight from Seattle to Chicago (using BA's CRS "code"), connecting to a BA flight to London.[132] By being listed via code sharing as a single airline service, the flight will appear in the CRS display with a higher priority.[133] In addition a United Airlines patron may prefer this "BA" flight if it earns United Mileage Plus frequent flyer award credits for the entire journey.

While carrier agreements undoubtedly are effective marketing tools, they are limited in being easy to cancel. BA could easily switch to another carrier to provide feed to its Chicago-London flight. United could win (or purchase) rights to fly the route as well. A parallel for this volatility existed with the U.S. feeder carriers in the immediate post-deregulation years. Some trunk carriers lined up feeder service at various hubs, only to see the feeder switch its allegiance to a different trunk. The trunk carriers needed to stabilize their feeder arrangements, and did so by taking equity positions in the smaller carriers.

***Strong Airline Alliances Involving Equity Swaps.*** This strategy might be referred to as the "strong alliance" option. Carriers of different countries maintain their own corporate identity, but they are affiliated in order to provide a global service network. In order to take full advantage of the potential of the global network, the component carriers will need to engage in much coordination of their marketing efforts. This will include routing decisions, schedule timing, the establishment of joint fares, code sharing in CRS data bases, common frequent flyer programs (where allowed), some coordination of dynamic yield management decisions, etc. There could also be coordination on the cost side, with joint purchasing of fuel, catering services, and possibly

[132] BA operates non-stop Seattle-London service on some days. It code shares with United on alternate days in order to provide the Seattle consumer with what appears to be a daily service. A Canadian example is the code sharing between CAI and Lufthansa, which allows both carriers to give the semblance of offering daily services.

[133] In late 1990, United proposed purchasing Pan Am's right to fly from Chicago to London. If this transaction is approved, it could jeopardize BA's code sharing arrangement with United.

aircraft. Ground services would be rationalized. In order to take advantage of these benefits, the carriers will need to make substantial investments, or to reluctantly give up some previous functions (or routes) to the other carrier. Such undertakings are not easily made, and can only be justified when a strong commitment is given by all parties.

A logical form for this commitment involves an equity stake of one carrier in another, or possibly mutual equity stakes. There is precedence for this in the relationship between a trunk carrier and its turboprop feeder carriers. After experiencing problems in the early 1980s with feeder carriers changing which trunk they were affiliated with, the U.S. trunks took minority equity stakes in their feeders in order to make the relationship more permanent. In many cases, the more permanent relationship resulted in substantial investment and expansion by the regional carrier. The same procedure could be employed for alliances between trunk carriers of different countries. In some cases, it may be logical for the affiliated carriers to take equity stakes in each other. The intent of these equity positions is not so much for one airline to control another (which may not be permitted by one or both countries), but rather to solidify an operating relationship.

It should be pointed out that many of the benefits from building a global network depend on information systems (e.g., yield management, frequent flyer programs, establishment of joint fares, etc.). The core of all of these airline information technologies is increasingly becoming the computer reservation system (CRS). This suggests that affiliated carriers will all need to share the same CRS system. When this argument is carried to its most extreme, it suggests that global carrier networks will be built around the existing CRS systems.[134] Since both of Canada's airlines use the Covia system, does this imply that one but not the other will become part of a global carrier network?

***Interlining Versus Code-Sharing***. Before closing this section, it should be pointed out that there are two possible forms for simple carrier alliances.

[134] The major North American systems are American Airlines' Sabre system, United Airlines' Covia CRS, Continental Holdings' SystemOne, and the proposed amalgamation of the TWA/Northwest PARS CRS with Delta's Soda system. Canada's Gemini CRs use the Covia technology and is partially owned by Covia.



One is referred to as interlining. Here, a Canadian carrier would strike a marketing agreement with a foreign carrier under which each would honour the others' bookings of passengers. Each carrier retains its own identity, and flight segments are clearly labelled as to which carrier is providing the service. There is no code sharing. In an interlining agreement, the carriers may establish a joint fare[135] and/or may attempt to coordinate their schedules in order to minimize connecting time for passengers. Interlining agreements are mutually beneficial and require little investment by the two air carriers.

A somewhat more committed relationship between air carriers involves code-sharing. In a code-sharing agreement, the consumer will perceive that one carrier is the carrier providing the entire service, even though two separate carriers may be involved. In an earlier example, a consumer in Seattle would perceive that they can book flights from Seattle to London via Chicago on British Airways. The computer reservation system and the printed ticket will indicate that both segments of the flight are operated by British Airways. In fact, the Seattle-Chicago segment is a United Airlines flight with the Chicago-London segment being a British Airways flight.

A code-sharing arrangement is a much higher level of commitment between the carriers. One of the carriers loses its market identity with the consumer. In code-sharing, one of the carriers may be required to make certain commitments or provide guarantees of certain levels of traffic to the other carrier. Typically, one of the carriers will have to agree to the other providing certain ground services and passenger handling functions. In general, it can be said that code-sharing agreements are less common and more stable than interlining agreements. The latter can be very transient, and are easily cancelled by one of the parties.

[135] A joint fare between points A and C is lower than the combined fare from A to B and B to C.

**Keys to Global Carrier Success.** There are three keys to whether or not a global carrier would have an advantage over present carriers for moving a passenger from origin to destination. The first is whether the global carrier can operate with significantly *lower costs* and thus sustain lower prices in the long run. Thus far the evidence seems to suggest this will not be the case. The second is whether passengers will be offered *more convenient service*. Here, a properly operated global carrier could offer some advantages. By coordinating flight schedules, passenger ground time for connections might be reduced. A key to a convenient operation will be ease of changing flights, including all the challenges of moving from one gate to another, passing through customs, no requirement for the passenger to retrieve and re-check baggage, etc. Also related here, is a requirement that the global carrier offer a minimum of backtracking or circuitous routing, in order to minimize travel times for the customer.

The third key to the success of a truly global carrier depends on building *customer loyalty*. A global carrier needs such loyalty to insure that a customer will choose it for all air travel, even if routings may be a bit circuitous at times. Perhaps one way to build loyalty is via superior service. However, the U.S. experience with frequent flyer programs suggests that they are more powerful in that they reward the passenger for loyalty. If carriers are thwarted in spreading frequent flyer programs worldwide, or if they are unable to design other loyalty inducing rewards, then perhaps globalization will never come about. However, a carrier which invents the right formula in this regard could reap enormous advantages and profits.

**Conclusion.** In conclusion, it can be observed that there are market forces inducing the airline industry toward increasing international airline connectivity. Consumers prefer to deal with a single large-network airline. Artificial incentives such as frequent flyer programs provide additional stimulus. There are a number of different levels or degrees to which this interconnectivity can take place. Simple carrier alliances are already taking place, as are code-sharing agreements. There are some moves to stronger carrier alliances involving minority equity stakes. We have not observed significant mergers of airlines of different nations, as yet.



## D. Airline Finance

It is beyond the scope of this paper to provide a detailed financial analysis of the airline industry. Nevertheless, it is important to appreciate a number of characteristics of this industry that have important financial implications.

**Seasonality.** The airline industry has a strong seasonality. Traffic peaks during the third quarter and has a trough during the fourth quarter. As can be seen in Figure 36, the trough month of November is only 50 percent of the peak in August.[136]

**Procyclical.** The airline industry is procyclical in the sense that its expansion and contraction is more pronounced than that of the economy as a whole. Income elasticities for this industry are approximately 2.0, indicating that for every one percent expansion in national income, air transport expands by two percent, and for every one percent contraction in national income, air transport contracts by two percent.[137] In the jargon of the financial industry, air transport has a high "beta" coefficient. This indicates that earnings in the airline industry are more volatile than earnings in the economy overall.

**High Operating Leverage.** Operating leverage is a measure of how earnings increase as output increases. In some industries, such as manufacturing, each additional unit of production is accompanied by a corresponding increase in costs of manufacturing. While profits rise with additional production, they do so proportionately. In the airline industry, the costs of providing services are somewhat fixed, in the sense that the carrier commits itself to operating a particular schedule of flights. Thus, if additional passengers choose to travel, the airlines might not have a corresponding increase in the cost of providing flights. They have already committed to providing a certain number of flights and thus, the additional revenues from these new passengers are reflected as profit to the carrier. This implies that whenever airline traffic increases above expectations, profits will soar. Similarly, when traffic falls below amounts which had been planned for, huge losses can be experienced.

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[136] 1982 data was used as it predates the era of widely available discount fares in Canada. Discounts are now used to induce some peak travellers to switch to off-peak times.

[137] See Gillen, Oum and Noble (1986).

| Airline | Financial Leverage |
|---|---|
| Continental | 40.3 |
| Singapore Airlines | 10.8 |
| United Airlines | 5.1 |
| British Airways | 4.7 |
| Japan Airlines | 4.2 |
| **Canadian Airlines Int'l** | **4.2** |
| **Air Canada** | **3.4** |
| American Airlines | 3.4 |
| KLM | 3.3 |
| USAir | 2.6 |
| Delta Airlines | 2.5 |
| Northwest | 2.2 |
| * Source: Carrier Annual Reports. | |

**Table 4:** **Financial Leverage Selected Carriers, 1988 (Total Liabilities Divided by Shareholder Net Worth**

**Moderately High Financial Leverage.** Financial leverage is the relationship between debt and equity financing for a firm. A firm is said to be highly levered when it has large amounts of debt relative to the stockholders' equity. In such a situation, small increases in net profit can be magnified into very large increases in return for the shareholder. Similarly, small losses will



| Airline | Asset Turnover |
|---|---|
| **Canadian Airlines** | **1.3** |
| Delta | 1.3 |
| United | 1.4 |
| Continental | 1.2 |
| Northwest | 1.2 |
| USAir | 1.2 |
| **Air Canada** | **1.0** |
| American | 1.0 |
| KLM | .6 |
| * Source: Carrier Reports. | |

**Table 5:** **Asset Turnover (Operating Revenues Divided by Total Assets) Selected Airlines 1988**

be magnified into very poor returns for the shareholder. The airline industry has relatively high financial leverage, although not as high as in some industries, such as the financial sector. Within the airline industry, there is considerable variation in the degree of financial leverage. Typically, liabilities represent two to four times the value of shareholder net worth. However, some carriers, such as Continental Airline Holdings, have ratios which are very high. **Table 4** gives an example of the financial leverage of a sample of air carriers.

**Asset Turnover of Unity.** Asset turnover is the ratio of the value of a firm's annual revenues to the value of its assets. Industries such as retail and wholesale trade have asset turnovers typically between two and ten times per year. Manufacturing industries generally have asset turnovers between one and two. The airline industry tends to have asset turnovers of approximately unity. This means that the revenues received each year are roughly equal to the value of assets used to provide services to its customers. **Table 5** gives asset turnover ratios for selected carriers.

**Changing Cash Flow Relationship.** Traditionally, airlines owned their own aircraft. Because aircraft were purchased with cash and depreciated over the life of the aircraft, airlines had very positive cash flows in most years. This was because part of the revenue collected from customers was used to cover depreciation of the aircraft. However, depreciation is an accounting charge and does not require the actual outlay of cash. Thus, even when carriers were suffering losses, the cash coming in usually exceeded the cash going out.[138]

In recent years, this cash flow relationship has changed dramatically. Whereas in 1961 three percent of aircraft were leased, by 1988, 42 percent of aircraft were leased.[139] With an aircraft lease, the airline does not lay out cash up-front when the aircraft is acquired. Instead, cash is laid out throughout the lifetime of the aircraft. With the adoption of leasing by airlines, carriers are now experiencing required annual cash outlays roughly equal to their cash inflows. Because of this, when difficult times are experienced--such as a recession or fuel crisis, carriers can experience negative cash flows. As a result, airlines are more likely to experience bankruptcy.

[138] The exception would be when carriers were taking delivery of (and paying cash for) new aircraft.

[139] Source: *Air Transport World*, June, 1989.



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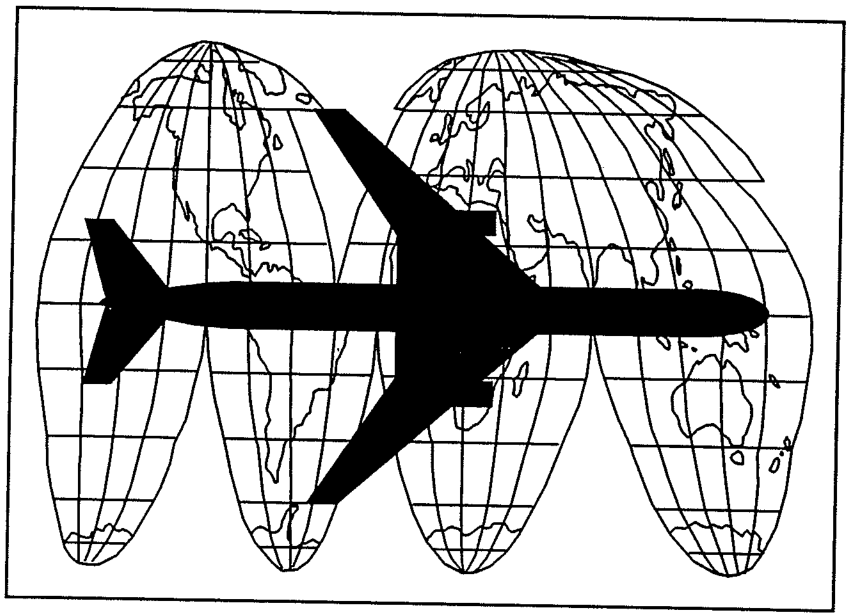

# Airline Economics:

*Foundations for Strategy and Policy*

by
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and
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University of British Columbia

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This book is intended as an introduction to the topic of airline economics. It was written in 1990 and published in 1992. While the book is now dated, many of the essential concepts have withstood the test of time. The Centre for Transportation Studies at the University of British Columbia have agreed to make this book available, at no charge, on the internet. The Centre asks that any use of the material in this book be done with reference to the original source and the copyright held by the University of British Columbia Centre for Transportation Studies. Permission to copy, reproduce or excerpt from this material, without attribution to the original source, is denied.

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# Table of Contents

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*This book is dedicated to the innovative airline managers and entrepreneurs at Federal Express, American Airlines, Wardair Canada, Laker Airways, Cathay Pacific, Singapore Airlines, SAS, and at other carriers throughout the world.*



# FOREWORD

Transportation has been a fertile field for the generation of economic concepts. Unfortunately, the regulatory constraints under which the various modes of transport operated for many years not only stifled innovative management but, also, inhibited the development of well formulated explanations of the economic principles on which corporate and public policies should be built.

Deregulation of the airlines has allowed corporations to pursue new strategies in many key aspects of the business. Fundamental decisions about the network to be operated and the planes to be used have crucial effects on the levels of costs and customer service. Some companies have got the fundamental economics (and timing) right and have been successful. Others have got the fundamentals wrong and are no longer in the business. Airlines have been innovators in the successful management of "inventory" in a service industry and have developed methods of gaining customer loyalty in a service industry in which opportunities for service differentiation are limited. Companies in other service industries are following the airlines' lead.

The corporate strategies have implications for public policies. The development of the airline networks has serious implications for the economics of the airports, which in this continent are mainly a public sector responsibility. Issues of regulatory policy now come up in the more general context of competition policy rather than in the straight jacket of transport regulation.

As a result, there is now a need for a book that provides a clear explanation of the economics that underlies the strategies of airlines. It is a subject that is crucial for private and public sector decision makers in the aviation field, and for those in other fields interested in the development of the industry. Economics must be the basis for any financial analysis of this industry.

Michael Tretheway and Tae Oum are particularly well suited to tackling the challenge of producing such a book. They are an economists who have studied the airline industry from many perspectives. They have advised airlines, governments, and financial analysts. Their knowledge and talents are self evident in this book.

The Centre for Transportation Studies is pleased to publish this book as a part of its ongoing program to publicize transportation research and to bring the benefits of transportation research to the widest possible audience.

Trevor D. Heaver, Director
Centre for Transportation Studies



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The original impetus for this work came from the need to provide a background paper in modern airlines economics for the Ministerial Task Force on International Air Policy and for other work undertaken with Transport Canada. An earlier and somewhat shorter version was published as a working paper with the title "The Characteristics of Modern Post Deregulation Air Transport." Some sections of this monograph draw on materials published in the articles indicated with an asterisk in the bibliography.

Typing of the original manuscript was proficiently provided by Susanna Lui. Formatting for the final version was provided by Teresa Cheung and Betty Gelean. All of their services are highly appreciated, but it was their smiles which were most valuable of all.

The views expressed in this report are those only of the authors. They do not necessarily reflect the position or endorsement of the University of British Columbia.

# EXECUTIVE SUMMARY

This report describes the underlying economic principles of the modern post-deregulation airline industry. The emphasis on the *post-deregulation* industry is important, as the methods of doing business have changed radically since the first tentative steps toward deregulation were taken by the U.S. in 1976.* The characteristics of the industry described in this report include the underlying economics of the industry, including both cost and demand elements; pricing practices and methods; marketing practices in the area of product distribution and brand loyalty; the construction of airline route systems; the role of public infrastructure (airports and airways); and airline finance. The main characteristics revealed in this study are summarized as follows (the heading numbers correspond to chapters of the report):

## II. Airline Economics: Cost

- Cost per seat declines with the size of the aircraft.

- Cost per kilometre flown declines with the stage-length (number of kilometres flown) of the flight.

- The cost per passenger declines as the load factor (the percent of seats filled with paying passengers) increases toward 100 percent.

* Formal deregulation of the U.S. airline industry did not occur until October, 1978. However, in 1976, carriers were given initial freedoms in the area of pricing. Canada's first steps toward deregulation began in 1979. An additional step forward took place with the 1984 New Canadian Air Policy of the then-Liberal government. Formal deregulation took place on 1 January 1988 when the Conservative government implemented the National Transportation Act of 1987.

- There are significant economies of *traffic density*, in this industry. This indicates that as the level of traffic increases, in a network of a given size, the cost per passenger falls. One way of viewing this is that costs per passenger fall as additional flights become viable in a particular market. Airlines the size of the former CP Air and PWA were too small to fully exploit available traffic density economies. Carriers the size of Air Canada appear to have reached the mass necessary to exploit available economies.

- There are roughly constant economies of *firm size*. This means that when holding the amount of traffic per route constant, adding additional routes/cities to the network does not lower costs per passenger.

## III. Airlines Economics: Consumer Demand

- In the deregulation era, there are at least two distinctly different types of airline consumer: business travellers and leisure travellers.**

- Leisure travellers are highly sensitive to price. In general, lowering price results in a more than proportionate increase in patronage.

- Business travellers, in general, are less sensitive to price, although not totally "inelastic."

- First class travellers tend to be insensitive to price.

** Sometimes business travellers are referred to as "must-go" travellers. The latter term embraces more than just business trips, but also includes travel for family emergencies, etc. Leisure travellers are often further sub-divided into vacationers, generally heading to popular tourist destinations, and visiting friends and relatives traffic (VFR) who travel to a widely dispersed set of destinations.



- The business traveller is highly sensitive to the schedule convenience of air services.

- The most important convenience attribute for the business traveller is the frequency of airline service.

- Business travellers tend to book their tickets at the last minute and need the ability to change their flight at a moment's notice.

- Business travellers do not always show up for flights they book, as their plans change at the last moment. This has led to the airline practice of overbooking flights to offset the loss of revenues due to "no-shows."

- Leisure travellers generally are able to book their tickets well in advance, tend not to change their flight plans, and are more willing to travel at less popular times.

- Consumers prefer large network airlines due to the ease of obtaining information on schedules and fares.

- Consumers strongly prefer same airline service (on-line service) to interline service requiring connections between different air carriers.

- An S-curve effect appears to exist whereby the carrier with the most flights in a market gains a disporportionately large share of the market.

- Consumers have proven to be very responsive to incentive programmes such as frequent flyer reward plans.

- Cargo is segmented into two distinct markets: air freight and air express.

- Air freight consists of large items which tend to be price sensitive with expected delivery times of 24-48 hours. This segment is best accommodated by cargo belly space in passenger aircraft. The incremental cargo revenues are very attractive to passenger carriers.

- There is a small service sensitive air freight market requiring dedicated (and expensive) cargo aircraft.

- Air express consists of small packages which are highly service sensitive. The high willingness to pay for the service combined with low weight provide economic justification for dedicated overnight cargo aircraft. A single nation-wide hub and spoke network works well for such cargo operations.

## IV. Airline Pricing

- Airlines have abandoned simple uniform pricing policies in favour of complex pricing schemes, such as *yield management*.

- Yield management systems have maximizing flight revenues as their objective. They achieve this by reserving only as many seats as necessary to accommodate full-fare paying business passengers, and selling remaining seats at a discount to leisure travellers.

- For yield management to be effective, it is necessary to prevent business passengers from availing themselves of discounts. This is done by attaching restrictions to discount tickets such as required Saturday night stayovers and advanced purchase requirements, which business travellers are unwilling to abide by.

- As the date of the flight approaches, the airline is able to more accurately predict the number of seats which will be required for full-fare passengers. Thus the airline may increase or decrease the number of discount seats which are available.



## V. Airline Marketing

- Airline tickets are sold by the airline, rival carriers, or a travel agent.

- 70 percent of airline tickets in Canada are sold by travel agents.

- 80 percent of travel agents in Canada use a computer reservation system (CRS) terminal to access flight and fare information.

- The order in which information is presented to the agent on the CRS screen strongly influences the choice of air carrier.

- CRS displays are regulated by governments to prevent bias of information presented to consumers.

- CRSs are owned by one or more air carriers. The owning air carrier tends to be preferred by travel agents when booking tickets.

- CRS displays are regulated by governments to prevent bias of information presented to consumers.

- Frequent flyer programmes create brand loyalty among airline consumers, in the sense that they raise the cost of switching patronage to another airline.

- Large carriers can offer frequent flyer programmes at a lower cost, and can provide the consumer with a wider choice of destinations.

## VI. Airline Route Systems

- Airline networks should be viewed as logistical systems for moving passengers from origin to destination.

- Consumers will switch their patronage to the air transport logistical system which provides them with the greatest convenience (or lowest price).

- Since deregulation, hub and spoke network systems have emerged as the most effective logistical systems for moving passengers.

- In order to extend their market coverage, the trunk (mainline) air carriers have forged alliances with smaller feeder carriers serving smaller communities.

- Although the traffic from feeder carriers is small relative to the overall air traffic volumes, it is very profitable traffic for trunk carriers.

- In order to ensure continuity of market coverage, the trunks generally take equity positions in their feeder carriers.

- Similarly, traffic from foreign destinations feeding into domestic routes is also important to domestic trunk carriers.

- To build their international market coverage and enhance feed traffic to domestic flights, carriers are forging alliances with carriers of other nations. In a few cases, the alliances are being made more permanent by taking minority equity positions in the foreign airline.

- Advances in aircraft technology are threatening the traditional flow of traffic through "gateway" airports. Longer range aircraft such as the Boeing 747-400 allow non-stop flights which overfly coastal gateways. Smaller capacity inter-continental aircraft such as the Boeing 767ER make international services to smaller communities possible.



- Airline scheduling is a critical element in consumer choice of carrier, as well as a major determinant of airline costs and productivity.

- The flight schedule determines the times and routes which are offered to consumers.

- Aircraft assignment attaches a specific aircraft to a flight, and is a major determinant of carrier productivity.

## VII. Other Issues

- Air carriers use publicly provided infrastructure (airports and airways).

- Both airports and airways are becoming increasingly congested, negatively affecting air carrier operations, service quality and cost. This is also making entry of new air carriers difficult.

- Because of advantages enjoyed by existing airlines, it is extremely difficult for a new air carrier to start operating. Economists refer to this phenomena as one of very high "entry barriers." Major entry barriers facing carriers include:

  *Economies of Scale*: The lowering of cost achieved by serving more cities (referred to as economies of firm size) seems not to be an issue for carriers the size of Air Canada and Canadian Airlines International, but could be for smaller carriers.

  *Economies of Traffic Density*: The more traffic which can be carried in a given market, the lower per passenger costs tend to be.

  *Airline Hubs*: Dominant carriers at hubs can channel traffic from a very large number of cities onto a particular hub city pair flight segment. An entrant to the segment would be unable to access this traffic, and thus would be confined to a very small market share.

*Control of the Marketing Distribution Channel*: If another airline controls travel agents and/or the computer reservation system in a market, then other airlines will be at a significant competitive disadvantage.

*Travel Agent Commission Overrides*: Commission rates which increase with sales may favour large airlines, as agents will find it easier to achieve the required sales thresholds, due to their large numbers of destinations and more frequent service.

*Code Sharing*: The representation of the flight of an affiliated feeder carrier as being a flight on a dominant carrier, raises the CRS priority for trips requiring connections. This tends to reduce the market share of small or entrant carriers.

*Airline Frequent Flyer Programs*: These programs are effective in creating customer loyalty to a particular carrier. Their existence may make it difficult for a new carrier to enter a market.

*Vertical Integration*: If a carrier controls the key suppliers to the airline industry (such as ground handlers, caterers, etc., then competitors could be placed at a significant disadvantage in terms of higher costs, lower reliability of service, etc.

*Control of Feeder Carriers*: Another form of vertical integration is controlling feed traffic. For example, if a carrier controls all the domestic traffic in a country, then foreign carriers can be excluded from carrying any "beyond the gateway" traffic, putting them at a disadvantage.



*Access to Public Infrastructure*: Incumbent carriers may have advantages in that they have access to airport facilities (ticketing counters, gates, office space) and to takeoff and landing "slots," when potential competitors are not able to obtain such access.

- Just as mergers resulted in the formation of large air carriers from small carriers in both Canada and the United States, forces are at work which could result in some form of union between carriers of different countries. This phenomena is referred to as *globalization*.

- The airline industry has a strong seasonality characteristic with peak month air traffic roughly double that of the trough month.

- The airline industry is procyclical, meaning that its traffic varies with a higher amplitude than that of the economy as a whole.

- Airlines have high operating leverage, meaning that small traffic increases can result in a large increase in profits, and traffic decreases can result in large losses.

- Airlines have moderately high financial leverage.

- As airlines switch from owning to leasing their aircraft, their finances are changing from strong cash generators to a position where cash in-flows and out-flows must be closely balanced. This could be lessening the ability of carriers to survive a recession in this procyclical industry.

## Chapter 1

# Introduction

Before a firm can develop a market strategy, or a government can design a policy toward a particular industry, it must first understand the basic economics and other characteristics of that industry. Some of the questions which must be addressed in this regard include:

- What are the nature of costs in the industry? Are there economies of scale? If so, what are their source?
- What are the characteristics of the industry's consumers? What factors do they respond to? Which are the most important? Is there more than one type of consumer? If so, how are the consumer segments differentiated?
- How are prices set by the firms in the industry?
- How do firms market their product? What channels or organizations do they use to distribute the product to the consumer? How do firms create loyalty among their customers?
- What is the nature of the production process of the goods or services of this industry?[1]
- What other issues are relevant to the conduct of this industry?

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[1] In the case of air transport, production might be viewed in large part as reflecting the route system the airline operates.

This report sets out to answer these questions for the deregualted segments of the world airline industry. The "deregulated" distinction is important. While airlines around the world fly similar aircraft types and follow similar flight rules and procedures, managerial styles differ radically. In many places in the world, airlines continue to be closely regulated by governments and/or an industry cartel. They have limited scope for setting prices, and route changes are done piecemeal over a time span measured in years or even decades. Capacity (the number of seats which can be offered for sale) also requires government approval. Even the size of sandwiches have been determined for the air carriers. Bankruptcy is almost unheard of.

In contrast, the deregulated air carriers have complete freedom to set prices, and often make decisions on an hourly basis. Route decisions are not made piecemeal, but rather are done on a network basis. The network can be radically changed in a short period of time whereas in the regulated era, route changes could take decades to achieve, if at all.[2] The prospect of bankruptcy has been all too real in Canada, the U.S., the U.K. and Australia, keeping airline managers in a constant state of attention to all details of operating a modern, competitive airline service. U.S. airlines have had 16 years of experience starting with effective liberalization of the industry in 1976. In Canada, carriers have had 4, 8 or 13 years of experience with deregulation, depending on where one sets the transition point in the typically Canadian evolution toward regulatory reform. Australia deregulated in 1990, New Zealand in 1984 and Chile in 1979. Since 1987, the European Community has embarked on a program of significant regulatory relaxation, and other nations have injected some elements of competition into their airline industries.

Deregulation has fundamentally changed the airline industry. The carriers' freedom to fly where they wish, and their freedom to make their own pricing decisions has resulted in a fundamental redefining of the airline product and route system. Previously suppressed aspects of consumer demand, such as the need for frequent service, can now be manifested and exploited in the marketplace. New market segments have been tapped for the first time, such as

[2] For example, when Eastern airlines filed for protection under U.S. bankruptcy law, and curtailed services, American Airlines was able to develop a major hub in Miami, a former Eastern base, within two weeks.



that of consumers only willing to fly at low fares. New methods of marketing and controlling the flow of information to and from the consumer have also emerged.

In this book, each of the five key areas of cost, consumer demand, pricing, marketing, and route systems are dealt with in their own chapters. An additional chapter is provided to help put some important issues in context. Specifically, the effective ability for new carriers to enter the marketplace is addressed, along with issues of industry globalization and industry finance. An executive summary is provided at the front of this book in lieu of a summary chapter at the end.

# Chapter 2

# Airline Economics: Costs

## A. Understanding Airline Costs

This chapter begins with a brief discussion of three fundamental aspects of engineering technology which are reflected in airline costs. **Figure 1** begins by showing the relationship between cost per seat and the size of the aircraft. The figure shows that small aircraft have higher costs per seat than larger aircraft. The figure is drawn to show the current maximum aircraft size of roughly 560 seats. This decline in cost per seat with aircraft size is a general representation of technology. Individual aircraft types, especially older ones, may lie above the curve. Nevertheless, the figure captures the essence of aircraft technology.

Another fundamental technological relationship is that between the cost and the distance an aircraft is flown. This distance of a flight *segment* is referred to as *stage length*. Significant amounts of fuel are expended simply in getting an aircraft up to cruising altitude. In addition, there are various flight preparation costs which are largely the same, regardless of the distance the aircraft is flown. The result is that the average cost *per kilometre flown* declines as the number of kilometres flown increases. This is shown graphically in **Figure 2**.

The third relationship is that between cost per passenger and flight load factor. *Load factor* is the industry term for the percent of seats which are filled with revenue-paying passengers. Airlines choose not to fly with 100% of their seats sold on every flight. To do so, would imply that passengers requiring



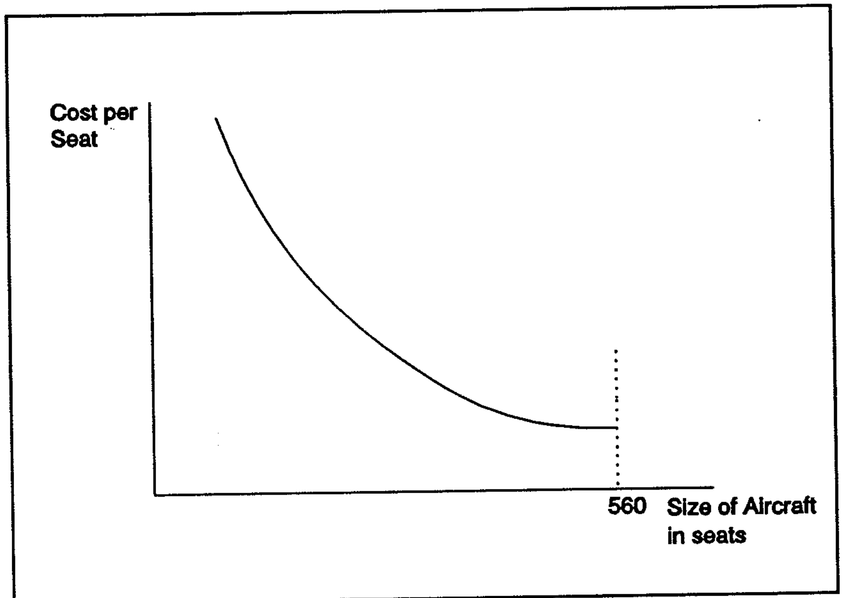


**Figure 1: Relationship Between Cost per Seat and Aircraft Size**

seats at the last minute would not be able to obtain them.[3] Since much of the cost of a flight is fixed, regardless of the number of passengers flown, the cost per passenger will decline as the percent of seats filled increases.[4] This is shown graphically in **Figure 3**. Note that load factors cannot exceed 100%.

[3] A study by Boeing Commercial Aircraft found that when flight load factors average 60%, then 7% of flights will be full and unable to accommodate an additional late-booking passenger. When load factor reaches 70%, this turnaway rate increases to 21%. Most airlines in the world operate with load factors in the 60% range. See *Surplus Seat Management* and *Discount Fare Management*, Boeing Commercial Airplane Company. For a general discussion of airline load factors, see M.A. Brenner (1982).

[4] For example, cockpit crew costs must be incurred whether the flight is full or almost empty. While fuel costs vary somewhat with load, a major portion of them are fixed, being associated with getting the weight of the aircraft itself into the air and along the route.

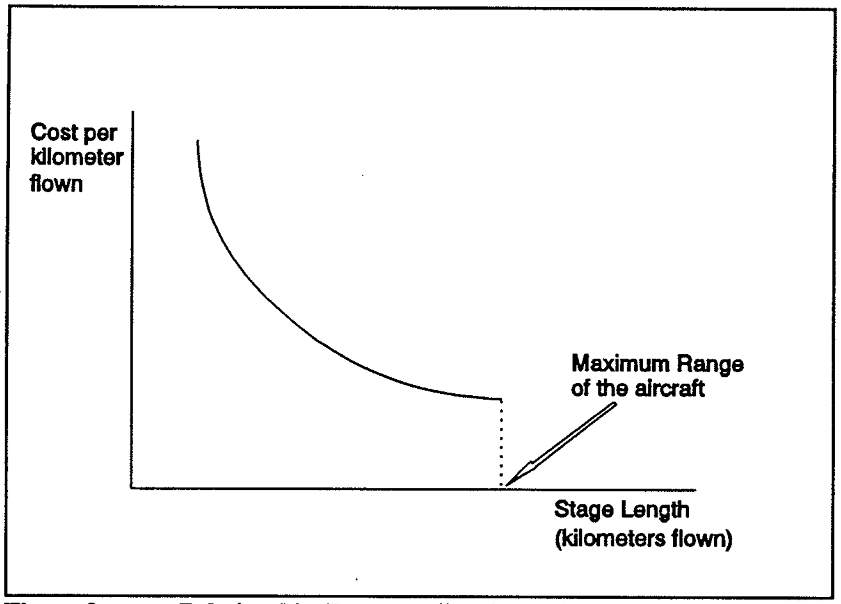


**Figure 2: Relationship Between Cost Per Kilometre and Kilometres Flown**

A final relationship is that between aircraft capacity and range. This is not strictly a cost relationship, but more of a technical constraint on aircraft performance. **Figure 4** shows that different aircraft have different capacity and ranges. Note, however, that at some point, the aircraft's range can only be extended by reducing capacity. In these cases, additional fuel can be carried to extend the range of a flight, but only by reducing other weight on the aircraft. This means, that passenger and/or cargo weight must be reduced in order to safely accommodate the weight of the additional fuel.



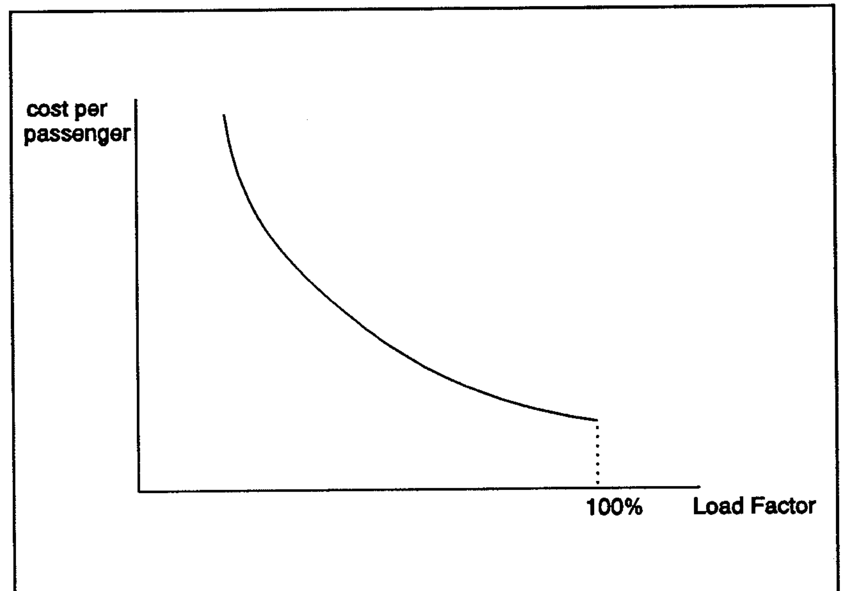


**Figure 3: Relationship of Cost Per Passenger and Load Factor**

## B. Economies of Scale

The cost relationships in the previous section indicate that costs fall as the size of the aircraft increases, as the distance flown by the aircraft increases, or as the percent of seats sold on the aircraft increases. These relationships should not be construed as evidence that there are economies of scale in airline operations. The question of economies of scale addresses the *magnitude* of the carriers operation. Consider, for example, two airlines. Both operate B-737 aircraft with an average 60% load factor on flights which average 500 miles. Airline A has a single aircraft which it uses to operate three round-trip flights per day in a single city pair market. Airline B has a fleet of 20 aircraft which it operates in several city pair markets. Both carriers have the same cost relationships from Section A, given that they are flying the same aircraft type, over the same distance, and with similar average load factors. The question of economies of scale is one of the magnitude of any given type of operation: a

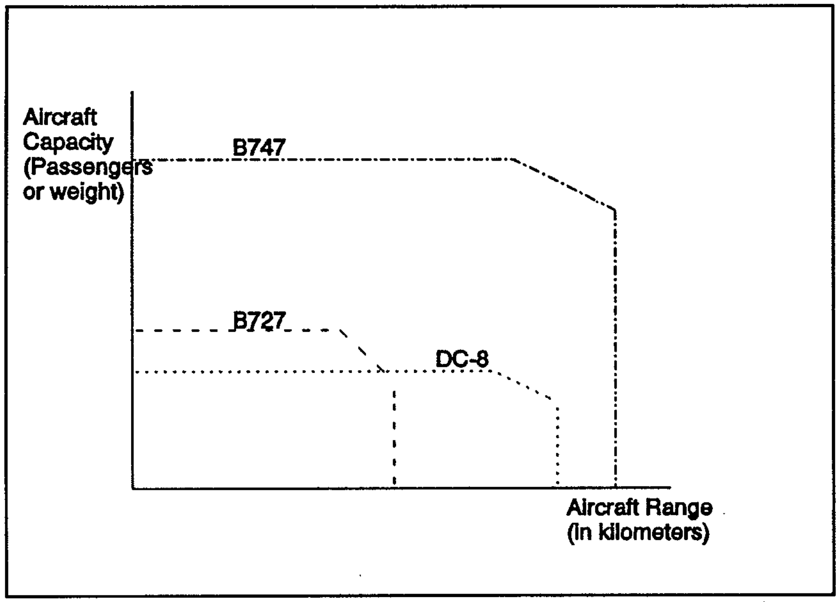


**Figure 4: Relationship Between Aircraft Capacity and Flight Distance**

one versus twenty aircraft operation, in this case. This section addresses the question of economies of scale.

White (1979) surveyed all major studies of the nature of airline costs and concluded that "economies of scale are negligible or non-existent at the overall firm level." Why, then, did the wave of airline mergers occur in both the US and Canada? The first reason is that a simple manufacturing industry concept of economies of scale is inadequate for modelling the relationship between inputs and outputs in this network-oriented service industry. Second, costs alone do not determine market structure. Demand is also relevant, and there are several aspects of demand that favour larger carriers.[5]

[5] These demand aspects are discussed in Section III.A.



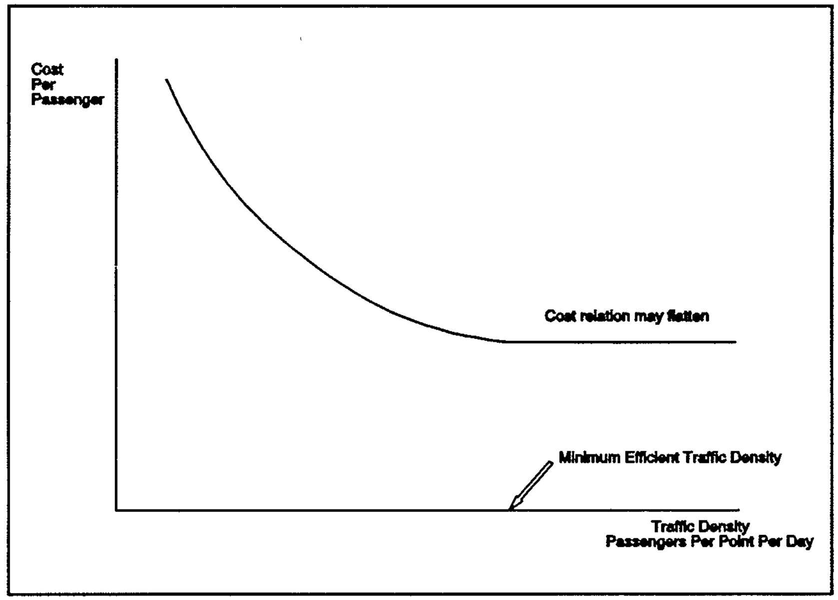


**Figure 5: Economies of Traffic Density**

Caves, Christensen and Tretheway (1984) distinguish between airline *economies of traffic density* and *economies of firm size*. Under the latter, output is expanded by adding points to the network; under the former, output expands by increasing service within a given network (set of points served). Gillen, Oum and Tretheway (1986) applied this concept to Canadian airlines, and developed it further by distinguishing between different types of airline traffic (scheduled, charter, freight). These and studies of other airlines reach a common set of conclusions.[6] Roughly constant returns to firm or network size exist for rather broad ranges of airline traffic. That is, adding or dropping cities from an airline's network does not raise or lower unit cost. In contrast, sizeable economies of traffic density seem to exist up to fairly large volumes of traffic.

[6] See, for example, studies of international airlines in Tretheway (1984), and Caves, Christensen, Tretheway and Windle (1987).

That is, adding more flights or more seats per flight on a given route will result in lower "per seat" costs. However, once the minimum efficient traffic density level is reached, the curve is flat over a wide range, indicating that there are no more gains associated with greater traffic density.

Intuitively, this makes sense. Adding a city to a network involves a set of fixed operation costs: airline counters, station managers, mechanics, ticket offices, advertising, etc. Every time a new city is added, another set of these costs must be incurred. On the other hand, once a set of cities are being served, additional traffic does not require any increases in the fixed operation costs; advertising need not be increased, etc. Thus, the fixed operation costs can be spread out over more traffic, allowing unit costs to fall.

Economies of traffic density are illustrated in **Figure 5**. Here, cost per passenger declines as the number of passengers per station increases. At some point declines in cost per passenger *may* taper off, and the curve may start to flatten. The traffic density where this occurs is referred to as the minimum efficient traffic density level. This is indicated in the figure.



## Chapter 3

# Airline Economics: Consumer Demand

## A. Basic Elements of Demand for Air Service

When economists refer to the "determinants" of consumer demand for air services, they mean the set of factors which influences an individual's decision as to whether or not to travel by air, and how much travel by air they will do in a given year. The main determinants of airline demand are:

- *Price.* Lower airline prices induces people to travel more.
- *Income.* Higher disposable income influences consumers to travel more.
- *Price and convenience of other modes of transport.* An individual living in Kingston, Ontario will be less inclined to fly to Toronto if the automobile is cheaper and/or more convenient.
- *Frequency of service.* More frequent service is more convenient service, increasing the willingness of the consumer to travel by air. A once-a-day flight from London, Ontario to Toronto would not generate as much traffic as a schedule with hourly flights. With the former, several travellers will be induced to either drive or not travel at all.[7]

[7] An hourly service makes it easier to accommodate "quick trips."

- *Timing of service.* In general, consumers prefer to fly first thing in the morning, or late in the afternoon. Flights offered at these times will induce consumers to fly by air, whereas flights at inconvenient times (such as 3 a.m.) tend to discourage consumers from air travel.

- *Day of the week.* Consumers are more likely to fly on certain days of the week than others. Typically, Sunday evenings are very popular, with business travellers leaving home for their first appointment of the week. Similarly, Friday afternoons are also a busy time, as travellers are returning home.

- *Season of the year.* July and August are popular travel times, whereas November and February are unpopular times. There are variations, of course, by market (sun spot destinations are winter peaking) and continent (e.g. Australia, New Zealand).

- *Safety and company goodwill.* A good safety record is good for business. Air travel drops whenever there is a major air disaster.

- *Demographics.* Age is often a factor in the travel decision. College students, for example, are notorious for airline pilgrimages to Europe, popular ski resorts, and holiday trips to home. Individuals raising children tend to travel less, while empty nesters seem to travel more. There are other demographic factors as well. New immigrants tend to travel back to the old country several times.

- *Distance.* The longer the travel distance involved, the fewer trips will be made. Business and leisure travellers make relatively fewer trans-oceanic trips than trips across the country. At the other end of the scale, few air trips are made over very short distances.[8]



- *In-flight amenities.* Consumers are somewhat influenced by how cramped seats are, the quality of food, the availability of in-flight movies, etc. On average, these factors are less important in the decision of whether or not to fly, but more important in the choice of air carrier.

- *Customer loyalty.* As in any industry, once the consumer has made the decision to purchase a service or product, loyalty factors may come into play in determining which carrier or firm will be chosen. In air transport, frequent flyer reward programs are especially important in fostering customer loyalty.[9]

- *Travel time.* When jets were first introduced, there was a noticeable increase in consumer demand for air travel. The reduction of transcontinental flying time from ten to five hours made air travel far more convenient. It was easier, for example, for businesses to justify meetings which might not have taken place previously. On time performance is also a factor here, especially when the consumer chooses which carrier to use.

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[8] Transportation economists refer to the *gravity law of travel demand.* This indicates that travel demand falls with the square of the distance between origin and destination. Mathematically, this can be expressed as $Q_D = f(1/D^2)$, with D = distance and $Q_D$ = travel demand, a formula which is similar to the gravity law of physics. This law is considered to be relevant for almost all modes of transportation, although not applicable for air transport over short distances.

[9] See Tretheway (1989).

## B. Which Elements of Demand Are Most Important

The previous section listed a number of elements of consumer demand. All of these are, of course, important. Some of the factors are beyond the control of air carriers. Carriers cannot influence the level of income a consumer has, nor the price and convenience of other modes of transport.

Of the elements which the carrier can control, certain are of special importance. Clearly, price is one of the most important determinants of consumer demand. One of the greatest lessons of airline deregulation was that lowering price induces consumers to travel more often. Discount airfares opened a whole new market segment for air travel. In a series of studies of airline demand, Oum and Gillen found that a 10% drop in price would increase demand for air travel in Canada by 11-13%.[10] Another important variable is frequency of service. This is especially important for business travellers, for whom the ability to maximize their time productivity is very important. In a study of U.S. air travel demand, Morrison and Winston found that a doubling of the frequency of air service would lead to a 21% increase in demand for air services by business travellers.[11] For pleasure travellers, who are less sensitive to the availability of frequent flights, the increase would only be 5%. The importance of frequency of service is underscored by the observation that in the top 25 domestic city pair markets in Canada, the number of flights doubled between 1983 and 1989.[12]

While income is a consumer demand determinant outside of the control of the carriers, it is important to comment on its importance. In their study of Canadian airline demand, Oum and Gillen (1983) found an income elasticity in the range of 1.6-2.5. This means, that if the economy were to grow by 10%, then airline demand would increase between 16-25%. Very few goods in the economy are as responsive to income as is air transport. The negative side of this is that in an economic contraction, of say 3%, air travel is likely to fall off

[10] Oum and Gillen (1983), and Gillen, Oum and Noble (1986).

[11] Morrison and Winston (1986), p. 17.

[12] NTA (1990), p. 31. This was intended to measure the impact of regulatory freedom on service offerings by carriers.



somewhere in the range of 5-7%. Air travel is then, not just cyclic but procyclic. This procyclic behaviour has likely been exacerbated by airline deregulation. Gillen, Oum and Noble (1986) in a study of U.S. air travel, were able to distinguish between business travellers and leisure travellers. Business travellers had an income elasticity of only 1.5 whereas leisure travellers had an elasticity of 2.1. As deregulation, with its lower prices, has made the proportion of leisure travellers grow, the average income elasticity for the industry has been creeping more and more toward the leisure traveller extreme. This procyclical behaviour of air travel contributes to the financial challenges the industry faces. These are discussed in Section VII.D.

A recent study in the U.S. focused on four key factors in the consumer's choice of airlines. These are shown in ? Selection factors were determined separately for leisure versus business travellers. As can be seen, price is the key determinant for leisure travellers, although schedule convenience is close behind it. For business travel, schedule convenience is clearly of main importance. Price and frequent flyer programs (to be discussed further in Chapter 5) are virtually tied and have less than half the importance of flight schedules.

## C. Market Segmentation

As has already been alluded to, air travellers are not a homogeneous group. There are at least two broad submarkets. The traditional bread and butter of the industry has been the business traveller. This traveller, whose ticket is typically paid for by an employer, is concerned with maximizing the productivity of his or her time. As a result, this individual is very sensitive to the frequency with which service is offered. This traveller also needs an airline service which is flexible, in the sense of accommodating last minute changes in plans. Thus, high probabilities of being able to obtain a seat at the last minute are essential, as is convenient air service with the shortest possible elapsed trip time. Business travellers are generally willing to pay for the higher quality of service, and thus tend to be less responsive to prices.[13] On time performance and reliability of the airline to its published schedule are also important to this

[13] For example, Gillen, Oum and Noble (1986), found that in the U.S., the price elasticity for business travellers was only 1.15 whereas that for leisure travellers was 1.5.

| Factor | Leisure Travel | Business Travel |
|---|---|---|
| Price | 3.9 | 2.1 |
| Schedule Convenience | 3.2 | 4.5 |
| Frequent Flyer Program | 1.5 | 2.0 |
| Airline Reputation | 1.5 | 1.5 |

Source: P.L. Ostrowski and T.V. O'Brien (1991), "Predicting Customer Loyalty for Airline Passengers," Dept. of Marketing, Northern Illinois University, June.

**Table 1 Airline Selection Factors (mean value on a ten point scale)**

group of consumers.

The second broad segment of airline consumers is generally referred to as the leisure traveller. This traveller is travelling on personal time, and is not quite as concerned with maximizing time productivity. Thus, these individuals are less sensitive with respect to how frequent service is offered, or to the total elapsed time of the air trip. However, these individuals are very sensitive to prices, as already been discussed. Schedule reliability is also less of an issue for these travellers. Another important characteristic of this consumer segment is that they tend to make their travel plans well in advance. As a result, they can be induced to book and pay for their airline tickets weeks before the actual airline flight. In contrast, the business traveller may not know until a few hours prior to the trip that the trip is necessary.



Airlines have been able to exploit this fundamental difference in the two consumer segments by tailoring different types of service for the two groups. Leisure travellers are offered a service at a low price, but which requires advance booking and has limited flexibility for accommodating change in travel plans. The business traveller is offered a service with relatively good seat availability at the last minute, and with no restrictions on the ability to change plans. They are charged a higher price for this more expensive service. They cannot avail themselves of the lower prices offered to leisure travellers, as they cannot abide by the advanced booking requirement, and/or the restriction on changing plans.

There are, of course, various sub-segments of consumers within these two broad groups. Some business travellers need complete flexibility and are willing to pay for it. Other travellers, such as those going to pre-planned business conferences, tend to be somewhat more sensitive to price, and have an ability to accommodate the airline by booking early. Leisure travellers can also be broken into several subgroups. One distinction is between leisure traveller to holiday resorts, versus leisure travellers to visit friends and relatives (VFR). Some leisure travellers, for example retired grandparents, are willing to make their travel plans months in advance and will travel at inconvenient times of the day, week or year in order to get a better bargain. There are also non-business trips which must be booked at the last minute, such as visiting a sick family member or attending a funeral. Like business travellers, these individuals tend to be price insensitive.

## D. Demand Side Forces Favouring Large Carriers

Market equilibrium and therefore market structure is determined by the interaction of both supply (i.e. costs/production) and demand. In airline markets there are demand forces such that consumers prefer large airlines over small ones, all other factors such as prices being the same. In this context, large airlines mean those that serve a large number of points. Some of these forces have been present for some time, while others have been stimulated by marketing practices introduced since U.S. deregulation.

In practice, there are at least three reasons why consumers prefer large airlines. One reason is due to information costs. A traveller knows that a large carrier can get him or her to just about anywhere in the country, while smaller carriers serve only a limited number of communities. Travel agents act as intermediaries for the consumer, but even here large network airlines have an edge, such as when an agent in one region needs to book flights in other regions.

A second reason why consumers favour large airlines is attributable to the higher quality of service these airlines offer. If connections must be made, less of the traveller's time will be required with a single airline than when the trip involves switching airlines because single airline flight connections are more likely to be timed to minimize waiting time at intermediate points (hubs).[14] Consumers are also aware that there is a lower probability of baggage being lost or delayed with a single airline, as well as a higher probability that the same airline's outbound flight would be held for a traveller on a delayed inbound flight.

The third factor causing consumers to favour larger over smaller carriers is the existence of frequent flyer programs. These programs reward the *individual* for patronizing a single carrier (even though the fare for business travellers may be paid by their employers). It is much easier to accumulate points with an airline that flies to a large number of destinations.[15]

In sum, there are natural market forces favouring large airlines in spite of evidence of constant returns to "scale." These are economies of traffic density, and in addition, the demand side factors such as information costs, higher quality travel, and reward programs inducing consumers to favour large over small airlines. It appears that economies of traffic density can be fully exploited by an airline the size of Air Canada and thus further consolidation is unlikely to reduce its cost per seat kilometre by very much.[16,17]

[14] Using the results of Carlton, Landes and Posner (1980), the value of an on-line connection to travellers can be estimated to be about $31 (1989 Canadian dollars). I.e., the average consumer is willing to pay up to $31 to avoid a flight itinerary requiring a change of airline.

[15] See Tretheway (1989) for a discussion of the potential anti-competitive effects of frequent flyer programs.

[16] See Gillen, Oum and Tretheway (1985), especially Chapter 8.



## E. Travel Time and Consumer Demand

One of the consumer demand factors that has been found to be important is the total elapsed time from origin to destination. A carrier which can offer a noticeable reduction in the elapsed time will be more successful in attracting passengers. Airline economists have found it useful to break up total elapsed time into four separate components. The four components are:

- *Schedule wait time.* This is the time from when the consumer desires a departure to the availability of an actual departure.[18]

- *Airport access time.* This is the time for the traveller to get from their home or place of business to the airport, check in at the airport, clear security and customs, etc.

- *Flight time.* This is the actual time from scheduled departure to arrival at destination. This might be broken up into three separate components:

    - Deviation from scheduled times. Flights take longer than published because of late departures and/or arrivals.

    - Actual in-air time. This is the actual time spent flying in the aircraft. It is affected by type of aircraft (jet versus propeller), air traffic control and other delays, and degree of route circuity with hub and spoke systems.[19]

[17] Some would point out that the higher quality of service offered by a larger air carrier can be viewed as reducing quality adjusted cost. Cost per seat kilometre is the same, but the seat kilometre of a larger carrier my be viewed by the consumer as being a higher quality.

[18] For example, a sales manager may conclude negotiations in Toronto at 1:30 and would like to immediately return back to the office in Thunder Bay. However, if the next departure is not until 5:00 pm, then the traveller will incur a "schedule waiting time" of 3.5 hours.

[19] In Europe, flight circuity is a major factor due to air space restricted for military purposes.

- Hub connection time. This is the time spent on the ground at a hub airport making connections from one spoke of a flight to another spoke.

- *Denied boarding time.* Occasionally, a passenger must wait from their originally scheduled departure until the next departure because the original flight was overbooked and they were denied boarding of the aircraft.

The segmentation of total elapsed time allows identification of opportunities for reduction. For example, more frequent flights reduces schedule delay time. Use of a close-in or downtown airport, provision of door to door limousine services, or expedited check in procedures can reduce airport access time. Use of faster aircraft (jets versus turbo props, Concorde versus traditional jets) allows for reductions of actual in-flight time. Procedures asking for volunteers when aircraft are overbooked help shift the denied boarding time component to those travellers less sensitive to total elapsed time. Sometimes, there are trade-offs between the various time components. The next section discusses one of the most important trade-offs: that between frequent air service with a one-stop hub connection versus infrequent but non-stop service.

## F. Effects of Hubs on Passenger Travel Time, Schedule Delay Time, and Passenger Demand

This section discusses the effects of hub and spoke routing networks on passengers' travel time and schedule wait time. A more complete discussion of hub and spoke systems can be found in Chapter VI, Section B.

**Effects on Passenger Travel Time and Schedule Delay Time.** As compared to non-stop flights, a hub and spoke network increases the average passenger's in-flight time because of the need for extra connecting time at the hub and the circuitous routing of the passenger's trip. On the other hand, it can also reduce the passenger's "schedule wait time," in the sense of Douglas and Miller (1974), due to the increased frequency of service on each route.



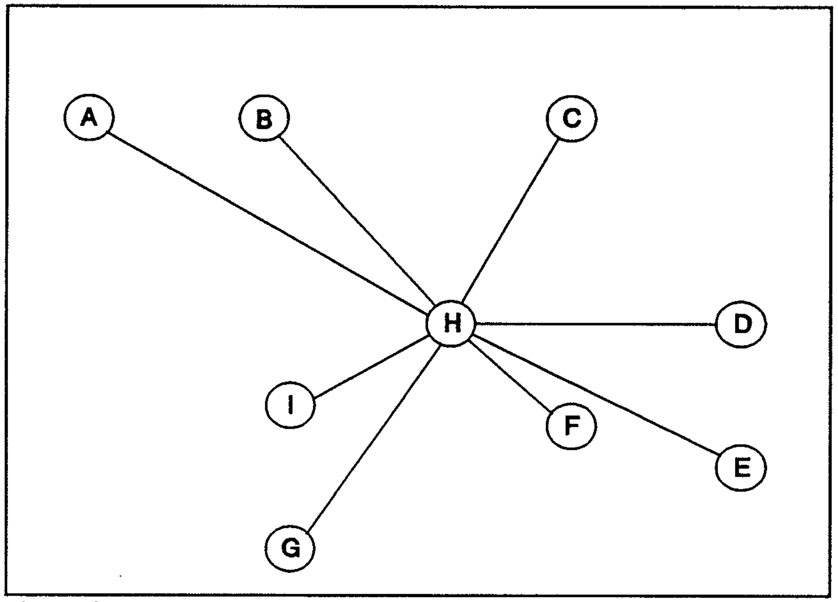



**Figure 6: Hub and Spoke Network**

As compared to a non-stop flight, a passenger flying from city A to city D via hub H (see **Figure 6**) faces an additional time penalty of the following magnitudes:

1) Roughly 30 minutes due to the *additional descent and ascent* at the hub.

2) Perhaps an average of 60 minutes for *time to connect* from one flight to another at the hub (Kanafani and Ghobrial [1985] use 60 minutes).[20]

[20] This is an average. Some passengers may be able to obtain connections of as little as 25 minutes, while at least a few others will need to wait more than an hour. An inspection of Figure 30 reveals that for Delta's Atlanta hub, the start of the arrival bank and the start of the departure bank in a complex are roughly separated by one hour.

3) *Extra cruise time* required for the circuitous routing. This extra cruise time depends on both the angle between the spokes connecting two stations through the hub and the relative distances of the two cities from the hub. This is shown by the law of cosines in **Figure 7**. A large angle (e.g. linking cities B to E through H in Figure 6) adds very little time, whereas a small angle with an equal distance (e.g. linking cities C to D via H in Figure 6) adds a great deal of extra time. As the distance on one spoke shortens, the circuitous routing time penalty will drop (e.g. A to F in Figure 6). Because of the time penalties of circuitous routing, passengers will be unlikely to fly via a hub when the penalty is high. Thus, in Figure 6, routings such as F-H-E and C-H-D may not be "viable."

The total time penalty of a hub versus non-stop flight is thus approximately 90 minutes plus the circuitous routing time. For purposes of exposition, let us assume the average angle through the hub of viable city pairs to be 125°. With spoke lengths equal, on average, this implies a circuitous routing penalty of roughly 25%. Assuming a typical flight through a hub involves two hours of flying time, the circuitous routing penalty is 30 minutes. The total time penalty is thus 120 minutes as compared to a non-stop flight.[21]

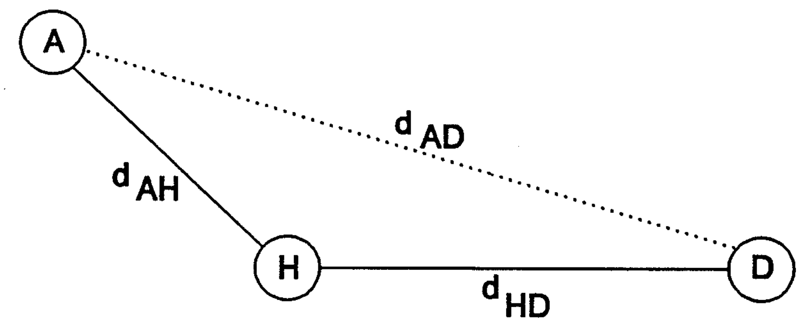
However, a hub and spoke system could allow the airline to increase schedule frequency.[22] The increased frequency reduces the passenger's "schedule wait time," the time between the passenger's desired departure and the actual departure time. The reduction in schedule wait time depends on the increased frequency with the hub and spoke system versus a system of non-stop flights. Assuming consumers' desired departure time are uniformly distributed over 14 hours per day,[23] one flight per day means that the expected frequency

[21] Prior to hubbing, airlines sometimes built up sufficient traffic to justify a flight by making multiple stops. Where this was the case, one stop hubbing may actually reduce travel time.

[22] This is discussed in Section VI.B.

[23] In reality, desired departure times tend to be at the beginning or end of the business day. Airlines try to schedule flights at desired times, but due to limitations to equipment availability not every low traffic point will receive an early morning flight.






$$d_{AD} = \sqrt{d_{AH}^2 + d_{HD}^2 - 2\, d_{AH}\, d_{HD} \cos(H)}$$

where cos(H) = cosine of angle from AH to HD

**Figure 7: Hub and Spoke Networks and the Law of Cosines**

delay is seven hours for an average passenger.[24] As the departure frequency increases to two, three and five flights per day, the schedule wait time decreases to 3.5, 2.3, and 1.4 hours, respectively. For the case when a move to a hub and spoke system increases frequency from one to three flights per day, schedule wait time is reduced from seven to 2.3 hours, a saving of 4.7 hours.

The total effect on travel time is thus the difference between the time penalties (extra ascent/descent, connect time, extra cruise time) and the

[24] Assume the single flight per day is at 11 a.m. Some passengers would prefer a 7 a.m. flight, and thus have a schedule delay of 4 hours. Some would prefer a 10 a.m. flight for a delay of one hour. Some would prefer a 6 p.m. departure and will need to wait 17 hours for the flight the next day. Alternatively, they could take the earlier flight, but nevertheless will experience disutility because of it.

reduction in schedule wait time.[25] For the example worked out above, this comes to a net decrease of 160 minutes: time penalties of 120 minutes offset by a reduction in schedule wait of 280 minutes (4.7 hours). Actual reductions will vary for each route (and passenger), of course.

**Effect on Passenger Demand.** The move to a hub and spoke system will affect passenger demand in several ways. As discussed, the hub system will affect passenger travel times; negatively for routes already with high frequency and those involving backtracking, and positively for routes which previously had infrequent service or involved multiple steps. However, there are other effects as well. These include the disutility of making connections, the effect on price and the effect of allowing the airline to serve many more city pair routes when new stations are added. Each of these are now discussed.

***Hub Disutility.*** A hub and spoke system can increase the number of transfers required to get from origins to destinations. This reduces the comfort and convenience of the passenger. We are all familiar with the "joy" of getting off one crowded airplane and boarding another. There is the potential to miss a connection if the inbound flight is late. These factors create "disutility" for the passenger. Disutility can be valued; the passenger is generally willing to pay to avoid these hassles (i.e. willing to pay somewhat more for a non-stop rather than a one-stop flight). The route choice model estimated by Kanafani and Ghobrial (1985) can be used to show that the revealed value of one transfer to a connecting flight is worth about 1.75 hours of transit time. Since the time required for a passenger to make a connection, one hour, was taken into account in Section A, the pure disutility of making a transfer is equivalent to a time delay of about 45 minutes. Assuming that the value of time is $30 per hour, then the value of the hub connection disutility is $22.50.[26]

[25] Typically, "schedule wait time" can be used more productively than other delay times, thus the former should be given a lower weight than the latter in aggregating for the total time effect. With schedule wait time, for example, a businessperson can be productive working in the office, making phone calls, etc. In-flight time cannot always be used to full productivity.

[26] The value of $30 was estimated by Kanafani and Ghobrial (1985). De Vany (1974) estimated a value of $10 per hour. This would translate into roughly $27 in 1987. If these figures for the value of time appear high, recall that the typical airline passenger has a higher income than the population at large.



***Effect on Price.*** Passenger demand for travel is highly responsive to price. Oum, Gillen and Noble (1987) as well as De Vany (1974) estimate the air travel price elasticity at about -1.2. Adoption of hub and spoke systems can affect price in several ways.

First are effects on costs. A move from non-stop to hub flights increases flight times, hence fuel and crew costs, etc. These extra costs can be offset in a number of ways. The move to hub and spoke systems can lead to increases in average traffic densities with a resulting drop in unit costs (e.g. spreading fixed station costs over more passengers).[27] The frequent routing of aircraft through the hub could allow more opportunities to increase aircraft utilization, achieve economies in maintenance, etc.

Second, the adoption of hubs and the resulting increase in city pairs served (see Section VI.B) can allow the carrier to better utilize its inventory of unsold seats via modern seat management techniques [see Kraft, Oum and Tretheway (1986)]. This may result in offering deep discounts for lightly travelled segments that can now be connected to popular destinations with a resulting increase in system-wide passenger demand.

***Effect on City Pairs Served.*** If a new station (let's call it K) had been added to the non-hub route structure in **Figure 8** via a flight to say F, then only a handful of new city pairs would be viable. If viable city pairs are those involving one stop, then the addition of K to F opens up three new city pairs (KF, KD, and KI). In contrast, adding a new station to a hub already serving (N-1) cities, opens up service to N new origin-destination pairs (including the OD pair from the new station to the hub).[28] Theoretically, a hub system with N stations (including the hub) will provide zero or one stop service to N(N-1)/2 stations. This greatly "levers" the effect of adding stations to an existing hub. For example, by increasing the number of stations connected to a hub from 9 to 14 (total stations including the hub rise 50% from 10 to 15), the number of OD pairs served more than doubles from 45 to 105.

[27] This was discussed in Section II.B.

[28] Of course due to backtracking, not all N new city pairs will be viable. This shows the advantage of adding stations in directional hubs where more OD pairs will, on average, be viable for a given N. See Section VI.B.

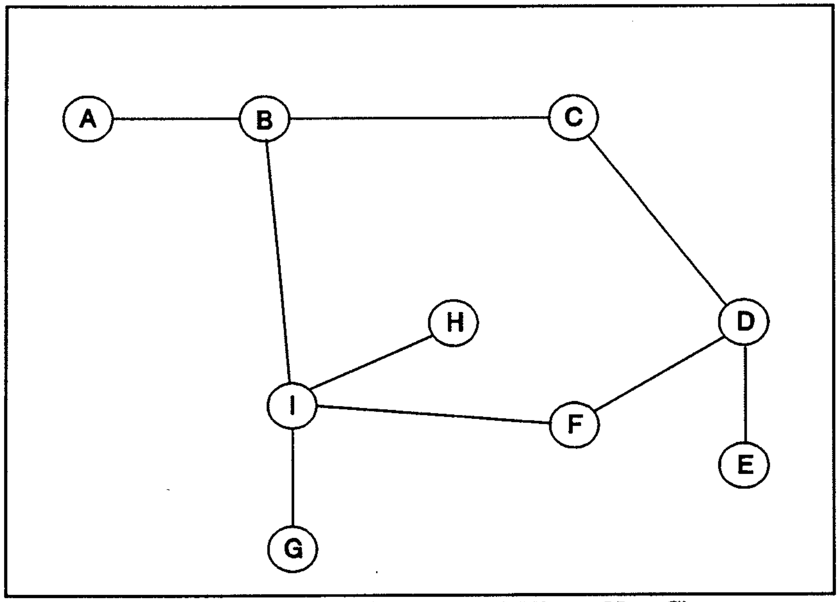



**Figure 8:** **Non-Hub Route Structure: Adding a New City**

One of the important consequences of this leverage is that it can make service to smaller communities viable. A community which generates as few as two passengers per day to each of 30 cities in a network can justify a daily jet flight. If, on average, it can generate six passengers per day in each OD pair, then three jet flights a day may be possible. This seems to have been a major "discovery" for some carriers after deregulation. Immediately after the regulatory reigns were loosened, some of the major carriers dropped service to small communities. As hubs have been established, however, they restarted jet service to small communities by tying them into their hubs.

**Summary of Demand Effects of Hubs.** In summary, hub systems have both positive and negative effects on demand. They involve some important time penalties as well as disutility associated with making a connection rather than flying non-stop. On the other hand, they can significantly reduce the



passengers' schedule wait and add many OD pairs to the network. Costs can go down due to higher traffic densities, but these are offset by the circuitous routings sometimes involved in hub operations.

## G. The S-Curve Effect of Flight Frequency

The importance of flight frequency as a key determinant of the consumer's choice of airline has been expressed by aviation economists in an S-curve. **Figure 9** shows this phenomena. It shows that as a carrier adds flights in a market it can gain a disproportionate share of total market traffic. For example, in a two carrier market, the one with 60% of the flights may receive 80% of the passengers.

This phenomena is consistent with the earlier data on the importance of schedule convenience in the consumer's choice of carrier. This is especially important for the business traveller. The power of the S-curve is further enhanced because the business traveller also tends to pay higher airfares. Evidence in Section 5.B suggests that business travellers account for two-thirds of industry revenues.

The S-curve effect may be an important factor in the strategic power of hub and spoke systems. As described in the previous section, hubs have considerable traffic generating power. As a hub carrier adds flights on a spoke, it will likely pick up increasing portions of the traffic on the route, making it more difficult for a competitor to maintain its share of the market. As this effect takes place on an increasing portion of the spokes from a carrier's hub, the carrier's strength in the market becomes formidable. This phenomena is sometimes referred to as *fortress hubs*.

## H. Overbooking

One final aspect of consumer demand is that some travellers do not always show up for flights they have booked. In 1961, it was estimated that 10

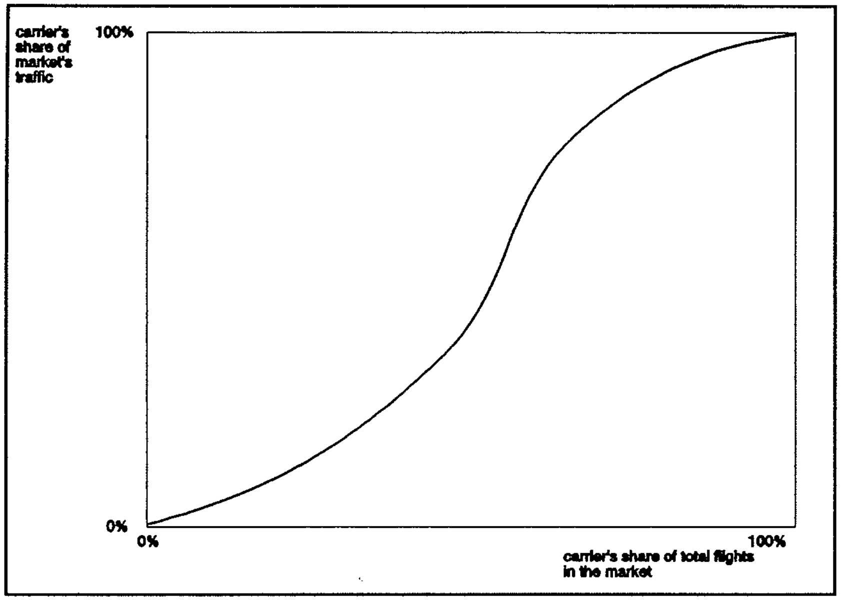



**Figure 9: The Flight Frequency S-Curve**

percent of passengers did not show up for their flights,[29] and in 1982 it was suggested that this figure was 20 percent.[30] Business travellers frequently fail to show up for flights, as their plans change from moment to moment. While leisure travellers flying on discount tickets tend to be more reliable in their travel plans, they too miss flights due to ground traffic, illness, etc.

Because of this stochastic (random) nature of consumer demand, airlines have offset the resulting loss of revenue by the practice of "overbooking"

[29] Economic Regulation Docket 11683, Civil Aeronautics Board, Washington, DC, 20 July 1961. See Discussion in Ruppenthal and Toh (1983).

[30] James (1982), p. 285.



flights.[31] Thus, if experience shows that Flight 147 has an average 15 percent no-show rate on Thursdays, then the airline may actually sell 108 seats even though the aircraft only has 100 seats.[32] This works fine for both airline and consumer if the actual number of "no-shows" is the same or higher than the average. Sometimes, however, all the booked passengers show up, and some must be turned away due to a lack of seats.

Prior to deregulation, carriers dealt with this "denied boarding" situation using a "first come-first served" rule.[33] However, the passengers who show up early tend to be those who are more willing to shift to a later flight. Business travellers, whose time is highly valued, tend to show up at the last minute. Recently, airlines have been given some freedom to change the rule as to which passenger will be denied boarding. While first come-first served remains the ultimate rule of last resort, they first attempt to solicit volunteers to wait for the next flight. As incentives, they may offer volunteers free travel, discounted travel or cash. This approach is generally acknowledged as being superior for all concerned.

## I. Air Cargo

Thus far, the demand for airline services has been discussed only in the context of passenger transportation. Carriers also provide significant amounts of cargo services. Air Canada reported that cargo accounted for 11% of its 1989 revenues while Canadian Airlines International's cargo accounted for 8%.[34] Just as passengers can be broken into two main market segments, cargo is segmented into air freight and air express. Air express generally consists of small size shipments which are very time sensitive. Air freight generally

[31] It should be noted that the loss of revenue is attenuated or eliminated for some discount tickets which attach penalties for change of plans or failure to show up for flights.

[32] The setting of the ratio of allowed oversales to the *average* no-show rate is very complicated. It varies by airline, city pair market, day of the week, hour of the day, etc.

[33] Government regulations in North America stipulated (and this is still the case) minimum compensation levels carriers would have to pay bumped passengers. In much of the rest of the world, there are no such minimum requirements for denied boarding compensation.

[34] Source: 1989 carrier annual reports.

onsists of larger size shipments, which are somewhat less time sensitive. Each f these are discussed.

*Air freight* can be further divided into three submarkets:[35] a domestic rice sensitive market, a domestic service sensitive market, and an international :ransoceanic market). The price sensitive market consists of freight which can e easily diverted to other modes, especially truck. This class of freight ypically tolerates delivery times of one to two days. Unutilized belly space in assenger aircraft is well suited to this type of cargo. As freight is typically ndered late in the day, it usually will not fly until the following day's assenger flights, with ultimate delivery between 24 and 48 hours. Such traffic an be priced on an incremental basis, as passengers generally cover all the verhead costs of the flight. Belly space cargo revenues can represent a ıbstantial increment to passenger carrier profits. Further, airlines without ırgo traffic bases, are at an important competitive disadvantage.

The smaller service sensitive domestic cargo market cannot wait for the ext day's passenger flights, and requires dedicated cargo aircraft, generally perating at night. Cargo too large to fit in bellyholds must also travel in edicated cargo aircraft. However, this traffic must be priced to cover the full osts of the flight, and thus is very expensive.

For inter-oceanic movements, longer delivery times are tolerated by the ıipper. The only competitive service is liner shipping which has very long ansit times. The large cargo carrying abilities of the typical transoceanic ıssenger aircraft provide a reasonable amount of "space-available" lift which ın be incrementally priced. Dedicated cargo aircraft are also operated for the ore time sensitive shipments. Sea-air combinations, which offer mid-range ice and service option between that of all-air and all-sea, are becoming more ommon.[36]

[35] See Weise (1980), pp. 35-37.

[36] An example of a sea-air service would be movements of fashion apparel from Asia to Europe. sea-air routing puts the goods on a liner ship from Asia to the West Coast of North America (with rival times less than a week). At this point, the goods are trans-shipped to an aircraft destined for ırope, providing total delivery times of less than ten days--which is very attractive relative to a sea-ly routing.



*Air express* was a small and expensive market segment until the debut of Federal Express in 1973. This market is highly service sensitive. The goods cannot wait until the next day's passenger flights. Thus, dedicated cargo aircraft flying overnight are required. While the costs of dedicated freighters is very high, the small size of express packages results in attractive economics. For example, transporting a 90 kilogram passenger (including baggage, carry-on luggage, meal service, etc.) one-way on a transcontinental passenger movement will generate $200-$800 of revenue, depending on whether the passenger is paying a discounted or full fare. The same 90 kilograms of lift could be used to transport 450 parcels of 200 grams each in one direction. At an average revenue of $8.00, the cargo revenue of $3,6000 is 4 to 18 times the passenger revenue. From this, the costs of local pick-up and delivery must be deducted, but the bottom line is still attractive. The key to the air express market is the high willingness to pay for the service, relative to the weight. Air freight (or passengers) generally does not have the same ability to pay per 200 grams.

Hub and spoke systems tend to be conducive to air express operations. Just as Section III.F described the levered effect a hub has for collecting passenger traffic from a new spoke, similar effects occur for cargo. However, cargo is not sensitive to backtracking, and thus a single multi-directional hub works well for air express.[37] Thus, an express package from San Diego to Seattle will likely travel via Memphis. Passengers generally will not tolerate such circuity.

[37] Section VI.B describes directional and other types of hub systems.

# Chapter 4

# Airline Pricing: Yield Management

## A. Introduction

Airline pricing in the deregulated era is significantly different than it was in the regulated era. Under regulation, the government placed severe constraints around an airline's ability to establish prices. In general, regulators in Canada as well as the U.S. followed formulas for establishing coach and first class fares. Any discount fares or other innovative fares were generally not allowed. Fares were set primarily on the basis of mileage. This was unfortunate, as often short distance routes which are operated with small aircraft can end up being more expensive than flying much longer distances when large aircraft filled with revenue paying passengers are used. Also, there was no variation allowed in prices to recognize that certain times of the day or week had higher demands than other times.[38]

When deregulation began, the carriers were freed from these constraints and found they had a blank sheet of paper for setting prices. Fortunately, a pricing technique, variously known as airline yield management, seat management, or revenue management, had been developed and was waiting for them.[39] This technique was developed by Boeing Commercial Airplane

[38] Carriers were sometimes allowed a small peak season surcharge.

[39] See Kraft, Oum and Tretheway (1986) for a discussion of the history of airline yield management.



Company.[40] Airlines, with their enormous computer systems and databases, had long had the ability to predict reasonably well how many seats would go empty for each and every flight. Yield management is simply a technique for selling these seats which have been predicted to go unfilled. The trick is to sell these seats to people who normally would not fly. These people could be induced to fly by offering the airline service at a significant discount. The challenge is to prevent existing customers from taking advantage of the discount. This is accomplished by placing restrictions on discounted tickets. The restrictions must be chosen such that very few of the existing travellers are willing to abide by them in order to access the discount. It has been found that business travellers are typically willing to continue to pay the historically high airfare in order to retain the ability to obtain a seat at the last minute, and to change their plans at will. Discount seats are only made available to those who can commit and pay for the ticket weeks in advance, and who are willing to forego any opportunity to change their plans.

To the airline consumer, airline pricing seems illogical and incomprehensible. Why should two passengers on the same aircraft sitting side by side be paying significantly different airfares? Why are there no "good" seats (i.e., discount seats) available on Wednesday, but a call on Friday reveals the availability of such seats? These seeming paradoxes can be comprehended with a grasp of the fundamentals underlying airline yield management. Section C describes yield management. Most of the concepts which will be used are relatively straightforward. The one concept which might be unfamiliar to some readers is that of a probability distribution. Probability distributions are briefly discussed in Section B.

## B. A Probability Distribution for Airline Demand

An airline forecaster has large amounts of data available. Flight 147 has been operating every day at 9 am for three years. There are almost 1000

[40] It is perhaps not surprising that Boeing actively developed this pricing system. If airlines were to offer seats at discounts, air travel would inevitably increase. This, in turn, would increase the demand for aircraft. Aircraft manufacturers' order books were very lean during the early and mid-1970s. From the late 1970s to the present, their order books have been sizeable, at least in part reflecting traffic stimulation by airline deregulation.

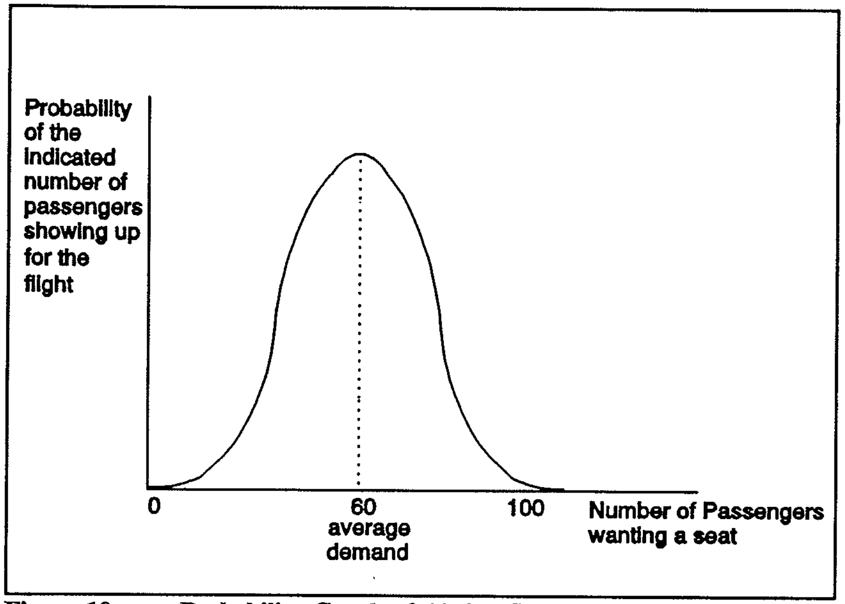



**Figure 10: Probability Graph of Airline Sales of Seats on Flight 147**

observations on how many seats have been sold on that flight. The forecaster can readily determine that, on average, 60 seats are sold on the flight. However, on some days sales will be fewer and some days they will be more. Using statistical techniques, the forecaster might determine that there is a 15% probability of selling 60 seats, a 10% probability of selling between 61-65 seats, an 8% probability of selling between 66-70 seats, etc. While this information can be kept in a cumbersome table known as a probability distribution, statisticians typically display it in a probability graph. An example probability graph for Flight 147 is given in **Figure 10.** This shows that the demand level with the highest probability is 60 seats. The further the deviation from the average of 60, the lower the probability of actually selling that number of seats. There is some probability, although a low one, that 100 seats would be demanded, and similarly a very low priority that no seats will be sold. This probability graph is a convenient representation of the statistical information on the demand for seats on Flight 147. It is used by the airline for determining



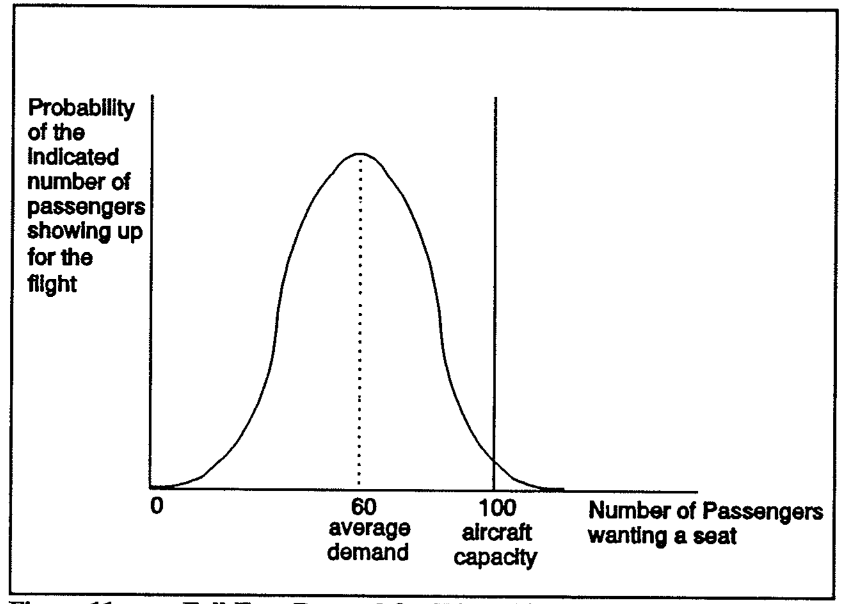



**Figure 11: Full Fare Demand for Flight 147**

how many seats are likely to go unfilled unless new travellers can be tempted by discount fares.

## C. Yield Management Fundamentals

For yield management to work, it is essential that the airline be able to predict, with a reasonable degree of accuracy, demand for each and every one of its flights. The advent of the modern computer reservations system has made this possible. By analyzing the results of perhaps millions of flights, reasonable short-run predictions are possible. Further, these systems also allow the determination of the probability distribution of demand for a flight. This allows the airline to predict not only how many seats *on average* it will sell by the flight's departure, but also how many seats it ought to keep available for existing customers if it wishes to accommodate all full fare passengers, say 95%

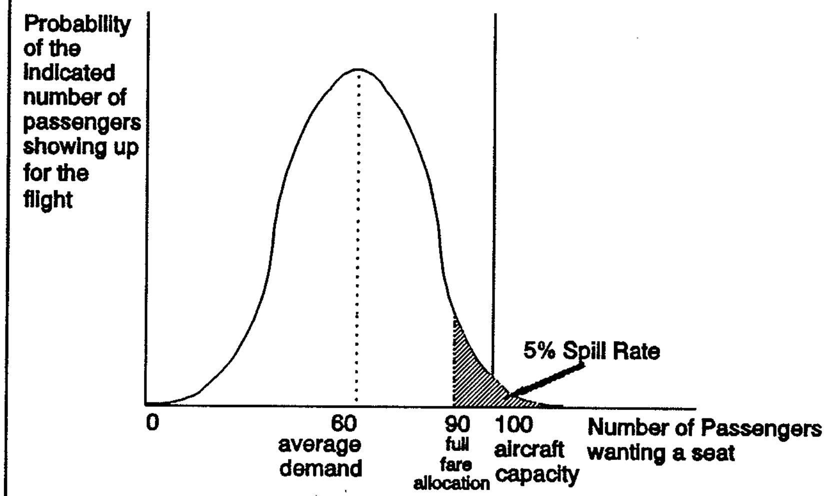



**Figure 12: Full Fare Seat Allocation**

of the time.[41] This information can be utilized to maximize a given flight's expected revenues. This is done by reserving an adequate number of seats to accommodate full fare passengers, and to make any remaining seats available to new customers at a discount.[42] A typical yield management system follows

[41] The probability distribution can be used to indicate things such as "95% of the time, sales will be 90 seats or less--only 5% of the time will sales be 91 seats or greater."

[42] It would be unprofitable to always hold all seats for full fare customers, as much of the time, many seats will be empty. Airlines instead target a certain customer service level of say 95%, and sell the rest of the seats at discount. The 95% figure indicates that 5% of the time, some full fare customers will call and not get on their first choice flight. These "spilled" passengers will shift to other flights, although in a few cases they will shift to a competitor airline. The choice of the customer service level is difficult. It should be high enough to prevent customers from routinely being discouraged, but not so high as to be unprofitable. These choices are faced by most businesses: retail outlets, restaurants, etc. Some days your favourite restaurant runs out of the grilled salmon, and you have to choose something else. It is unprofitable to stock inventory for the rare cases of exceptionally heavy demand.



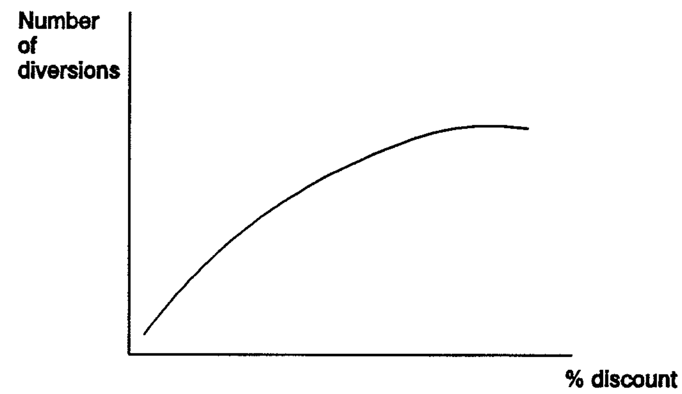



**Figure 13: Diversion From Full Fare Class to Discount Fare Class**

these steps:

**Determine the Capacity of the Flight.** The first step is determining how many seats will actually be available for sale on a specific flight. This is often predetermined. Flight 147, for example, is always flown with a 100 passenger Boeing 737. In some cases, airlines with fleets with varying number of seats per aircraft will attempt to optimize the assignment of aircraft to flights in an attempt to maximize its profits. This optimization of the flight schedule is a very complex process and is not covered here. For simplicity, this discussion assumes that a 100 seat aircraft has been allocated to Flight 147.

**Forecast the Demand by Full Fare Passengers.** The next step is to rely on the airline's historical database of Flight 147 and related flights to forecast (1) the number of *full fare* passengers expected to fly; and (2) the

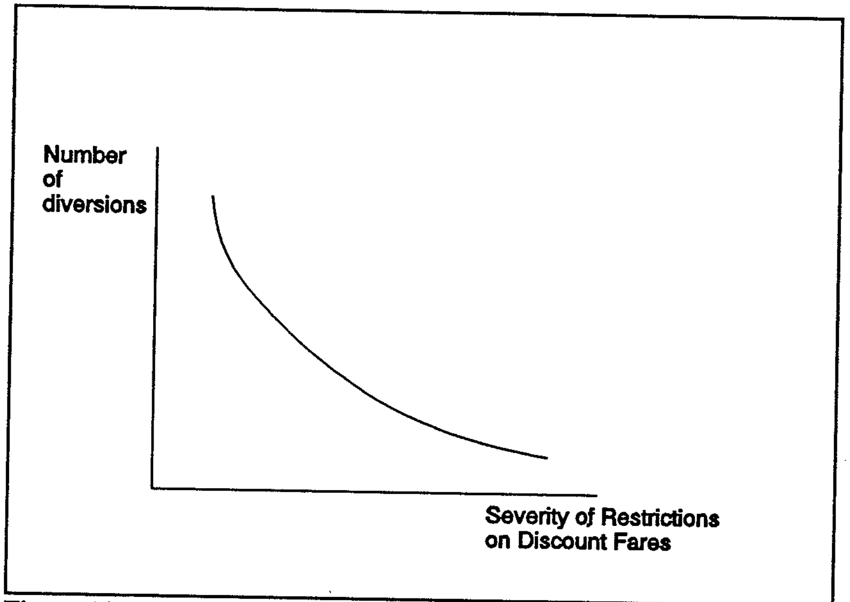



**Figure 14: Severity of Restrictions and Diversion from Full Fare Class.**

probability distribution around the expectations. **Figure 11** demonstrates this. Based on experience with this and related flights, Flight 147 has an average demand of 60 full fare passengers.[43] There is a probability associated with the actual realization of 60 as well as with the realization of any other number of seats. It has generally been observed that passenger demands are normally distributed.[44] The capacity of the airplane is indicated in Figure 11 with a solid vertical line at 100 seats. Note that there is a small probability that demand could be greater than the 100 seat capacity of the aircraft.

**Determine a Spill Rate and Reserve Seats for Full Fare Customers.** The next step is to determine how many seats should be allocated

[43] Statisticians use the term "expected" demand for average demand.

[44] See, for example, Brenner (1982).



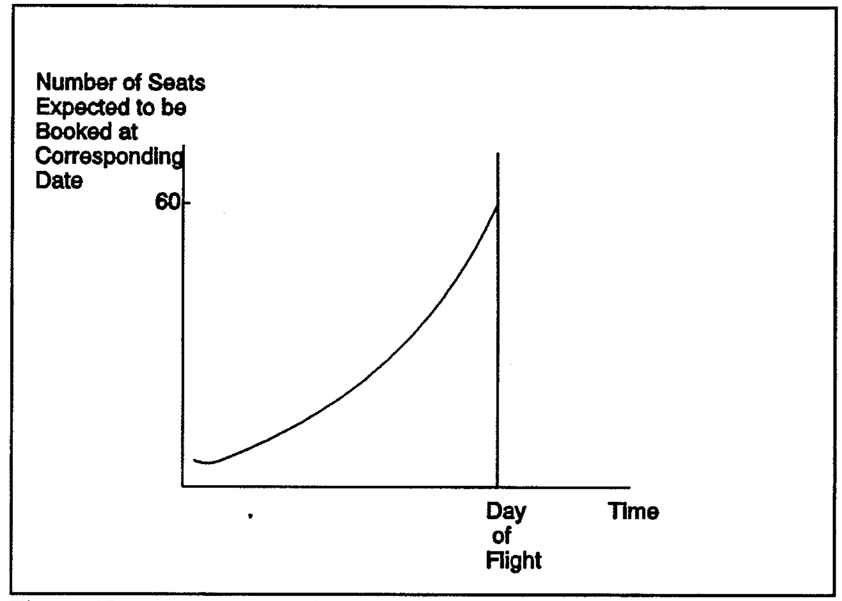



**Figure 15: Expected Flight Booking Curve**

on this flight for full fare passengers. This is done by choosing a probability level for seating all full fare passengers. For example, the airline might choose to allocate seats to full fare passengers such that 95% of the time all full fare passengers will be accommodated. The use of a spill rate of 95% is arbitrary. Actual spill rates are closely guarded airline secrets. This is easily determined using the probability distribution of demand for the flight. **Figure 12** shows that if 90 seats on Flight 147 are allocated to full fare passengers, then 95% of the time all full fare passengers will be accommodated. If only these 90 seats were available to the full fare passenger, then 5% of the time some customers will be turned away. This 5% is referred to as the "spill" rate. Not all of the "spill" is actually lost to the airline. Some of these potential customers will be captured

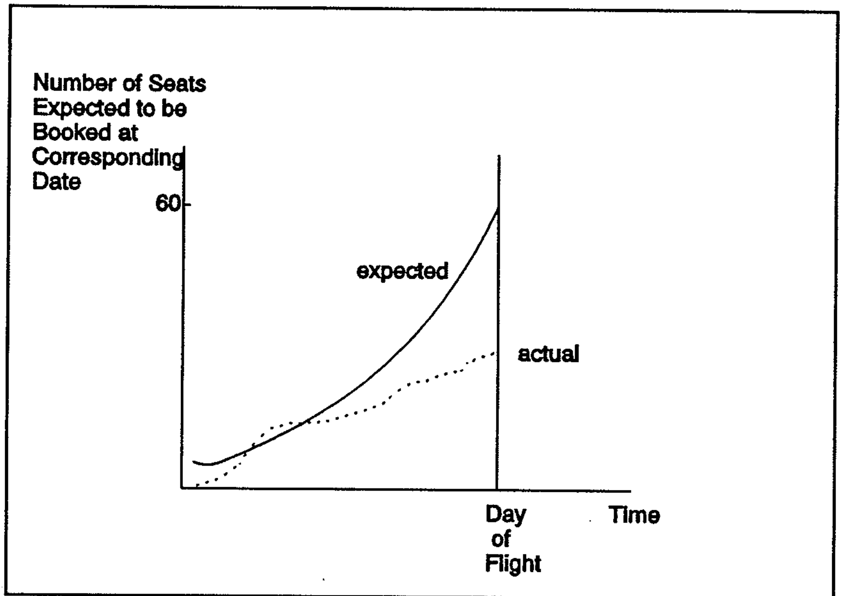



**Figure 16: Actual Versus Expected Bookings**

on other flights of the same airline.[45] A good yield management system accounts for this.

**Assign Remaining Seats to Discount Fare Classes.** Figure 12 indicates that ten seats are now available on Flight 147 for a discount fare class. This is the difference between the 100 seat capacity of the aircraft, and the 90 seats reserved for full fare passengers.

**Determine Discount Fare Level and Restrictions.** The airline must now sell the remaining ten seats to new customers. This requires choosing the level of the discount fare and associated restrictions. Restrictions

[45] Flight 147 is a 1 p.m. flight. Some of the spill will be recaptured by Flights 145 (10:45 am) and 149 (3:15 pm).



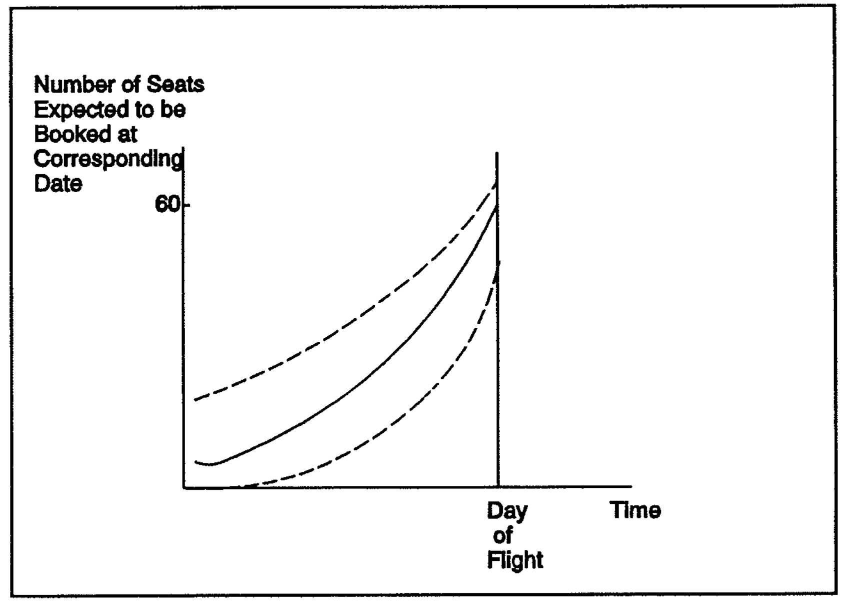



**Figure 17: Threshold Range**

are essential if the airline is to limit the full fare passengers from availing themselves of the discount fare. The discount level and associated restrictions should be chosen to maximize the amount of revenue the airline can get for these seats. If demand for these seats is high, the airline will only offer a modest discount. If demand is low, the airline might offer deep discounts.

A discount has two effects. The first effect is "stimulation." That is, the discount fare attracts those who would not have flown. The second effect is "diversion." Some of those who would have flown at the full fare, will divert to the discount fare.[46] Luckily, with modern yield management systems, the

[46] Economists would say that there is a positive cross elasticity of demand between the two products: unrestricted full fare seats versus restricted discount seats. See, for example, Oum, Gillen and Noble (1984). "Demand for Fareclasses and Pricing in Airline Markets," (Working Paper No.

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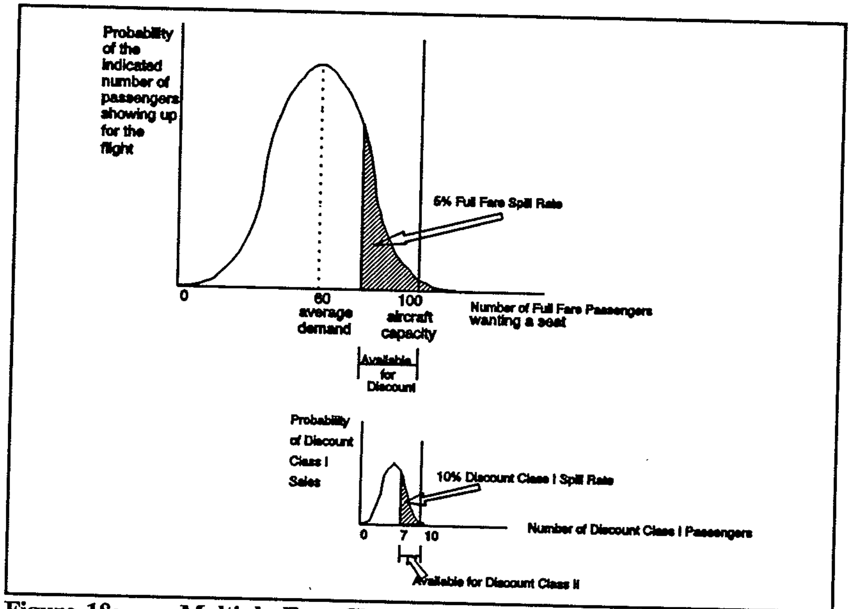


**Figure 18: Multiple Fare Classes**

amount of this diversion can be predicted. It has been found that the amount of diversion is positively related to the size of the fare reduction. See **Figure 13**. Airlines have found in recent years that with large fare reductions, they get substantial stimulation and diversion of traffic. With smaller fare reductions, the amount of diversion is considerably reduced.

The airlines have also observed that the number of diversions is inversely related to the severity of the restrictions on the discount fares. See **Figure 14**. For example, there will be fewer diversions to a 60% discount fare when the restrictions include 90 day advanced booking, 60 day advanced purchase, 14 day minimum stay, 31 day maximum stay, and no cancellation

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[46](...continued)
1000, Faculty of Commerce, U.B.C.) for estimates of our own and cross-price elasticities on various major U.S. routes.



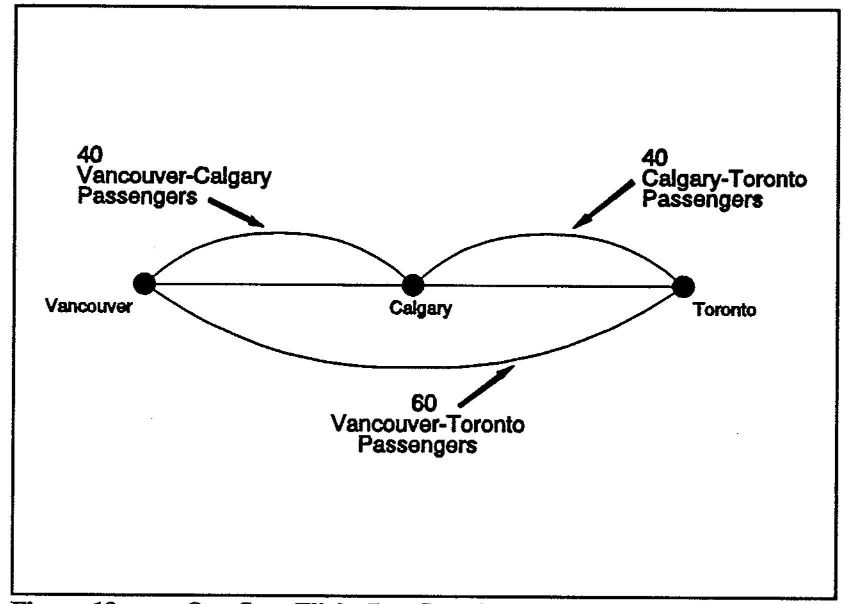


**Figure 19: One-Stop Flight Leg Seat Allocations**

privileges; than to a 60% discount fare where the only restriction is three day advanced purchase and staying over a Saturday night. **Table 2** gives a list of some typical restrictions used by airlines.

## D. Other Yield management Issues

Three other issues associated with yield management programs are now discussed.

**Dynamic Adjustment of Seat Allocations.** The above discussion was for a one time "static" allocation of seats between full fare and discount classes. This is typically done three to six months before the actual date of the flight. In practice, most airlines revise their expectations of the demand for the flight as they gather information on actual sales for the flight. This is typically done using a "booking curve." **Figure 15** is an example of this.

| Restriction | Description |
|---|---|
| **Advanced booking** | Book seat at least $N_1$ days in advance of flight |
| **Advanced purchase** | Pay for ticket at least $N_2$ days in advance |
| **Minimum** | Time between originating flight and return flight must be at least $N_3$ days |
| **Maximum stay** | Maximum of $N_4$ days are allowed between the originating flight and return flight |
| **Return (or round trip) ticket** | Ticket must be round trip to qualify for discount. This excludes one way, triangular or complex itineraries |
| **Saturday night stayover** | There must be a Saturday night between the originating and return flights |
| **Refund penalty or no refund** | If booking cancelled before flight, traveller forfeits all or part of airfare |
| **Rebooking fee or no rebooking privilege** | If traveller wishes to change to another flight for originating and/or return flights |
| **Limited or no stopover privileges** | On a flight from Toronto to Rome via London, traveller cannot spend time in London |
| **Limited or reduced service** | Reduced service depending on fare type, e.g., reduced in-flight service |
| **Limited to specific time of day** | e.g., Nighthawk or Redeye service |
| **Class of service restrictions** | If flight full, no upgrade privilege to a higher class which might have empty seats |
| **No interline privilege** | Tickets cannot be endorsed to another carrier |

**Table 2: List of Fare Restrictions Typically Used by Air Carriers**



As the day of the flight approaches, more and more of the full fare seats should be booked. In the example, the expectation is that on the day of the flight, 60 full fare seats should have been booked. The shape of the curve is drawn intentionally to reflect the fact that most full fare passengers book close to the day of the flight.

The airline compares actual bookings against this expected booking curve. **Figure 16** is an example. Here we see that actual bookings are falling below expectations as the day of the flight approaches. In this case, the airline may choose to increase the number of seats it has available in the discount fare categories or decrease the discount fare. If bookings run ahead of expectations, then the carrier might choose to reduce the number of discount seats available on this flight or increase the discount fare. By tracking actual versus expected bookings, the airline obtains better predictions of the number of seats that will be flown empty as the flight date approaches.

Since airlines may have to track thousands of flights on any given day, it is not feasible to manually compare actual versus expected bookings for all flights. Instead the computer will be instructed to make the comparison itself. Flights which seriously deviate from expected bookings are flagged by the computer and brought to the attention of management for a decision. This is generally done by a daily "exception report" indicating all flights that have exceeded or fallen short of a "threshold" level. **Figure 17** illustrates this. Here upper and lower bounds are given for the threshold range. When actual bookings fall outside of the threshold range, then the flight is added to the exception report list. Flights whose bookings fall below the threshold range may be cancelled, the number of discount seats increased or the discount fare can be decreased. If a flight rises above the threshold range, the number of discount seats can be reduced, larger equipment might be substituted, an extra section might be flown or the discount fare may be increased.

**More Than One Discount Class Can Be Offered.** The case of a flight with a full fare class and a single discount fare class has been described. In fact, air carriers will apply the same yield management concept to the discount fare class and offer additional discount fare classes. **Figure 18** illustrates this. The top part of the figure is a duplication of Figure 12. Here a 5% full fare spill rate was chosen for the full fare seats, making 10 seats available for discount classes. Discount fare class 1 is offered with some restrictions and a modest discount. Just as for the full fare class, there is a probability distribution of actually selling the 10 discount seats. This is plotted in the lower part of Figure 18. A spill rate can be specified for this class, 10% in the case of Figure 18, indicating that 7 seats are to be allocated to discount fare class 1.[47] This leaves 3 seats available for a second discount fare class, usually with a deeper discount, but more stringent restrictions. The multiple fare class system is effective in allowing the airline to fine tune its price discrimination so as to maximize revenues.

**Route Assignment.** The discussion thus far concerned itself with a non-stop flight. Consider the one-stop flight depicted in **Figure 19**. Here the plane flies from Vancouver to Toronto making a stop in Calgary. There are 100 seats available on the Vancouver/Calgary "leg" and 100 seats on the Calgary/Toronto leg. The question now becomes how many seats on the Vancouver/Calgary leg should be allocated to Vancouver to Calgary passengers and how many should be allocated to Vancouver to Toronto passengers. The profit-maximizing solution will be a function of the demand on the Calgary to Toronto leg as well. This problem is very difficult to solve. In general, short passenger trips reap higher fares per mile. This is offset by the fact that it may not be possible to fill all of the short haul seats on both flight legs. There can be severe traffic imbalances. A flight from Vancouver to Kamloops to Prince George might stimulate significant amounts Vancouver to Kamloops traffic during the ski season with little ability to sell the Kamloops to Prince George seats.

Again, a modern yield management system with a sophisticated optimization program can determine the optimum "blocking" of seats between the various route legs. The program accounts for different demand elasticities (and cross elasticities) and traffic bases on different flight legs.

[47] Typically, carriers are less concerned with not having a discount seat available on their first choice of flight. These consumers are not very time sensitive and generally will be willing to shift to another flight. Thus, the spill rate for a discount fare-class is higher than for full fare tickets.



## Chapter 5

# Airline Marketing

## A. Distribution/Marketing Channels

**Figure 20** depicts the typical airline marketing channel. A channel is the set of organizations which sells a firm's product or services. As can be seen, carriers can and do sell direct to their customers. They can also authorize other carriers (affiliates and/or competitors) to sell tickets for their flights. This requires an "interline" agreement of some form between the carriers.[48,49]

Airline tickets may also be sold by independent travel agents. Agents must be authorized by carriers to sell tickets.[50] Another outlet for airline services is the tour wholesaler. This independent operator purchases airline seats (typically in large, discounted quantities) and may combine these with hotel services, ground transportation, local tourist attractions, etc., in order to sell the traveller a complete vacation/conference/etc. package. The tour wholesaler differs in an important way from the travel agent. Agents merely *facilitate* the sale of airline services, and receive a fee/commission from the airline for doing so. They bear relatively little risk. On the other hand, the tour operator buys

[48] In interline agreements, the ticketing carrier collects the revenues from the customer. These are paid to the carrier providing the service when the latter presents the former with the customer's used ticket coupon. The International Air Transport Association operates a ticket clearinghouse service, similar to bank clearinghouse services, to facilitate such payments.

[49] Some interline agreements make provision for joint fares between carriers. With a joint fare, a consumer travelling from A to B on Airline 1, and then B to C on Airline 2, pays a fare which is less than the combination or sum of the A-B and B-C fares. How the joint fare is shared between the two airlines is a matter of considerable negotiation between the carriers.

[50] IATA also provides a travel agent approval service for carriers.

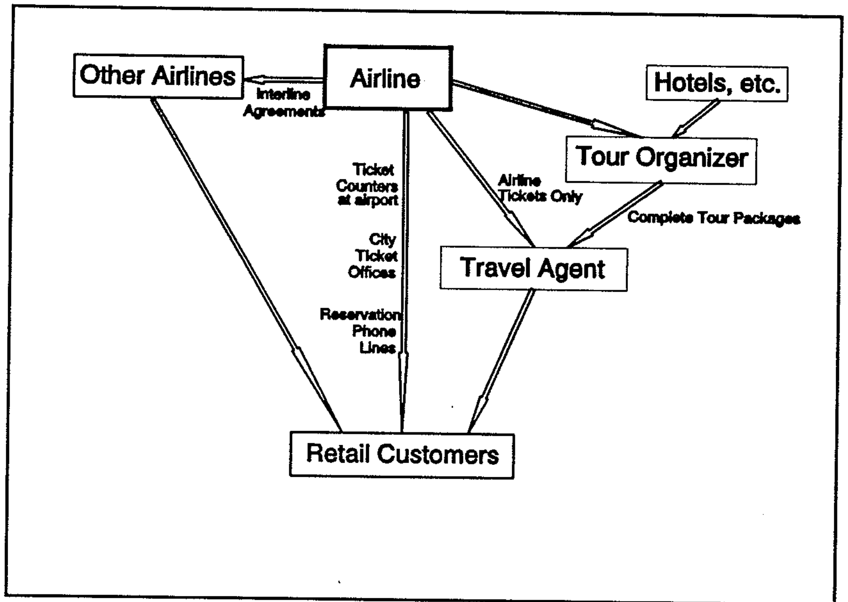


**Figure 20: Airline Marketing Channel**

airline services on his/her own account, and *resells* these to the consumer. The tour wholesaler bears considerable risk of not being able to resell what it has purchased from the carrier. While the wholesaler can and does sell to the consumer, more typically, sales are made via travel agents, to whom the wholesaler pays a commission. The two largest tour operators in Canada are Touram and Canadian Holidays, each of which are wholly owned subsidiaries of Air Canada and Canadian Airlines International, respectively.[51,52]

[51] Canadian Holidays was formerly known as Treasure Tours, which in turn consolidated CP Air Holidays, and Wardair Holidays.

[52] In the U.S., airlines typically do not own tour wholesalers, as there is no equivalent to the Canadian regulation that charter tickets cannot be sold directly to the public by an air carrier.



Even though airlines have the ability to sell tickets directly to consumers, 70% of airline tickets in Canada are sold by travel agents.[53] While the agents are supposedly independent and impartial, they are agents of and paid by the airlines, not the consumers. Airlines have two methods of influencing agents choices. The first of these is by paying higher than normal commissions on airline tickets sold by the agent. This gives the agent an incentive to steer the consumer to the services offered by the airline paying the "override." To a certain extent, consumers have preferences as to which carrier they use, and this restricts the agents' abuse of overrides. Nevertheless, the U.S. D.O.T. (1990) study observed that "some industry participants believe that agencies can choose the carrier for half of their leisure customers and one-fourth of their business travellers. Agencies have a greater ability to control the leisure passengers' choice of carrier because fewer leisure travellers will have a carrier preference."[54]

Since overrides are hidden to the consumer and sometimes to competing airlines, the effect can be anti-competitive. A recent survey in the U.S. indicated that 24% of travel agency locations "usually" chose a specific carrier in order to get an override commission, and an additional 27% "sometimes" made such a choice, for a total of 51%.[55] Typically, override commissions increase as the ticketing share of a particular carrier increases at the agency.

The second avenue airlines have for controlling decisions of agents is via ***computer reservation systems (CRSs)***. CRSs were originally designed as an internal tool to improve airline efficiency. In the late 1960s, a few airlines experimented with putting CRS terminals in travel agent offices. However, these efforts were put on hold as carriers tried to develop a common industry CRS for travel agent use. When this effort broke down in 1976, United, American and TWA started to market their own CRS systems in a major way to travel agents. By the early 1980s, they were joined by Delta and Eastern. Other airlines without their own CRS services to sell to travel agents eventually

[53] For a discussion of the role of travel agents in the marketing of airline services, see U.S. D.O.T. (1990), pp. 7-30.

[54] U.S. D.O.T. (1990), p. 29.

[55] "1988 Louis Harris Survey," *Travel Weekly*, p. 4.

were forced by the market to either buy into an existing airline's CRS system, or to pay substantial fees to their competitor's CRS subsidiary in order to access the market.

To date, all CRS systems used by travel agents have been developed by airlines. Development costs of a new CRS have been estimated to be as high as $500 million. There appear to be such significant synergies between airlines providing CRS services to travel agents and the revenues they receive for selling airlines seats, that it is unlikely an independent CRS system will ever be developed. Because of this, airlines without their own CRS have attempted to buy into the CRS subsidiaries of rival airlines. Lack of a CRS system may also have been an important factor in the 1986 wave of mergers in the U.S. industry.

Ninety-five percent of U.S. travel agents are now automated.[56] Studies in the United States have found that the way the information is displayed in a computer reservation system has enormous influence on consumer choices. American Airlines, for example, testified to Congress that 92% of all ticket sales come from the first computer screen displaying information on a given market. 54% of sales come from the first line on the first screen! This creates an overwhelming incentive for the carriers to bias CRS displays of flight information to favour the flights of the airline owner of the CRS. Even if CRS displays are unbiased, a "halo" exists which results in the agents favouring booking on the airline which owns the CRS.[57]

In 1982, the U.S. Civil Aeronautic Board launched an investigation into the anti-competitive implications of biased CRS displays, as well as other CRS abuses, such as manipulation of information provided by competing airlines. A set of rules were adapted in 1984 which *prohibited* certain practices, including bias of displays and discriminatory pricing. The elimination of (or, more accurately, reduction of) display bias reduced carrier incremental revenues of extra traffic induced by the bias, but these were replaced with higher direct fees charged to other airlines.

[56] U.S. Department of Transportation, "Study of Computer Reservation Systems," May 1988, p.70.

[57] For example, the agent will have greater confidence that the information in the CRS is most up to date for the owner airline than for other airlines. This is especially important when booking last minute tickets, which are usually full fare.



In Europe, *prescriptive* rules for CRS conduct were adopted in 1989. Two large CRS systems are being developed there, as partnerships of two separate groups of European airlines. Both use U.S. CRS technology. In addition, American Airlines is directly marketing its Sabre system to European airlines (and railroads).

Eighty percent of travel agents in Canada now use a CRS.[58] In the 1960s Air Canada developed the world's first airline computer reservation system. This system eventually came to be known as Reservec. Until 1984, it was the only CRS system available in Canada. In January 1984, CP Air, recognizing the problem that it was facing with its primary competitor controlling the travel agent portion of the distribution channel, launched a competing CRS system, Pegasus. However, CP Air quickly discovered that penetrating the market would be difficult at best. Air Canada had already locked up the major travel agents with its Reservec system. CP Air found that it could successfully market its Pegasus system only to the smaller agents. Further, while CP Air paid Air Canada a fee for every CP Air ticket sold on Reservec, Air Canada refused to make any payments to CP Air when an Air Canada flight would be booked on a Pegasus system. CP Air claimed that its Pegasus effort was failing, and approached Air Canada about merging the systems. Apparently Air Canada refused.

CP Air then opened negotiations with American Airlines to bring its Sabre system into Canada as a replacement for Pegasus.[59] Sabre dominated the U.S. and was making significant penetrations elsewhere in the world. This threat appears to have been sufficient to get Air Canada to come to the bargaining table. Effective June 1, 1987 Air Canada and CAI (the successor of CP Air) agreed to merge their two CRSs into a single system, Gemini. Gemini was then owned 50/50 by the two airlines. Gemini decided to abandon both

[58] The 20% of agents who are not automated account for a very small proportion of airline ticket sales.

[59] See Hine (1990), p. 82.

carriers' home grown systems, and to replace them with a U.S. system. An initial agreement was arrived at with TWA/Northwest's PARS, but this was eventually replaced with Gemini adopting United Airlines' Apollo/Covia technology. Covia became a one-third owner of Gemini.

The Gemini merger resulted in a consolidation of the CRS market in Canada. Gemini's Canadian market share was 90% at the time of the merger, compared with a 10% share for Sabre.[60] Although the merger was contested by the Bureau of Competition Policy under the *Competition Act*,[61] the case was settled with a Consent Order under which CAI and Air Canada are required to provide complete, timely and accurate information on the information in its CRS to all other CRSs operating in Canada on the same basis as it is given to Gemini. Air Canada and CAI were ordered to participate in all CRSs operating in Canada on commercially reasonable terms. They were ordered to make available to other CRSs in Canada the same advance seat selection and boarding pass capability which has been provided to Gemini. Further, Air Canada and CAI were ordered to provide a "look but not book" link (effective January 31, 1990) and a "look and book" link to other CRSs (effective June 30, 1991). In addition, the Consent Order specified a set of rules for the operation of CRSs.

Before closing this section, a few other comments ought to be made about the travel agent industry. A recent U.S. study observed that "agencies generally operate on narrow profit margins, and some surveys suggest that a large proportion of agencies are at best barely profitable."[62] While there are a large number of agencies, and the industry is quite competitive, there are a handful of mega-agencies with large market shares. Data for the Canadian industry is not available, but in the U.S., two agencies have a combined 10%

[60] See Competition Tribunal, *Statement of Grounds and Material Facts for the Application by the Director of Investigation and Research under Section 64 of the Competition Act*, Ottawa, 7 December 1988, pp. 6-7. It is believed that in the two years after the statement, Gemini's market share has been reduced somewhat by Sabre.

[61] Competition Tribunal, *Consent Order* and *Reasons for Consent Order* (Ottawa, July 17, 1989) re Director of Investigation and Research and Air Canada, PWA Corporation et al.

[62] U.S.D.O.T. (1990), p. 16.



market share and the top ten agencies sold $8.5 billion of airline tickets in 1988.[63] The trend is toward greater concentration in the industry.

## B. Creating Brand Loyalty: Frequent Flyer Programs

As deregulation began in the United States, air transport could largely be viewed as a commodity. That is, consumers had little loyalty to particular producers. Some airlines, such as People Express, followed the appropriate strategy for a commodity: follow a cost leadership strategy (i.e., low costs) and compete on the basis of price. A few other airlines, notably American Airlines, decided to pursue strategies to create brand loyalty where it did not exist and thus undermine the commodity nature of the service. The most notable of these strategies was the introduction of frequent flyer programs by American Airlines in 1981.[64]

Because large carriers can offer frequent flyer rewards at lower costs, these programs create a significant barrier to entry.[65] Frequent flyer programs came to Canada in July 1984 only a few months after they were permitted under the *New Canadian Air Policy*. Prior to this they were not allowed by the government. The Canadian carriers introduced these largely in order to maintain market share on trans-border routes to the U.S. as they were losing customers to the U.S. carriers offering these reward systems. Elsewhere in the world, frequent flyer programs are non-existent, although some carriers have responded with programs on routes to/from North America.

A trunk carrier awards points for travel on its affiliated feeder carriers. However, it never allows a competing carrier to join its frequent flyer plan. Non-aligned smaller carriers are also generally excluded from these plans.

[63] American Society of Travel Agents, "Outlook: Travel Agency Industry in 1989."

[64] Economists would describe this process as one of putting some slope in the carrier's demand curve.

[65] It is easier to build points with a carrier that flies to all destinationsthe consumer is interested in. Thus the large carrier may choose to offer one free trip for every thirty paid trips. To offset the difficulty of accruing points since it only flies to a few destinations, the smaller airline may have to provide rewards at a one to fifteen or a one to ten ratio. Tretheway (1989) discusses the nature of these programs and their success in building brand loyalty.

Because of their attractiveness to consumers, membership by an air carrier in the frequent flyer plan of a large carrier is almost required these days in North America. Both PSA in the U.S. and Wardair in Canada cited frequent flyer programs as a problem and as a major reason for their mergers into larger airline systems.

Some observers claim that programs such as American Airlines' AAdvantage have resulted in an increase in an individual carrier's business by 20-35%.[66] The programs have been so successful that every North American significant air carrier has been forced to either offer its own program or to join the program of another major carrier.

Stephenson and Fox (1987), in their article on frequent flyer programs, gathered the following facts:

- 54,000,000 adults in the U.S. took at least one airline trip in 1986.
- 32% were classified as business travellers (i.e., the employer paid for the trip).
- 46% of all airlines trips were business trips.
- Business trips accounted for 68% of industry revenues.
- 3% of air travellers were frequent flyers (i.e., take more than 12 trips per year).
- These frequent flyers accounted for 27% of the airline industry trips.
- From these facts, it can be determined that frequent flyers accounted for a minimum of 40% of the industry's revenues.

[66] Does the Frequent Flyer Game Pay Off for Airlines?", *Business Week*, August 27, 1984.



- In 1985, 10,000,000 individuals were members of U.S. frequent flyer programs.
- 70-75% of all business travellers were members of at least one program.
- These members received $1 billion worth of free travel and accrued an additional $2 billion in free travel.
- The value of the frequent flyer awards represent approximately 7.5% of the industry's revenues, and the liability for 1985 alone represented 5% of 1985's revenues.
- In 1986, frequent flyers sold $75 million in awards to brokers.[67]
- 3% of passengers on any given flight are likely to be frequent flyers cashing in a free ticket.[68]

The airlines consumer is likely to view frequent flyer programs as a real bonanza. Even customers who pay for their own fares see the frequent flyer reward as some form of rebate from the airline.

As the facts above show, two-thirds of airline revenues come from business travellers (i.e., travellers for whom the ticket is paid for by the employer). These passengers may well view the frequent flyer bonus as something for nothing. However, the purchaser of the ticket, the employer, is not receiving the rebate. The benefit, the free air pass, accrues to the individual traveller. This is a case which economists refer to as the principal-agent problem. Agents, employees travelling on tickets paid for by their employers, make the decision as to the quantity, price and choice of carrier, and receive the benefits of the frequent flyer program. The principal, the employer paying for

[67] "Frequent Flyer Awards Tougher to Sell as Airlines Tighten Rules, Press Brokers" (1988), *Wall Street Journal*, 6 September, p.31.

[68] J. Ibbiteson, "Fight for Frequent Flyers", *Vancouver Sun*, 14 November 1988, p.D2.

the ticket, pays the cost but is unable to optimize air travel purchases since the decision is being made by the agent.

It might be argued that the frequent flyers are confined to seats which the airline can predict would otherwise fly empty. If the airline was successful in confining the frequent flyer to these otherwise empty seats and if these seats could be filled with no incremental cost to the airline, then perhaps there is some form of social benefit accruing here. Of course, these two assumptions are not likely to be true. Many of us have personal experiences unable to get onto a fully booked flight, only to later learn that many seats were occupied by airline employees or frequent flyer award users. Statistically, it is known that when airline load factors average only 60%, 6% of flights will be fully booked. When the average passenger load factor rises to 70%, this jumps to 21% of flights that are fully booked, and at an 80% load factor the percent of fully booked flights jumps dramatically to 64%.[69] Thus, at the very least, a certain proportion of the time, airline frequent flyer award users are likely to displace paying passengers. When this happens, an opportunity cost is created in terms of foregone revenues.

When the employer pays for an airline ticket, frequent flyer programs should not be viewed as a rebate for quantity purchases. This is because the recipient of the frequent flyer benefit is not the same person or entity which made the payment for the original flights. A true quantity discount would be one where the employer would receive the frequent flyer benefit. The employee will make his or her decision so as to optimize his or her own utility. An employee may make sub-optimal decisions because there is no cost for him in taking a flight that may cost more than necessary. Instead the cost goes directly to the employer.[70]

The magnitude of overpayment for and overuse of airline services can be quite large. In Canada, it has been estimated that 13-20% of business travel

[69] See M.A. Brenner (1982), "The Significance of Airline Passenger Load Factors" in G.W. James, *Airline Economics*, Lexington Books, Lexington, MA.

[70] See C. French (1989), "Will Frequent Flyers Still Get the Point?", *Globe and Mail*, 4 February, p.11, for a discussion of how business travellers are spending 13-20% more than necessary on airline services in an attempt to maximize their frequent flyer benefits.



is unnecessary.[71] In the United States, it has been estimated that there is $4.2 billion in frequent flyer cost overruns annually.[72] This is almost 10% of the total revenues received by the airline industry. Stephenson and Fox point out that "the U.S. Internal Revenue Service has estimated the value of unnecessary travel accumulated by frequent flyers to be $9.5 billion."[73]

In addition to the dollar cost of this unnecessary air travel, airline frequent flyer programs also cost the employer in terms of squandered work time. When an employee travels New York-Dallas-Los Angeles in order to earn additional frequent flyer points rather than New York-Los Angeles, the employer is losing a minimum of one hour of work time. In addition, there is a chance that the Dallas-New York leg of the flight could be delayed or even cancelled. There is also the possibility that totally unnecessary trips would be taken. Perhaps in the absence of frequent flyer programs an employee would choose not to go to a particular convention. The employee may be only a few thousand miles short of that coveted trip to someplace warm and sunny, so he or she chooses to go to the convention, costing the employer in travel expenses and foregone work time.

Another issue to be considered is whether or not airline ticket prices have been inflated in order to cover the cost of frequent flyer programs. Certainly, there are some costs for the airlines to manage these programs. *Business Week* estimated that the startup expenditures to establish a frequent flyer program were between $2 and $12 million in 1984.[74] In addition to the annual program administrative cost, the airlines incur some costs in servicing the awards. As discussed, there is a potential opportunity cost for the airlines when frequent flyer passengers fill seats that could have been sold to revenue paying customers. Even when seats would have otherwise been empty, the airline needs to provide an additional meal, expend additional fuel for the roughly 200 lbs. of passenger and luggage, and incur additional passenger service cost. The latter

[71] Ibid.

[72] See Stephenson and Fox (1987), p.18.

[73] Stephenson and Fox (1987), p.1. The authors cite as a basis for this observation L.K. Jereski (1985),. "High Times for Marketers," *Marketing and Media Decisions*, April, p.143.

[74] "Does the Frequent Flyer Game Payoff for Airlines", *Business Week*, 27 August 1974, p.75.

are costs involved in handling the passenger's reservation and in processing the passenger at the airport. *Frequent Flyer* estimates that ticket prices are 10-15% higher than they would be without frequent flyer programs.[75] Layer and Reid estimate that frequent flyer programs "may be costing American business as much as $7 billion a year in added travel costs."[76]

These programs have definitely been successful in building product loyalty in airline consumers.[77] The first airlines to introduce these programs undoubtedly experienced an increase in traffic and revenues. Eventually the other airlines had to offer similar programs in order to stem the losses of traffic to those airlines offering the programs.

Now that just about every airline of any importance in North America offers a program, one might ask whether or not there is any residual advantage for the industry in their maintenance. Once all firms in any market offer a particular innovation to their product or service, its marketing effect has essentially been neutralized. The question then becomes whether the industry as a whole has been stimulated by frequent flyer programs. In the discussion above, statistics have been cited indicating that indeed this is the case. One of the reasons that corporations have higher travel budgets due to frequent flyer programs is due to extra travelling in the form of unnecessary trips and circuitous routings.

Another market advantage of frequent flyer programs for an air carrier is the ability to build information on its customers. The frequent flyer program gives the carrier information on the customer's name, address, employer, number of flights flown and destinations, preferences for meals, seating, etc. In the past, airlines had information on the total travel taken by their customers

[75] "Will the Airlines and Corporations Fight it Out?" (1986), *Frequent Flyer*, November, p.79.

[76] See R. Layer and D.R. Reid (1988), "Have the Frequent Flyer Programs Defeated the Purpose of Deregulation and How Much are they Costing Your Firm?", *Business Travel Review*, June, p.16.

[77] It should be pointed out that the brand "loyalty" induced by frequent flyer reward programs is a peculiar type of brand loyalty. Some would argue that it is not necessarily a loyalty won from providing a differentiated product which the consumer highly values. Rather it might be viewed as a grudging type of loyalty due to high costs of switching to another brand. The high cost is that of forgoing reward benefits by having to restart collecting points.



but little, if any, on the patterns of individual customer. As this database accumulates, the airlines will be able to take advantage of it in terms of market research, specialized promotions, differentiating its product by automatically booking a certain customer's favorite seat, etc. Airlines with this information definitely will have advantages over their rivals.

A final question is whether or not frequent flyer programs can be used by one airline to harm another. One way this could happen is if the cost of a frequent flyer program is higher for one's competitors. If this is the case, then introducing such a program will raise their cost relative to yours, thereby lowering their profitability and/or increasing your market share.

One way in which frequent flyer programs can be less costly to some airlines than others is via the payout ratio. This ratio indicates how many miles a customer must fly in order to achieve a frequent flyer reward of a given value. An airline who awards a transcontinental return ticket upon accumulation of 45,000 miles of travel will have lower costs than one who must award such a ticket after only 14,000 miles of travel. This relationship between cost and the payout ratio is obvious. What is not obvious is whether in equilibrium consumers will require one airline to have a more generous payout ratio than another. In our view, this is likely to be the case. Consider an airline customer located in Toronto. This business traveller makes trips to various destinations in North America during the year. If Airline A flies to most of these destinations, then it will be easy for that customer to accumulate frequent flyer points. Airline B, on the other hand, might only fly to a limited number of the customer's destinations. Even if the customer always chose Airline B for those destinations, it would be choosing between Airline A and Airline B for a trip to a destination served by both, the customer is likely to choose Airline A if the payout ratio is the same for both carriers. A marginal trip on A is more likely to bring the customer to a given mileage level necessary for a particular reward. This is especially important given the accelerating nature of rewards as mileage accrues. To counter this disadvantage, Airline B must offer a more generous reward payout, thus raising Airline B's cost.

## Chapter 6

# Airline Route Systems

One of the strategic decisions of any business is defining the product it will produce and sell. In the case of air transport, perhaps the key decision an air carrier makes in this regard is the determination of its route structure. Which cities will be served? How will the cities be linked? This chapter deals with these issues. It starts with a discussion of viewing air transport as a logistical system for moving people. However, there is not one unique route system, but a wide range of alternatives which can satisfy passenger needs. The chapter then discusses the hub and spoke concept, the role of feeder traffic, and the role of international traffic.

## A. Viewing Air Transport as a Logistical System

**Logistics.** Logistics is the management discipline which deals with systems for moving goods from source to use. It is referred to in some contexts as "physical distribution management" (the movement of finished goods from manufacturer to consumer), or as "materials management" (when the focus is on the movement and procurement of raw materials to be transported to the factory). Logistics covers the movement of good in both space and time. The geographical characteristic is obvious: goods are produced at a single location, but are consumed by individuals at many locations. There is also a temporal link: goods (like apples) are produced at a particular point in time, but are consumed later. Transportation solves the problem of the geographical movement of goods from source to use. Inventories provide the temporal links.

Logistical systems for moving goods through time and space consist of nodes and links. Nodes are the places where inventory is held: at the factory, regional warehouses, and retail outlets. Links are the connections between the nodes. A link might use truck, pipeline, rail, water or air transport. There are



trade-offs in logistical systems between links and nodes. A system using slow, unreliable rail transport would require inventory stored at regional warehouse nodes. In contrast, a system using more expensive but speedy and reliable air transport, may be able to ship from factory to customer, thus eliminating the need for intermediate nodes and inventories.

**Passenger Logistics.** While logistics is normally thought of in terms of freight, it also applies to moving passengers. Passengers move from origin to destination. In doing so, they will travel along links (air routes) and between nodes (airports). Note that generally there are several alternative routings for moving passengers. The alternatives increase as the distance between origin and destination increase. There can be trade-offs between nodes and links. Non-stop routes are possible, but they may not have enough volume to economically justify frequent service. Hub and spoke systems add a node in the passenger's journey, but their traffic pooling ability may allow increased service frequency (reducing the temporal dimension of the passenger's journey).

Business passengers are especially concerned with getting from origin to destination *on a timely basis*. Before deregulation, much of the U.S. was served by non-stop, but often infrequent, air service. Since deregulation, airlines are providing (and travellers seem to be preferring)[78] more frequent, but one stop routing through major hubs.[79] Most travellers feel that the "cost" of increased time spent in flight is more than offset by the "benefit" of more frequent service.

Tourists can also be viewed as purchasing complete logistical packages. For example, tourists from Japan may wish to see the Rockies and spend some

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[78] See Morrision and Winston (1986) for evidence that passengers vote with their dollars for frequent hub service over infrequent direct service.

[79] Gordon (1990) provides evidence that since deregulation *more* non-stop service is available. He criticizes Dempsey (1990) and Good, Nadiri and Sickles (1989) for perpetuating the "myth" that deregulation has required passengers to travel extra miles due to the circuity of hubbing. Gordon points out that hubbing has resulted in more non-stops to hubs, and since markets to and from hubs dominate passenger volumes, this has led to an overall improvement. He substantiates this with evidence from the top 300 markets in the U.S. showing a roughly 10% increase in markets with non-stop services. He further points out that many prederegulation non-stop markets had single or few daily flights, whereas after deregulation flight frequency has increased. (See pp. 38-41.)

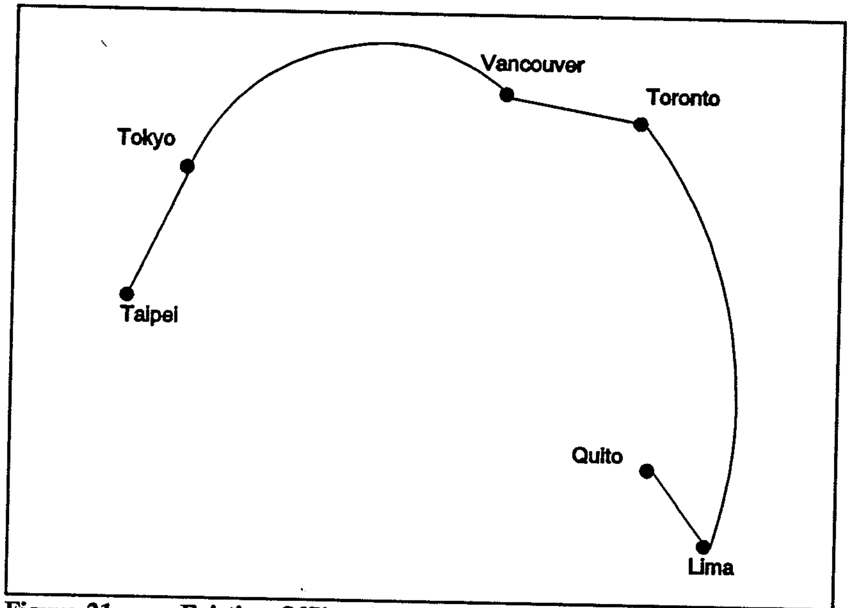


**Figure 21: Existing Offline Asia to Offline South America**

time shopping in a large city. They may be indifferent between a package which routes through Vancouver and one that routes through Seattle.

**Airports as Nodes in Logistical Systems.** An airport, as part of a logistical system, facilitates the flow of goods and people into and out of a region. It can also act as a transfer node (an in-transit node) between two very distant regions. An airport is also an intermodal facility, transferring passengers or freight from one mode of transport, air, to another, usually motor transport. A particular airport competes with other logistical systems. For example, air freight can fly to Seattle and then be trucked to Vancouver as an alternative to flying into Vancouver and using a local truck for delivery. Depending on frequency and reliability of service, relative customs clearance times, etc., one system may give the customer superior performance.



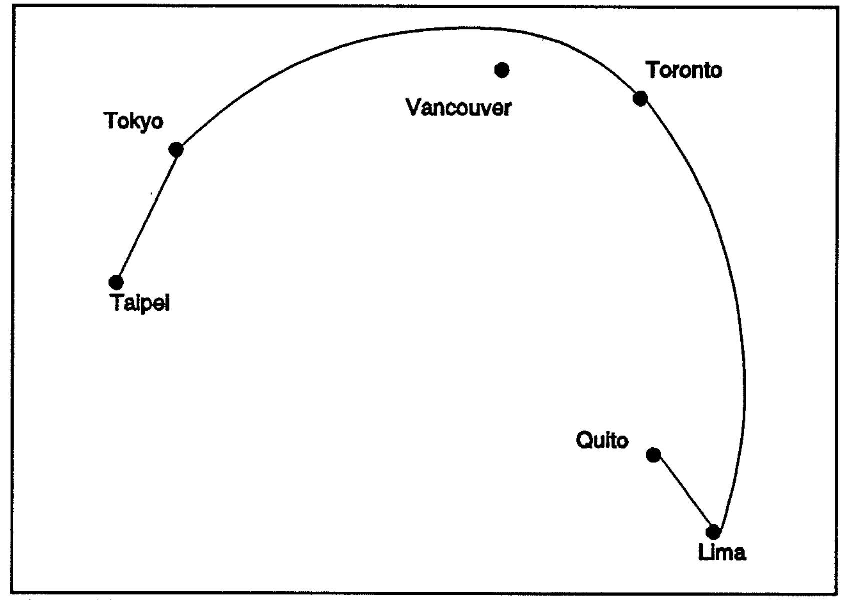


**Figure 22: Alternative Route System: Overfly Vancouver**

To illustrate how one country's air transport system fits into a broader logistical system, consider the traffic routing in **Figure 21**. A traveller from an "off-line: (i.e. non hub) point, such as Taipei in Asia, wishes to travel to an off-line point in South America, such as Quito. The historical routing pattern using Vancouver requires no fewer than five stops, a minimum of three airlines and, depending on the day of the week, 2-4 days travel. It is now technically possible to fly directly from Tokyo to Toronto (see **Figure 22**). This eliminates one stop and hours of flying and in-transit time. Alternative methods of improving the traveller's utility of routing through Canada exist; off-line points in Asia can be connected to Vancouver (**Figure 23**), and Vancouver could be more directly connected to hubs with access to off-line South American points (**Figure 24**), or directly to South America (**Figure 25**).

The main point of this section is that air transport routing must now be thought of in terms of global networks, not just as country-to-country origin-

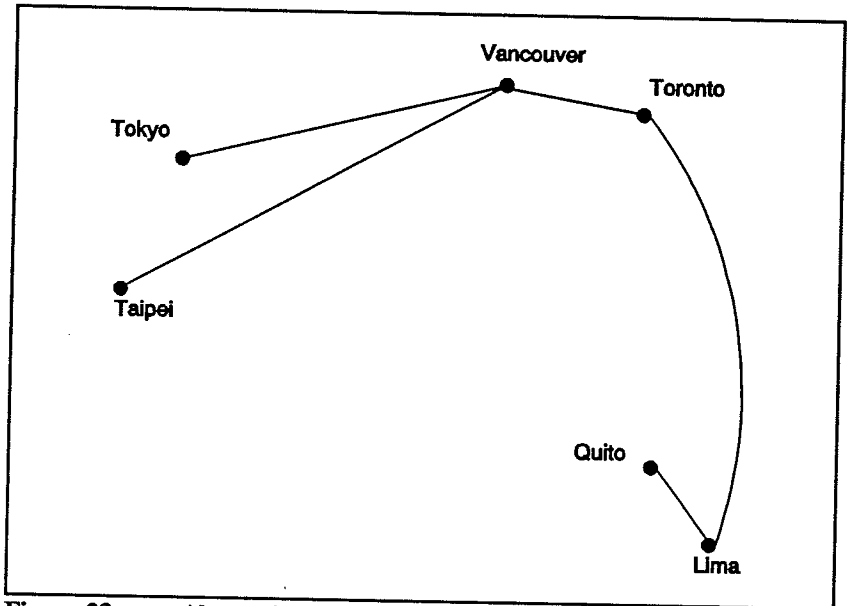


**Figure 23:** **Alternative Routing System: Connect Vancouver to Off-line Asia**

destination statistics. Canadian traffic can be routed indirectly through the U.S. Similarly, Canada's airlines can enjoy some non-Canadian global traffic flows by proper design of their route networks. As Canada becomes better connected to the globe, it becomes a more attractive place for doing business. Better network connections for Canada will result in lower costs for moving goods and people into/out of Canada.

## B. Airline Hub and Spoke Systems

With the background of how airline route systems should be viewed as logistical systems for moving people (and goods), the rest of the chapter discusses three important elements of post-deregulation airline route systems: hub and spoke systems, feeder carrier connections and international connections.



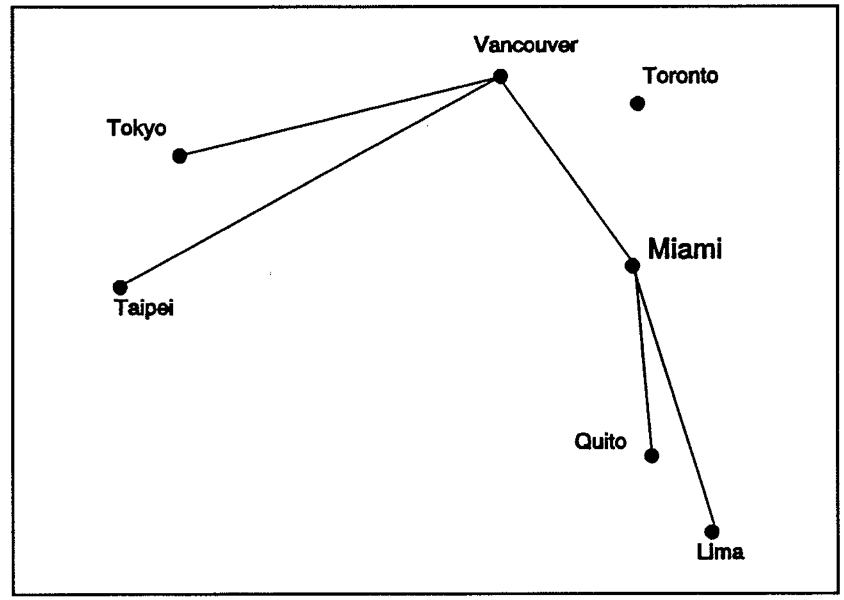


**Figure 24:** **Alternative Routing System: Connect to Gateway to South America**

**Introduction.** During the era of economic regulation of air transport, U.S. and Canadian carriers were constrained in their choices of routes. With the new freedoms of deregulation, there has been a dramatic restructuring of airline routes. In the U.S., with many major population centres scattered throughout its geography, the carriers' new route networks almost invariably follow a hub and spoke pattern. Canada, with less opportunity to rationalize its route networks around hubs,[80] has nevertheless also witnessed development of hub and spoke networks at both the trunk and feeder carrier levels. This section describes the nature of hub and spoke systems.[81]

[80] Canada's strong East-West travel pattern, confined to a narrow band along the U.S. border, is less conducive to hub routing than the more geographically dispersed U.S.

[81] The impact of hub and spoke systems on consumer demand was described in Section III.E.

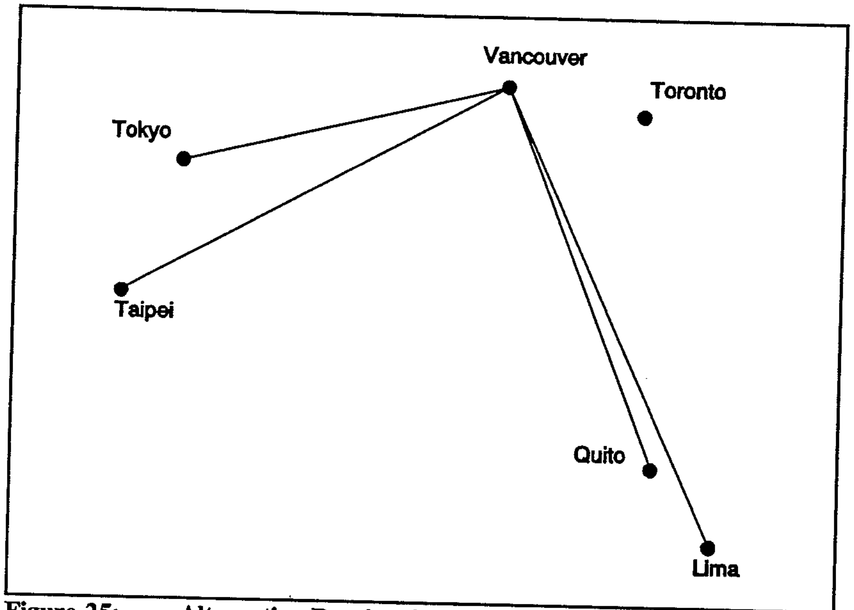


**Figure 25: Alternative Routing System: Vancouver Direct to Asia and South America**

**Hub and Spoke versus Linear Networks.** **Figure 26** shows a typical pattern of an air carrier's routes before airline deregulation. This example shows that the route system does not have any dominant focus. Station I has four direct routes emanating from it, while Stations B and D have three each. Some noticeable gaps exist in the route structure. Passengers travelling from H to E, for example, must make four stops if they choose to use this airline. Because this pre-deregulation route structure is not a hub and spoke type, it is sometimes referred to as a "linear" route system. This is because the original government awards of the components of the route system tended to be straight line routes. For example, the airline may originally have been awarded "Route 1" for service from A to B to C to D to E. "Route 2" may have been awarded some time later for the D-F-I-G sequence. The remaining routes (B-I, H-I) were probably awarded by the government regulator one at a time, on a piecemeal basis, over a span of twenty years.



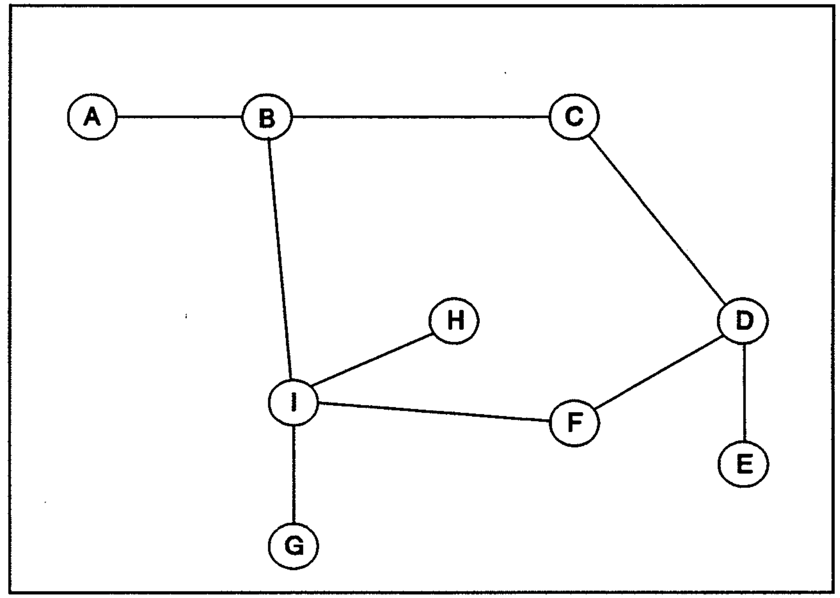


**Figure 26: "Linear" Route Structure**

It should be pointed out that this airlines' route system was likely not of its own choosing. It may have put in applications with the government regulator to serve the B-H and H-F-E routes several times; but due to politics or a failure to conclusively prove public convenience and necessity for their proposed service, it was consistently denied an award.

**Figure 27** shows ABC Airlines' route system after deregulation. The same cities are served, but now all cities are connected to city H. This route network resembles the hub and spokes of a bicycle wheel thus giving rise to the term "hub and spoke" route structure. City H, which before deregulation was only linked to a single station, has become the focus of the system and now connects with all other stations. Notice that city H was chosen as the hub station due to its central geographic location, even though city I had the most service before deregulation. Any station on the system is now at most one stop away from all other stations. This is of course, an idealized hub and spoke network.

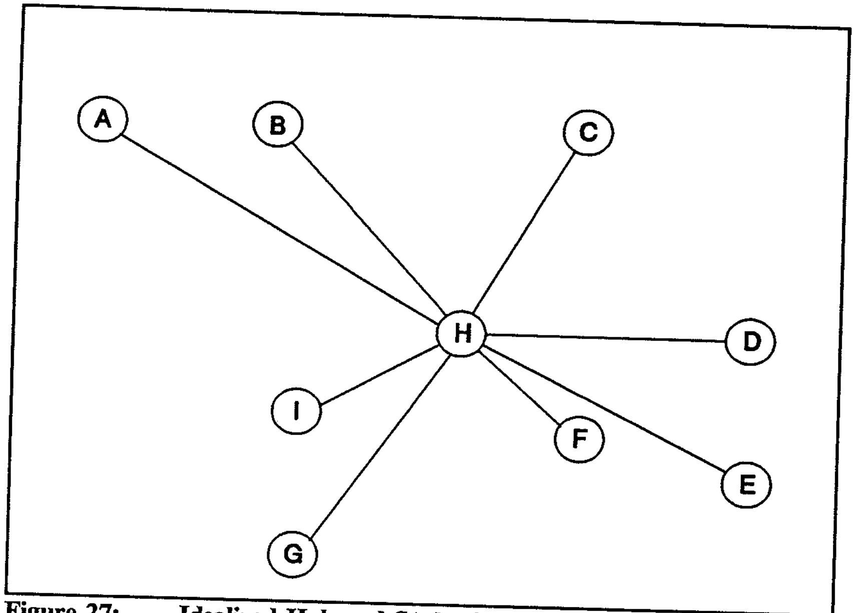


Figure 27: **Idealized Hub and Spoke System**

**Figure 28** shows a somewhat more typical pattern, with a few stations being one stop away from the hub (perhaps due to low traffic generating ability), a high traffic route overflying the hub (CK), and a few more stations which were not served during the regulation era (J,K) added to the network.

**Simple Versus Complexing Hubs.** The idealized hub shown in Figure 27 can be of either simple or complexing types. Simple hubs are ones where the flights on various spokes operate independently of each other. In contrast, in a complexing hub operation, flights on all spokes are timed to arrive and depart from the hub within a short period of time. As will be discussed below, this allows passengers travelling beyond the hub to make quick connections between flights on various spokes, and thus reduces their travel time.



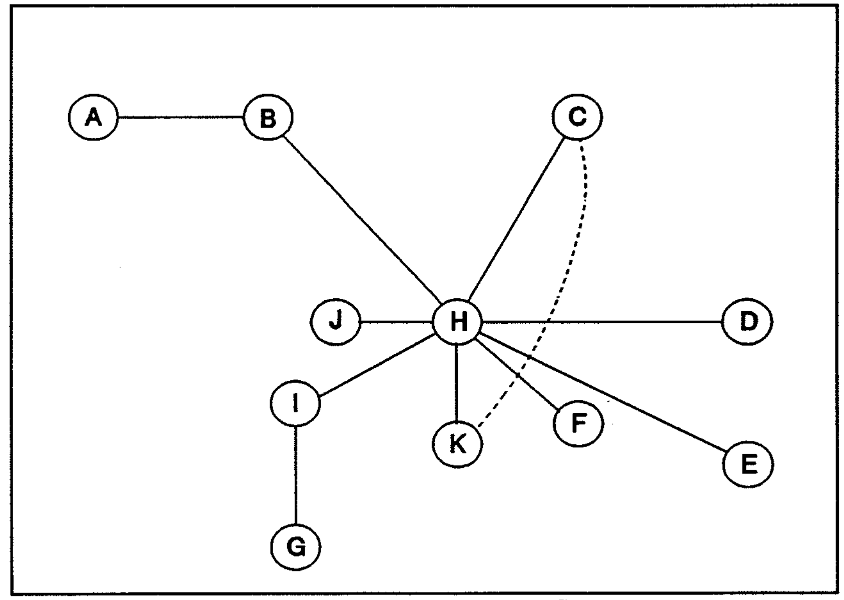


**Figure 28: "Typical" Hub and Spoke Route System**

**Figure 29** and **Figure 30**, taken from Gillen, Oum and Tretheway (1985), show the pattern of arrivals for a simple hub, that of People Express in Newark, and for a complexing hub, that of Delta airlines in Atlanta. Notice that the People Express operation had flights arriving and departing on a continual basis, while Delta's flights arrived in batches and departed in batches. The coordinated arrival of a series of flights followed by a rapid series of departures is referred to as a "complex" or a "bank." Delta operates several complexes each day as can be seen in Figure 30. For example, there is a complex that begins with arrivals around 8 AM, followed by 9 AM departures.

Complexing hub operations offer better connections for passengers, but they can be much more expensive for the air carrier to operate. Since flights arrive in large batches and must all be serviced quickly, the hub station will require more service vehicles, airport gates, personnel, etc. than if the flights were more spread out. Both capital and personnel will be poorly utilized

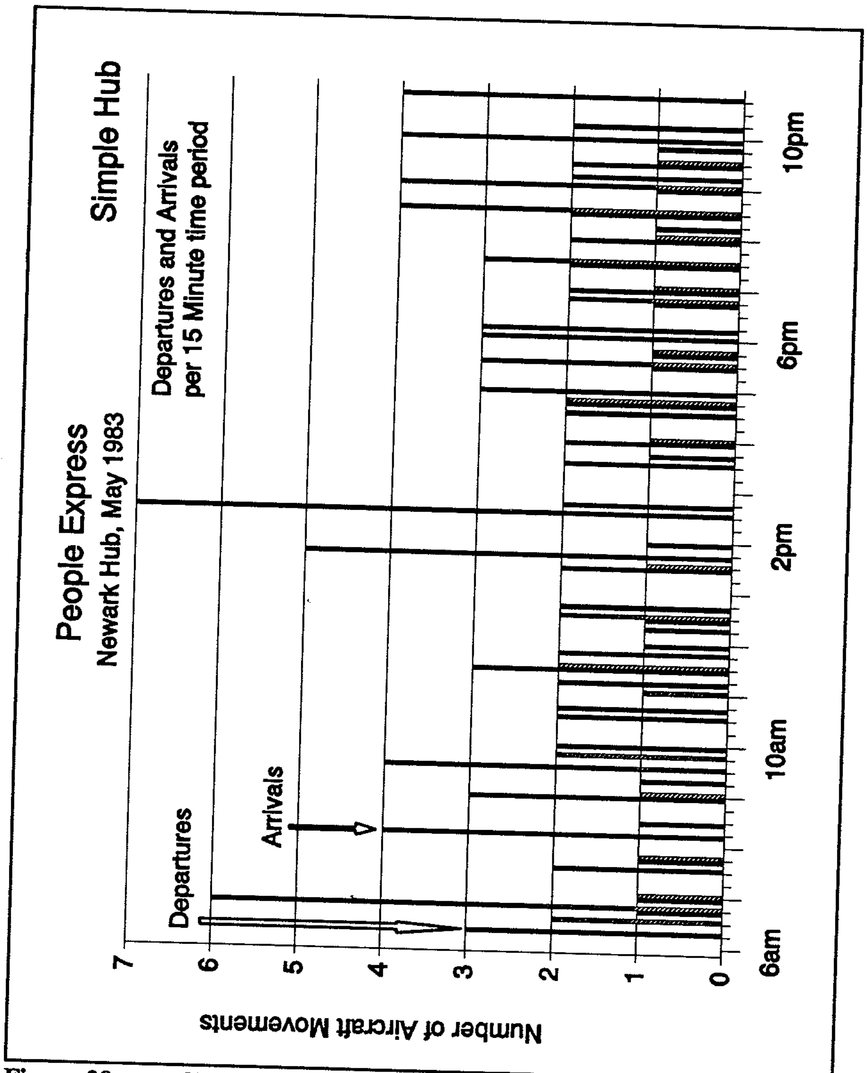


Figure 29: Simple Hub and Spoke Scheduling Pattern



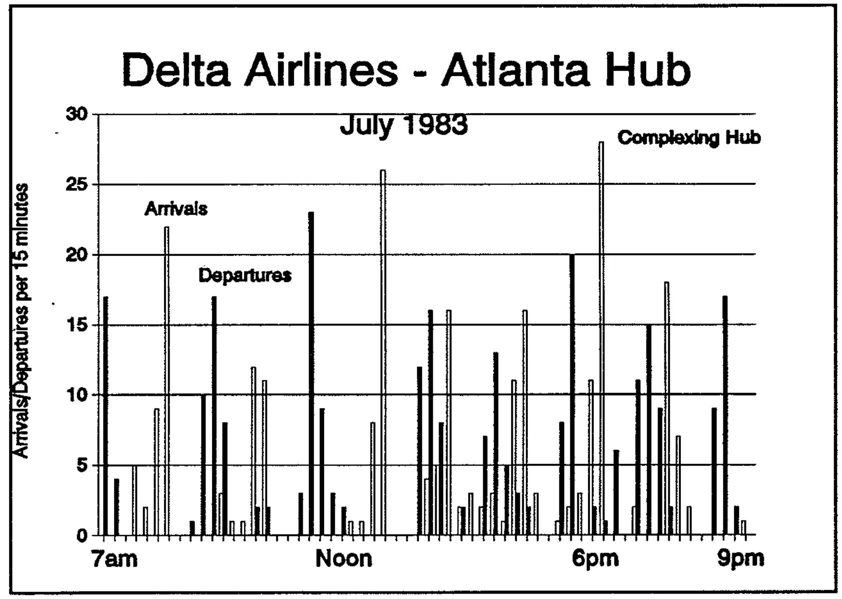


Figure 30: Complexing Hub and Spoke Scheduling Pattern

between complexes. If the airport is congested, the timing and performance of the complex can be affected. This in turn can ripple down the system, especially if the carrier operates multiple hubs.

**Directional Hubs.** The hub and spoke network in Figure 27 shows that it would be possible for a passenger to fly from City E to City F via the hub, H. This would require much backtracking, and if competing service is available (and since deregulation it probably is) passengers are not likely to choose ABC Airlines. Theoretically, passengers boarding in city E can travel via the hub to 8 other cities (including the hub), and thus 8 city pairs are served from E. In reality, because of the backtracking problem, only subset of these will be "viable" city pairs. Recognizing this, some airlines operate "directional" hubs. Such carriers choose to operate only that set of routes which generates a large amount of connecting traffic at the hub. These tend to be routes which operate in east-west or north-south orientations, but not both. Routes in a

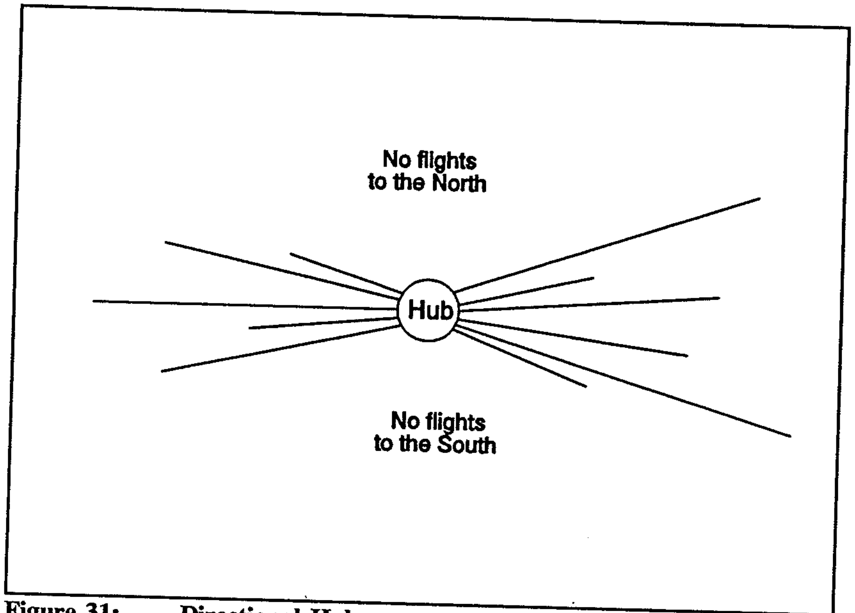


Figure 31: Directional Hub

perpendicular direction tend not to be viable. For example, a passenger travelling from Kansas City to Seattle is not likely to hub through Chicago, but may be willing to travel via Denver.

**Figure 31** shows an example of a directional hub, east-west in this case. In this example it is assumed that the airline only has six gates at the hub airport. If a carrier is constrained to a given number of gates at the hub, a directional orientation is likely to maximize the number of potential connections between flights, and thus increase the carrier's revenues.[82] Stations North or South of the hub either are not served by this airline or, alternatively, are served via another hub operated by the airline. American Airlines operates

[82] A complex in a directional hub is directional as well. E.g., flights are timed so that a bank of inbound flights from the east converge in a complex, with the departure sequence being to the west.



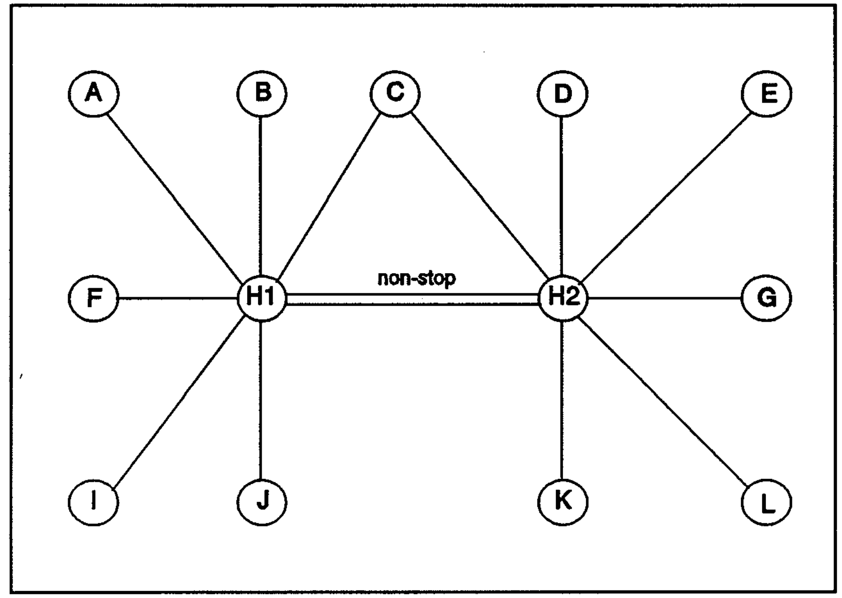


Figure 32: Multiple Hub System

predominantly east-west hub operations in Chicago and Dallas/Fort Worth, and North-South oriented hubs at Nashville and Raleigh/Durham. Of course, at a coastal hub like Raleigh/Durham it is not possible to operate with an East-West orientation, but Nashville could have been oriented in either direction.

**Multiple Hubs.** The discussion in the previous paragraphs indicated that some airlines will operate more than one hub. Typically, these are serving different regions. As in the previous section, these could also be directionally oriented. In the American Airlines example, Raleigh/Durham serves north-south markets on the east coast, while Nashville serves north to south in the midwest. **Figure 33** shows one type of multiple hub network. Notice that the hubs are linked by frequent non-stop flights, and that a few spoke stations will be linked to each hub. **Figure 32** shows another example of multiple hubs; this one linking stations in the north east quadrant with both an east-west hub at H1 and a north south hub at H2. This arrangement is common for the large network

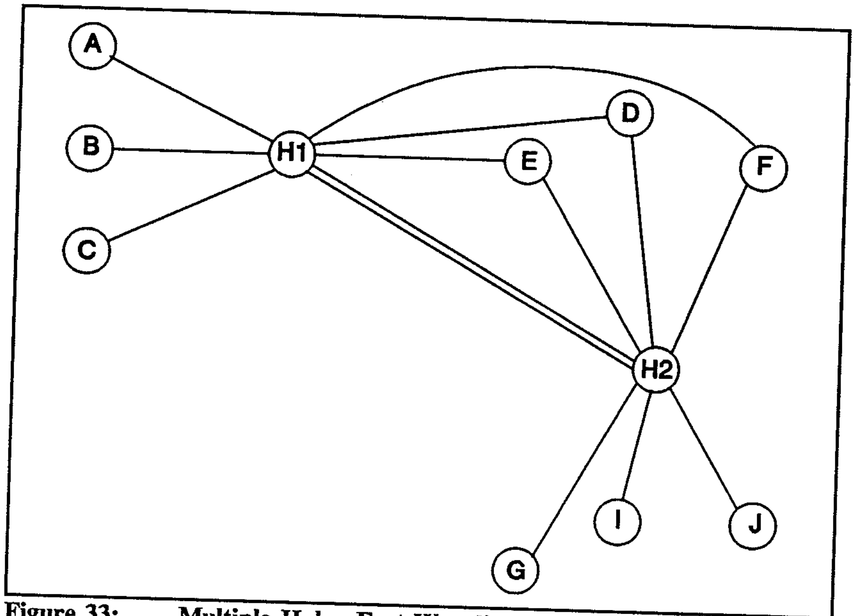


Figure 33: Multiple Hubs: East-West linked to North-South carriers.

## C. Feeder Traffic and Its Importance

**Extending Market Coverage.** Section III.D discussed how consumers prefer to patronize carriers offering service to a large number of communities. There were three reasons for this. First, it is easier for consumers to gather information from a single large airline than from many small airlines. Second, the consumer often perceives the large airline as providing a higher quality of service in the sense that connecting flights are better timed, there is a lower probability of baggage being lost, etc. Third, carriers have created marketing incentive programs, such as frequent flyer award plans, which create artificial incentives for the consumer to favour large carriers over small.



In order to extend the number of communities which they service, North American trunk carriers have developed "families" of feeder airlines. A feeder airline is one which operates small capacity, limited range aircraft. Typically, these aircraft are turbo-prop. They are ideally suited to serving low traffic points, and/or points which are less than 45 minutes flying time in jets. With these properly sized aircraft, services to smaller communities are more economic. The improved economics allows for the provision of frequent air service. Thus, under deregulation, many communities may have witnessed a twice-daily jet service being replaced by a much more frequent service in small turbo-prop aircraft. The slightly longer flight times and noisier ride in smaller turbo-prop aircraft is more than compensated for by the convenience of frequent air service. The experience of both Canada and the United States has been that smaller communities have benefited greatly from the advent of the feeder carrier. Services which had been previously dropped by trunk carriers are now once again viable. A community which previously had a sole air carrier serving it may now find competing air services are available.[83]

While it would be possible for a trunk carrier to operate such turbo-prop aircraft itself, in practice this is not done. One reason is that turbo-prop operations are significantly different from jet operations. Maintenance needs are quite distinct. Different types of training are required for pilots, flight crews and mechanics. Second, wage scales typically differ between turbo-prop operations and jet operations. Bringing turbo-prop operations into a unionized jet carrier could result, through the collective bargaining process, in relatively high wage rates being paid to turbo-prop crews. This, in turn, reduces the economic viability of many feeder routes. Third, trunk carriers appear to prefer that a feeder operation be managed by a local entrepreneur who closely monitors developments in local markets. The typical executive rotation in large trunk air carriers could make it difficult to maintain the consistency required for good market intelligence.

**Importance to Trunk Carriers.** These feeder operations are of great importance to trunk air carriers. On the surface, it may appear that feeder

[83] NTA (1989) reports that "in Canada, the proportion (of city pair markets) served by two or more competing carriers rose from 44 percent to 77 percent between 1983 and 1987." (p. 30). For example, see Vellenga and Vellenga (1986) for evidence from the U.S.

traffic is of minor importance to the trunk carrier. For example, a feeder flight (with a 40-passenger aircraft and 30 arriving passengers) might hand over only 20 passengers for connections to its affiliated trunk air carrier. These 20 connecting passengers might be spread over 10 flights for an average of only two each. Considering that the trunk flights may be operated on aircraft of 100-400 seats, this traffic may seem to be of minor importance. However, this is not the case. The trunk carrier has already committed to operating the jet flights, and the addition of the few feeder passengers will not motivate it to offer any additional flights. Thus, the cost of operating the trunk flights should be viewed as sunk (or fixed) from the point of view of the incremental traffic from the feeder air carrier. Any revenues it gets from connecting feeder passengers are almost pure profit.[84] If two trunks are competing in a market, operating the same number of flights with identical-sized aircraft, the one which gets an additional two passengers per flight from a feeder carrier will experience higher profits. Revenues from feeder passengers translate almost directly to the bottom line.

In addition, there is a greater tendency for feeder airline passengers to be paying full fares. Consider the Kingston, Ontario to Toronto market. A Kingston family planning a vacation trip to Vancouver are unlikely to fly from Kingston to Toronto, but rather will drive to Toronto and pick up a flight to Vancouver. This family would undoubtedly be flying on a heavily discounted airfare. In contrast, the person most likely to use the Kingston to Toronto air service is the business flyer, who is likely to be paying a full airfare. Thus, not only do feeder passengers contribute directly to the trunk air carrier's bottom line, but they are more likely to be high fare paying passengers as well. Thus, there is a double leveraging of the impact of the feeder passenger on the profitability of the trunk air carrier.

Airlines have attested to the importance of feeder traffic. One U.S. jet airline president stated that the traffic from its feeder airlines provides only 5 percent of its total jet traffic, but that this traffic accounted for all of its profits. In Canada, Wardair's experience provides a further illustration of its importance.

[84] The trunk carrier will incur minor costs for an additional meal, some additional flight cruising fuel, etc.



Wardair only operated services between the major Canadian cities. Since it had no feeder carrier affiliates, it was essentially locked out of the feeder traffic market. In its last month of operation, Wardair proposed paying the entire cost of a feeder airline flight to any passenger who connected to an ongoing transcontinental Wardair flight. As Wardair had to pay the full retail price of the ticket to the feeder carriers of its competitors, this shows how important the incremental profits from feeder passengers can be.

**Ownership.** It was in the U.S. (where deregulation occurred first), that the first formal alliances between feeder and trunk carriers were developed. Typically, a trunk carrier contracts with only one feeder airline in each region it serves. The trunk carrier can be viewed as having a family of feeder carriers, one for each region. In the early days of deregulation, the trunk carriers used various marketing agreements to formalize the links with the independent feeder carriers. However, several trunks experienced their feeder carriers changing loyalty to a rival trunk carrier. This left them with no feed traffic in a particular region, and given the limited number of feeder carriers which any given market can support, the trunk carrier would have little prospect of finding a new source of feed traffic. Subsequently, the trunk carriers began to forge more stable links with the feeder carriers by taking equity positions in their affiliates. At first, minority rather than majority positions were considered to be ideal. With a minority position, airline unions would not be able to petition for common employer status and thus gain access to the more generous collective bargaining agreements of the trunk carriers. In addition, it was felt that a local entrepreneur, with a majority ownership of the feeder carrier, would be more vigilant in keeping costs under control, staying abreast of changing market conditions, etc. Over time, however a few carriers started to develop majority and eventually complete ownership positions in their feeder carriers.[85] In Canada, Canadian Airlines International Limited (CAI) found that one of its minority-owned feeder carriers, InterCanadian (formerly Quebecair and Nordair Metro) could defect, in spite of a minority ownership stake, and set itself up as an independent, rival carrier. Following the InterCanadian defection, both Air Canada and CAI have moved to take majority equity positions in many of their feeder carriers.

[85] For example, the American Eagle carriers are almost wholly owned by American Airlines.

**Summary.** In summary, although a small proportion of a trunk air carrier's total operation is represented by feed traffic, it has a highly levered impact and has thus become of vital importance to the modern trunk airline. Feeder traffic contributes directly to revenues and little, if at all, to trunk airline costs. Thus, feeder traffic represents incremental profit to the trunk airline. Furthermore, feed traffic has a tendency to be full-fare. Today, every major trunk air carrier in North America has a family of feeder carriers extending its reach into the smaller communities.

## D. International Carrier Alliances: Another Form of Feed Traffic

Just as feed traffic from small local airlines is important to a trunk carrier's mainline profitability, traffic obtained from international flights is also important to the profitability of the domestic system. International flights arriving in Toronto, for example, will have a certain number of passengers who will connect to domestic flights segments. The number of such connections is usually not sufficient to justify additional domestic flights. Thus, any incremental revenues from the international feed traffic will accrue to the domestic trunk carrier as incremental profit. Because of this, and because consumers prefer to do business with a single airline, carriers have been increasingly attempting to forge alliances with international airlines in order to feed their domestic networks.

In general, carriers will strike alliances with international carriers who complement their services. For example, Air Canada, which does not fly to Hong Kong, has a marketing agreement with Cathay Pacific. This agreement benefits both carriers. Cathay receives traffic which Air Canada collects on its domestic system, some of which might have gone via Cathay's rival CAI, or via a rival U.S. carrier. Air Canada benefits from receiving overseas traffic in Vancouver, some of which normally would have gone to its rival, CAI.

Sometimes, a carrier will strike an alliance with an international airline who would appear to be its competitor. For example, CAI has an agreement with Lufthansa Airlines. While both compete for traffic from Western Canada to Germany, CAI is able to feed traffic to destinations beyond Germany to



Lufthansa, and similarly use Lufthansa to gather traffic from other countries it does not serve to its flights from Frankfurt to Western Canada.[86]

There are a number of different forms which international carrier alliances can take. These are discussed in Sections VII.C below. Before finishing this section, it is appropriate to point out a major difference between international feed traffic versus domestic, small community feed traffic. The latter tends to have a high portion of travellers paying high airfares, thus leveraging the impact on the trunk carrier's profitability. In the case of international feed alliances, there tends to be no disproportionate amount of traffic flying at full fares.[87]

## E. Technology

Air traffic route patterns are highly dependent on aircraft technology. Perhaps the two most important aspects of technology in this regard are the range and capacity of aircraft. In the past few years, a number of new aircraft have appeared which are starting to change airline routings, and additional aircraft are on the drawing boards. On the distant horizon, some major breakthroughs in technology may be possible.[88]

**Recent Aircraft.** Prior to the 1980s, aircraft travelling overseas were required to have a minimum of three engines. For this and other reasons, most overseas markets were served by one of the following long-range aircraft types:[89]

- Very high capacity aircraft, such as the 747-200

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[86] In this particular case, CAI and Lufthansa codeshare. Since neither airline is able to offer daily service, they alternate days, and list the other's flights as being their own.

[87] International feed traffic is sometimes referred to as flow traffic.

[88] This section does not consider aircraft developments such as advanced turbo-prop aircraft, which are not expected to be used in intercontinental service. Nor does it cover technological developments for ground services (such as electronic scanning baggage flow systems) or air traffic control.

[89] Source: *Aviation Week and Space Technology,* 20 March 1989, pp. 137-191.

(Typical Range: 11,000km/7,000miles; typical payload: 350-450 passengers)

- High capacity aircraft, such as the DC-10-30 and L-1011 (Typical Range: 9,700km/6,000miles; typical payload: 300 passengers)

- Medium capacity older aircraft types, such as the DC-8-63 (Typical Range: 8,000km/5,000miles; typical payload: 250 passengers)

- Small capacity supersonic aircraft (Concorde) (Typical Range: 6,100km/3,800miles; typical payload: 100 passengers)

In the 1980s, a series of decisions by ICAO, the U.S. FAA, Transport Canada, etc., enabled the use of new design twin engine aircraft for overseas markets. The importance of these decisions is that aircraft of smaller capacity could now be used. This, in turn, allowed the provision of frequent service (such as daily service) in what were formerly considered to be thin markets. Thus, many medium-sized communities are now receiving direct air service to foreign destinations. Previously, these communities were serviced indirectly, via the major gateway hubs. A typical aircraft in this category is the B767-200-ER (extended range), with its 9,500km/5,900mile range, capacity around 170 seats, and attractive operating costs.

Another new aircraft is the B747-400. This aircraft increases both the range (to just under 13,300km/8,000miles) and capacity (to 500) of the very high capacity aircraft. The 747-400 is now capable of stages such as Toronto-Tokyo, with very high loads.[90] The extra range is making new non-stop services viable. As with the new small capacity aircraft, a consequence is that former gateway airports are seeing diversion of their traffic base.

[90] An earlier aircraft, the 747-SP had a longer range than the 747-200 (12,300 km/7,600 miles), but also a smaller capacity (275-350 seats).



Finally, there are a number of new long range aircraft in the medium to high capacity range. Foremost among these are the MD-11, Airbus 340, and Boeing 777. To a certain extent, these are replacements for older versions of existing high and medium capacity aircraft, although the improved engine economics are extending their ranges and/or capacities. The MD-11 is a replacement for the older DC-10 and L-1011. It has an operating range of 12,900km/8,000miles and a capacity of around 370 seats. The A340 (290 seats, 11,300km/7,000miles) and the A330 (350 seats, 8,000km/5,000miles) are replacements for the older medium range DC-8 type aircraft, or the high capacity aircraft such as the L-1011/DC-10.

**Speculative Aircraft.** Aircraft manufacturers are contemplating new "stretches" of existing aircraft, such as the 747 and DC-10/MD-11. McDonell-Douglas already has a proposal for a full length double deck aircraft dubbed the MD-12. Boeing believes a full-length double-deck 747 is possible. This aircraft could carry in excess of 600 passengers, with very attractive operating costs. Airbus is considering an "A-350" design which would have very large capacity.[91] All of these aircraft are considered to be possible with existing technology.

Another potential aircraft is a replacement for the now aging Concorde. Most replacement strategies would increase capacity to a minimum of 200. The low capacity of the existing Concorde (just over 100 seats) has resulted in poor economics for this aircraft. Noise will continue to be a concern for aircraft of this type at supersonic speeds.

More speculatively, two radically new types of aircraft are being considered. One would be of very high capacity, perhaps 1000 passengers per flight. Flying wing designs have been suggested for it. The other would be a hypersonic aircraft. This aircraft would likely achieve suborbital flight. Flying times of one hour Toronto-Tokyo could be possible.[92] The suborbital nature of the aircraft could eliminate the supersonic noise problem. For both of these

[91] 700 Passengers with 11,200 km range. *Vancouver Sun,* 24 December 1990, P. E11.

[92] "A Long Wait at the Spaceport," *The Economist,* 3 September 1988, p. 26-27.

radical types, existing airports would not likely be able to accommodate the new services. Runway length and parking space at gates are both a factor here.

## F. Airline Scheduling

Airline scheduling can be broken up into two components. The *flight schedule* indicates the times that flights are offered to airline consumers. A number of factors go into determination of the flight schedule and these are discussed below. *Aircraft assignment* is a second phase of scheduling.[92] This is the process of assigning specific aircraft to specific flights on a given day. This is a difficult process as time must be allowed for required aircraft maintenance, yet full productivity of the aircraft is desired.

Airline scheduling is of critical importance to the airline for both marketing as well as cost reasons. On the cost side, improper scheduling can result in the need for more aircraft and groundside crews, more gates at airports, and low fleet utilization resulting in high capital costs. On the marketing side, improper scheduling can result in a competitor taking market share with more attractively scheduled airline services. Scheduling which is too tight can result in flight delays and missed connections, lowering the marketing power of the carrier. On the other hand schedules with too much slack in them result in higher costs. The airline scheduler has a challenging problem in finding the optimum way to operate the airline.

**Flight Schedule.** Perhaps the most important factor in determining the airline's flight schedule is customer preferences. **Figure 34** shows that consumers have preferences for early morning and early evening flights. These are convenient times as they maximize productivity of individuals. The morning peak is at 8 a.m. with an evening peak running from 5-7 p.m. There is a "shoulder" during the middle of the day, and after 10 p.m. traffic drops off rapidly, almost disappearing during the late night.[93,94]

[92] In practice, there is interaction between aircraft assignment and flight schedule development.

[93] An important exception to this are the so-called *redeye* flights which generally consist of departures from the west coast around midnight with arrivals in the midwest and east coast around 7-8 a.m.



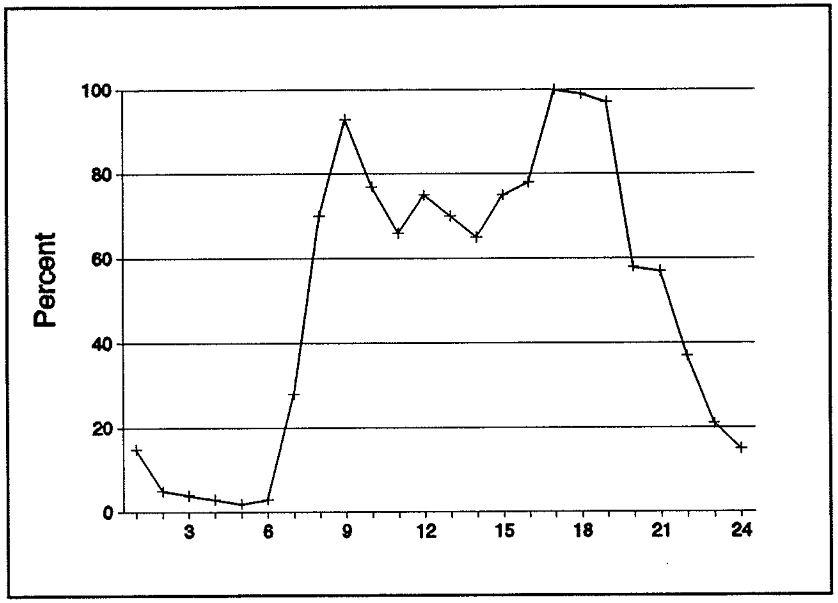


**Figure 34: Hourly Traffic Pattern**
**U.S. Airlines, 1969 Survey**
**Hourly Traffic as % of Peak Hour Traffic**

**Figure 35** shows that consumers also have a preference for flights on certain days of the week. Thursday and Friday are attractive flight times, as they allow the business traveller to return to home and office at the end of the week, or to allow leisure travellers to depart at the end of their work week. Sunday is also a popular time as it allows business travellers to leave home to be ready for business appointments the first thing Monday morning, and to allow leisure travellers to return home prior to the commencement of a new work week.

[95] Data for the figure were obtained from 1969, a period prior to deregulation, and thus are more likely to reveal actual consumer preferences. Data taken after deregulation would distort preferred travel patterns as some consumers are induced by discount air fares to travel during an off-peak period.

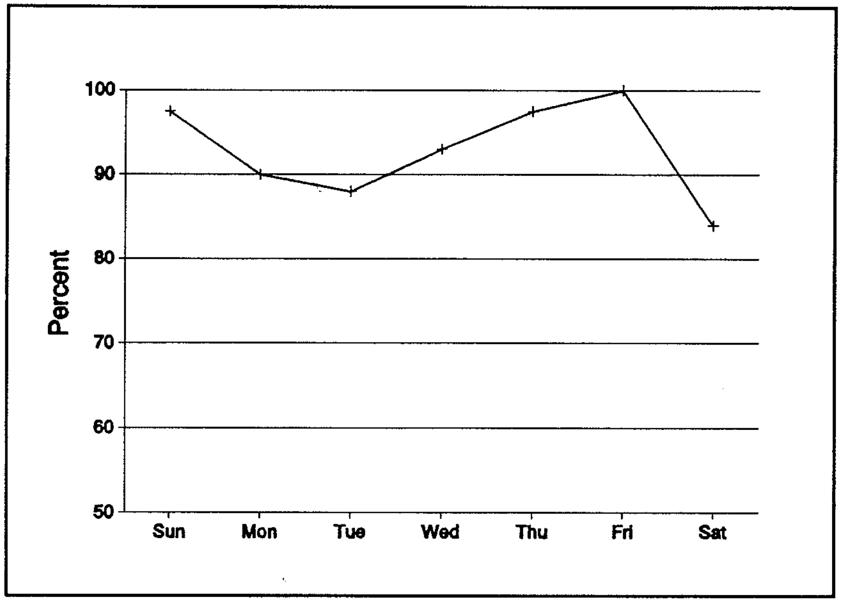


**Figure 35: Weekly Traffic Pattern**
**U.S. Airlines, 1969 Survey**
**Daily Traffic as % of Peak Day Traffic**

**Figure 36** shows traffic patterns for a particular airline during the months of the year. This pattern is fairly typical of many carriers. July and August are peak travel times, primarily due to an influx of leisure travellers. There is a sub-peak some time in the March to April period reflecting a slight increase in travel during the Easter period.[96] Traffic at many airlines drops dramatically during the winter period, although there is often an increase during the December-January period for those travelling for Christmas and the western New Year.

[96] Travel patterns will vary of course by continent, culture combination and airline. As an example, carriers in Islamic nations do not experience an Easter uptake in traffic, but have noticeable increases in traffic during the Hadj season.



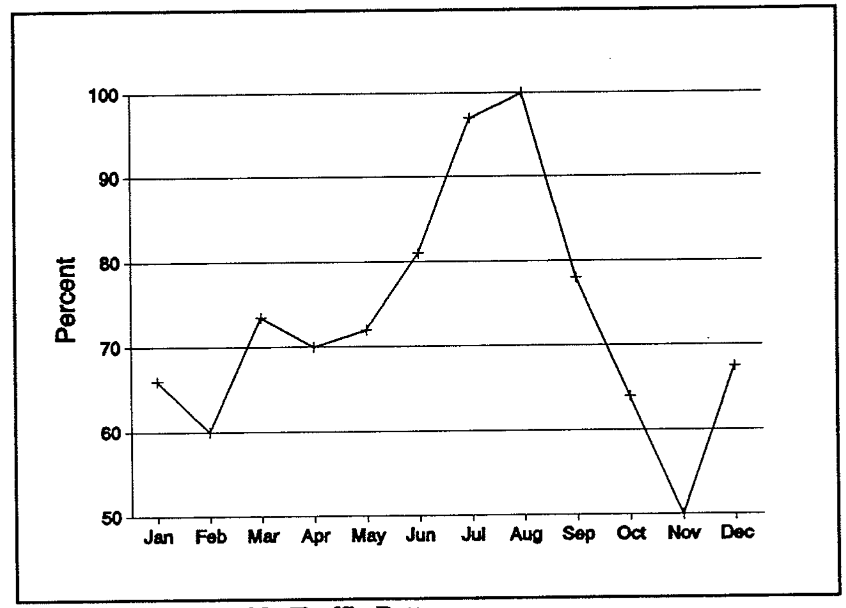


**Figure 36: Monthly Traffic Patterns**
**Air Canada, 1982**
**Monthly Traffic as % of Peak Month Traffic**

Passengers are not the only consumers of airline services. Air cargo is also an important source of revenue for carriers. Unfortunately, the schedule preferences of cargo shippers differ from those of passengers. Cargo shippers prefer to have nighttime services, as that allows them to spend an entire day preparing the shipment. They want to offer the shipment to the airline for transportation at the end of the day, and wish that their customer will receive it first thing in the morning. Because of this, dedicated cargo carriers such as Federal Express, have emerged. These cargo carriers operate flights in the late afternoon and early evening to meet the needs of shippers. While attempts have been made to schedule night passenger services to coincide with express air cargo traffic, it is rare.

**Traffic Imbalance.** It is safe to say that most airline passengers purchase round-trip tickets.[97] This means that there will roughly be an equal number of people flying to a particular destination as will be flying from it. Nevertheless, there can be day-to-day imbalances in traffic flows. Years ago, when transatlantic traffic was dominated by North Americans travelling to Europe, flights would be full in the early summer carrying passengers from North America to Europe, but the return flights would be relatively empty. At the end of the summer, just the opposite would take place, with flights in August returning to North America full and departures from North America empty. Imbalances can also exist on travel to and from conventions, special sporting events such as the Super Bowl, etc.

Another form of traffic imbalance is due to particular legs of a flight being more popular than others. Consider the example of an airline flying from Vancouver to Kamloops to Prince George in British Columbia in **Figure 37.** Vancouver is a city with a large traffic base. Both Kamloops and Prince George are much smaller communities, but Kamloops has popular ski hills. The aircraft flies from Vancouver to Prince George with a stop in Kamloops. The carrier may find it easy to fill up the aircraft with Vancouver-Kamloops passengers, but the consequence may be that the Kamloops-Prince George section of the flight would be empty. While it might be suggested that the airline should operate a different aircraft on the Kamloops-Prince George sector, this may not be possible, because of the lack of such an aircraft in the carrier's fleet, the inability to position such an aircraft at the right place, the low utilization of the plane, etc.

Finally, there can often be advantages to moving a flight schedule by just a few minutes relative to the competition. One U.S. airline, for example, has a policy of "sweeping the clock" by moving its flights five minutes prior to departures of a competitor. This airline has found that in its air markets,

[97] Cargo is uni-directional and significant cargo traffic imbalances exist. One consequence is that it is difficult to build an international all-cargo service under the existing bilateral air treaty system. While there may be sizeable traffic flows from country A to country B, the backhauls may be empty. A viable service may be to fly A to B, B to C, then C back to A. However, an airline of country A would not in general be allowed to fly from B to C.



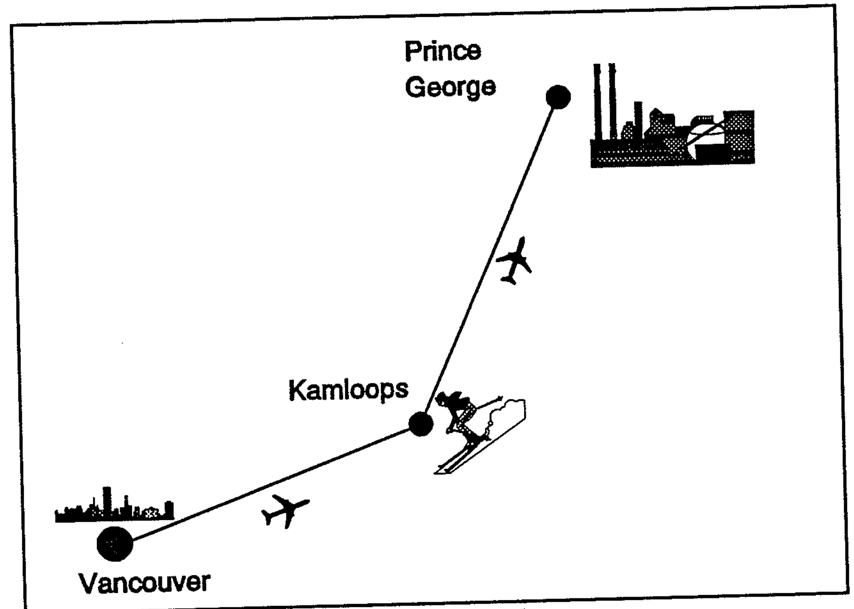


**Figure 37: Flight Leg Imbalance Example**

consumers have a preference for the slightly earlier flight.[98]

**Time Zones.** Another important aspect of airline scheduling is that of *time zones*. We have seen that evening departures are generally preferred by airline consumers. In the case of a flight from New York to Los Angeles, a 6 p.m. departure would arrive at 8 p.m. in Los Angeles. This is a 5 hour flight, but the 3 hour gain from crossing three time zones creates an arrival at an attractive time. However, in the opposite direction, a 6 p.m. departure would be highly undesirable. In this case, a 6 p.m. departure with a 5 hour flight

[98] The reader is cautioned that this effect can vary by market and time of day. For example, at the end of the day flights leaving five minutes after another airline's may be desirable as it allows the passenger a little more flexibility in the case of rush hour traffic delays, etc.

results in an arrival at 2 a.m. in New York (because of the gain of three time zones).[99]

To illustrate the effect of time zone differences, and to give a simple example of an airline scheduling problem, consider the Vancouver-Toronto market. Passengers in Vancouver, a city on the west coast of Canada, would likely prefer departures at 9 a.m, 1 p.m, 4 p.m. and midnight. The 9 a.m. departure would arrive in Toronto at roughly 4 p.m.,[100] giving the business traveller time for an evening appointment or the leisure traveller time to reach their destination and settle in. The 1 p.m. Vancouver departure would arrive at 8 p.m. This is attractive as it allows the traveller to spend half a day in the office the morning before her departure. The arrival is at a convenient time, allowing the passenger to relax. The 4 p.m. departure allows the individual to work most of the day. It arrives at 11 p.m., somewhat late in the day, but still allowing time for an adequate night's rest. The midnight, *redeye* flight is attractive in that it allows a full day in Vancouver and a complete evening with family prior to departure. This flight arrives at 7 a.m., in time for a full day of work in Toronto.

At the other end of this market is Toronto.[101] Popular departure times in this market are 9 a.m., 1 p.m., 5 p.m. and 7 p.m. The 9 a.m. departure arrives in Vancouver at 11 in the morning, allowing a lunch meeting plus a full afternoon. The 1 p.m. departure allows a full morning's work in Toronto, and a late afternoon appointment after the 3 p.m. Vancouver arrival. A 5 p.m. flight arrives in Vancouver at 7 p.m., allowing most of the day in Toronto. A 7 p.m. departure arrives in Vancouver at 9 p.m. allowing a full day in Toronto.

Having determined the desirable departure times at each end of this route, the challenge for the scheduler becomes one of making the schedule work with as few aircraft as possible. **Figure 38** shows the various departure and

[99] Note that because of the prevailing winds at certain times of the year flights from east to west can be up to 1 hour shorter than flights from west to east.

[100] In the winter, an eastbound Vancouver-Toronto flight requires 4 flight hours, plus 3 hours due to time zone loss.

[101] In the winter the flying time westbound from Toronto to Vancouver is 5 hours less 3 hour gain from time zone differences.



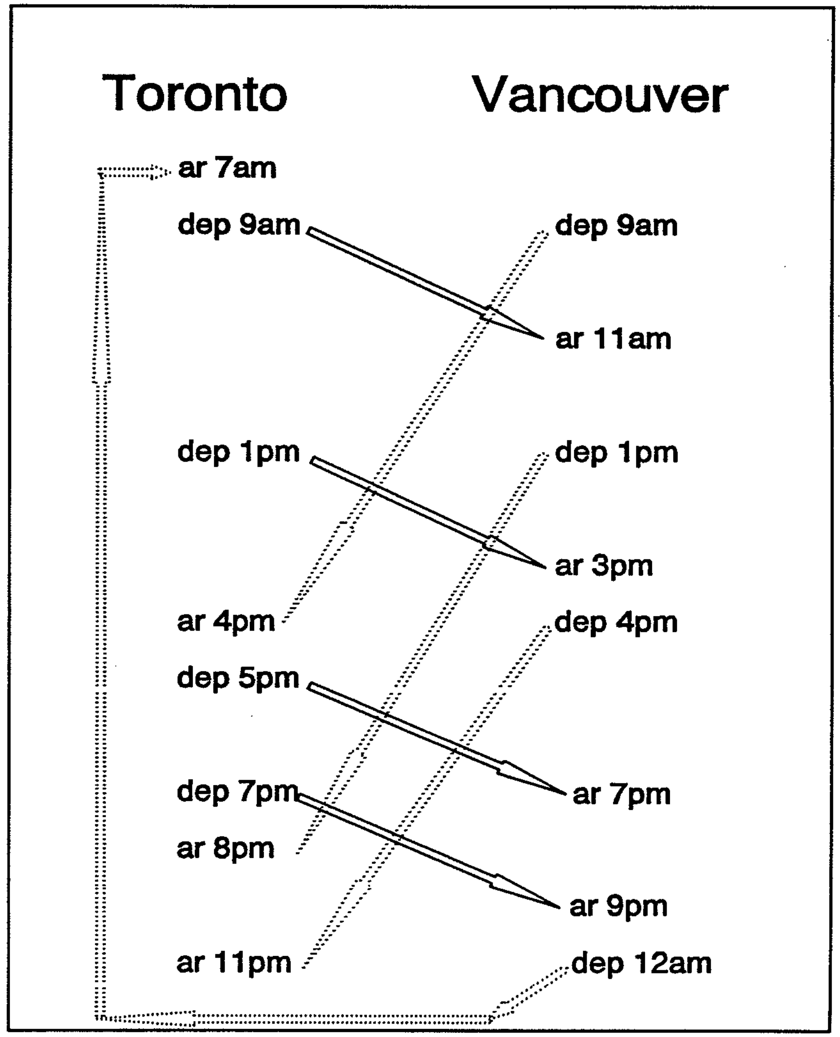


**Figure 38:** **Initial Schedule: Toronto-Vancouver Marked 4 Flights/Day/Direction**

arrival times in each of Toronto and Vancouver. The arrows show how a departure in Vancouver is linked to an arrival in Toronto and vice versa. The solution to this problem is in part the solution to the aircraft assignment problem. Altogether there are eight flight segments to be flown. This schedule can be operated with eight aircraft, one for each of the flight segments, but it is also clear that the schedule could be operated with four aircraft. For example, the departure from Vancouver at 9 a.m. arrives in Toronto at 4 p.m. This aircraft then can be used for the 5 p.m. Toronto departure arriving in Vancouver at 7 p.m.[102]

However, upon closer inspection, it is almost possible to operate this schedule with three aircraft. **Table 3** shows how three aircraft can be used to come close to operating the schedule. Aircraft 1, for example, is able to fly three flight segments during the day. The only major problem in the Table is that aircraft number three arrives from Toronto at 8 p.m. but is needed for a departure at 7 p.m. This problem would be resolvable if it is possible to adjust a) the 1 p.m. Vancouver departure to an earlier time, perhaps at noon; and/or b) adjust the Toronto departure time perhaps to 8 p.m. If this is possible, only three aircraft are needed to fly the schedule.

This example shows how the requirements of aircraft assignment need to interact with the desired flight schedule (developed by the marketing department) in order to balance cost and realities of what can be done with a given fleet.

**Airport Constraints.** Another aspect of scheduling is to recognize various constraints at airports. Some airports, such as Toronto, have restrictions between 11 p.m. and 7 a.m. During these hours, aircraft operations are generally not allowed.[103]

[102] One problem with this particular routing is that it may not provide adequate "turn-around" time in Toronto between the arriving flight and the departing flight. Time is needed to service the aircraft (refuel, restock food supplies, clean the aircraft, etc.), as well as to allow time to deboard and reboard the aircraft, in time for a contingency in case bad weather or other circumstances delay the inbound flight from Vancouver.

[103] In some cases, arrivals with the very quiet Stage 3 aircraft are allowed during curfew periods.



| Aircraft | Flight Segments | | | Notes |
|---|---|---|---|---|
| 1 | dep | Van | 9 a.m | |
| | arr | Tor | 4 p.m. | |
| | dep | Tor | 5 p.m. | |
| | arr | Van | 7 p.m. | |
| | dep | Van | 12 a.m. | A/C #1 positioned for A/C #2 or #3 sked next day |
| | arr | Tor | 7 a.m. | |
| 2 | dep | Tor | 1 p.m. | |
| | arr | Van | 3 p.m. | |
| | dep | Van | 4 p.m. | A/C #2 positioned for A/C #3 or #2 next day |
| | arr | Tor | 11 p.m. | |
| 3 | dep | Tor | 9 a.m. | |
| | arr | Van | 11 a.m. | |
| | dep | Van | 1 p.m. | |
| | arr | Tor | 8 p.m. | } sked must be changed |
| | dep | Tor | 7 p.m. | |
| | arr | Van | 9 p.m. | this A/C positioned for A/C #1 sked |

**Table 3: 3 Aircraft Solution to Toronto-Vancouver Schedule**

Another set of airport restrictions affecting airline schedules is due to chronic congestion at airports. Four U.S. airports are slot constrained in the sense that slots, a particular time when an airline can perform a takeoff or landing operation, have been assigned to airlines via a lottery or auction. For example, Airline A may operate a flight into Chicago's O'Hare at 9:05 a.m., and wishes to move this flight to 9:20. But this may not be possible, if it does not have a 9:20 a.m. slot.

In addition to the slot congestion costraint, many airlines face problems with availability of gates for loading and disembarking passengers. The section on hub and spoke systems discussed the concept of operating banks or complexes of flights. A carrier may wish to add flights to a complex, but be unable to do so because additional gates for accommodating the aircraft are not available.

**Aircraft Assignment.** Once the flight schedule has been developed, the next step for the airline is to assign a particular aircraft to fly a particular flight in the schedule. This process is referred to as aircraft assignment. The previous subsection discussed the problem of time zones and used the example of four flights per day in the Vancouver-Toronto market. An initial flight schedule was developed and a solution was found requiring only three aircraft to perform the set of four daily round-trip flights. As is typical in the real world of airline scheduling, the solution with three aircraft required some adjustment in the original flight schedule.

When assigning aircraft flights, an important consideration is the scheduling of adequate "downtime," (time when the aircraft is not available for flight) to perform required heavy or light maintenance. Typically, maintenance requirements are stated in terms of maximum times between maintenance.[104] However, waiting until the last moment to do the maintenance is not always possible, as the aircraft might not be at a maintenance base. A solution to this scheduling problem is to perform the maintenance earlier than necessary, utilizing time when the aircraft would not have been useful for scheduled flights. For example, aircraft whose four year heavy maintenance is due in August,

[104] Time must also be available for refurbishment or reconfiguration of the aircraft.



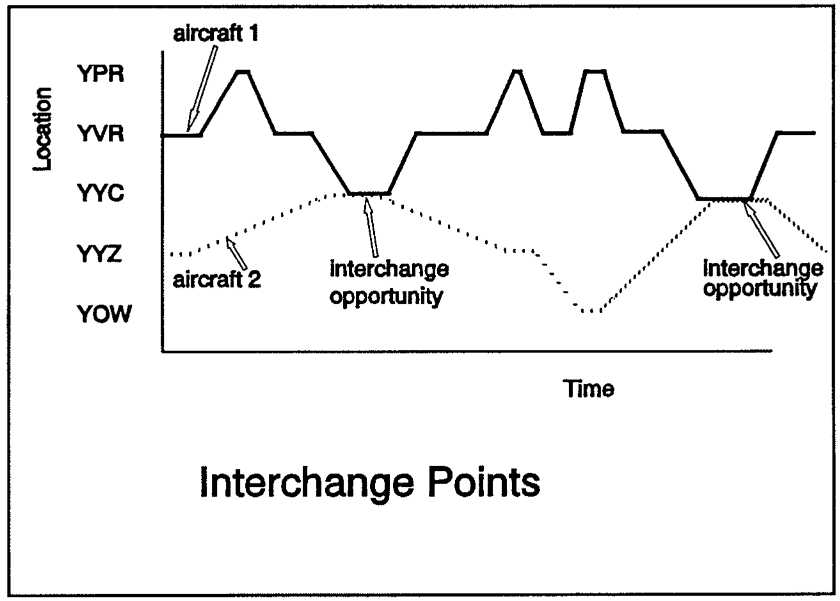


**Figure 39: Interchange Points**

might have that maintenance done at a slow period in March. This is an attractive solution in the sense that the aircraft is available during the peak months. In another sense it is unattractive since the costs of the heavy maintenance are being incurred earlier than would be required, and as a result the total number of flight hours over which the maintenance cost can be amortized is reduced.

In scheduling aircraft assignment, airlines often attempt to develop frequent "interchange" points. An interchange point is a time and place where two aircraft of an identical configuration cross paths. This creates an opportunity for one of the aircraft to be substituted on to the other's schedule. **Figure 39** gives an example of an interchange point. Here there are two aircraft. Aircraft 1 starts at Vancouver (YVR) and flies to Airport YPR, then cycles back to Vancouver, then down to Calgary (YYC). The dashed line represents Aircraft 2, which starts in Toronto (YYZ) and flies to Calgary. As can be seen by the time and location plot, both Aircraft 1 and Aircraft 2 share time in Calgary. If Aircraft 2 requires servicing, and if the service is normally done at YVR, then Aircraft 2 can be switched in Calgary to follow Aircraft 1's schedule and vice versa. The next time Aircraft 2 (now flying Aircraft 1's schedule) arrives in YVR, the service can be done. Aircraft 2 continues on Aircraft 1's originally assigned route until the two aircraft again interchange in Calgary. At this point the two aircraft can return to their regular cycle.



# Chapter 7

# Other Issues

## A. Infrastructure Problems in Air Traffic Control and Airports

**Public Infrastructure.** Among the various modes of transportation, economists distinguish between those which provide all of their own infrastructure versus those which make use of public infrastructure. Railroads, in addition to providing their own vehicles (locomotives and cars), also provide and maintain their own right-of-way infrastructure--the roadbed, rails and accompanying signalling and communications systems. The same is true for pipelines.

Airlines, buses and trucks use publicly provided infrastructure. In the case of buses and trucks, they make use of the public road system. The trucking and bus companies do not own the road system themselves; they are provided and maintained by various levels of government. Both trucks and buses do provide their own *terminal* facilities for the exchange of passengers or freight.

Airlines also use public infrastructure. Just as trucks and buses make use of publicly provided high*ways*, air carriers make use of publicly provided air*way* systems.[105] In addition, they also make use of publicly provided terminal facilities--airports. Carriers do not construct, own and operate their

[105] These are the navigation and communication systems used to regulate the flow of all types of air traffic.

own airports. Rather, various levels of government own and operate airports, which are shared by many airlines and other air transport users.

Because airlines make use of publicly provided facilities (at a fee, of course), the public infrastructure can often be a constraint on their own operations. An airline may wish to open a service to a particular community. However, if there is no space available at that community's airport, the entrant could be locked out of the market, either temporarily or for extended periods of time. Because of the public nature of the decision-making process at airports, expansion of facilities can often encounter significant delays. In addition, just as highways become congested, airways can become congested as well. When this happens, airlines can be restricted in their ability to operate, and the operations they are able to perform will be at a higher cost because of the congestion.

**Congestion and Shortage.** In general, throughout North America, there is a shortage of airport facilities, and a growing problem of congestion in the airways. At certain key airports in the United States and Canada, carriers' ability to take-off and land are severely restricted. The busy times of the day are divided into "slots," the period of time required to perform a single take-off or landing. Since carriers desire more slots than are available, they are rationed. Rationing mechanisms include lotteries (often used in the U.S.), scheduling committees (used in Canada),[106] and pricing (used in the U.K.).[107] The first two methods have been criticized for a number of reasons, among which are the difficulty of new airlines to get access to peak hour slots on a timely basis.

**Competitive Implications.** The shortage of adequate airport and airway capacity is not just an engineering operational issue. It also has important implications for competition among air carriers. Incumbent carriers have large advantages over new entrants in being able to launch new services.

[106] A scheduling committee consists of representatives of the airlines and other users of an airport. They try to work out among themselves who gets which slots.

[107] The U.K. charges significantly higher landing fees at peak times, giving incentives to carriers to move some operations to off-peak times.



Because they have already been allocated a large number of take-off or landing slots, or have historically been able to acquire adequate airport ticketing and boarding gate facilities, they have an advantage in mounting competitive responses to developments by rivals.

The issue of infrastructure constraints is very important for international air transportation. For example, a new bilateral treaty with Japan might give Canada the right to designate an additional airline. However, if that airline is unable to obtain a slot at the Japanese airport (or ticketing and gate facilities), it can be effectively prevented from competing in the market. As Canada discusses the issue of a more open-skies arrangement with the United States, the ability of Canadian air carriers to obtain access to slots, gates and ticket space is very important in determining whether or not the Canadian carriers will be effective in their ability to compete for their fair share of the traffic. Airport congestion is also a factor when carriers choose which airport they will serve.

## B. Entry Barriers

"Entry Barriers" is a term economists use to denote frictions which prevent new firms from commencing operations in a given market. This section discusses various types of entry barriers which might exist in the airline industry. Understanding them is important both for appreciating whether or not Canadian carriers will be able to compete with foreign carriers, and for understanding what types of service and access conditions it may be necessary to negotiate with foreign governments.

*Economies of scale* have often been considered a potential barrier to entry to small firms into an industry. Gillen, Oum and Tretheway (1986) measured economies in the Canadian airline industry.[108] They distinguished between cost economies of network size and cost economies of traffic density. Network economies would occur if adding additional cities to an airline network allowed cost per passenger to fall.[109] The evidence suggests that in the range

[108] Gillen, Oum and Tretheway (1986).

[109] This assumes that the amount of traffic per city is unchanged after the addition.

of carriers the size of Air Canada or Canadian Airlines International Limited (CAI), such economies do not exist.

*Economies of traffic density* would occur if cost per passenger drops when a carrier experiences an increase in traffic in a network of a given size.[110] Smaller carriers are likely to operate with higher unit costs, unless they can confine their service to a handful of cities and provide very large volumes of service between these cities.

*Airline hubs* are alleged to be barriers to entry.[111] Section II.F already discussed how hubs lever the effect of adding new stations. The example was given of how increasing the number of stations by 50%, from 9 to 14, increases the number of city pairs served by more than 100%, from 45 to 105. When applied to U.S. hubs, such as American's 100 city hub at Dallas-Fort Worth, the traffic generating potential of an additional city can be awesome. Relatively small amounts of traffic can justify frequent daily services. A new entrant to a city pair market connected to a major hub would be unable to replicate the network of the hub carrier, and thus would be confined to a small portion of the market. Air Canada has cited this as a problem it faces in competing with U.S. carriers in the transborder market.[112] On a route such as Toronto-Chicago, Air Canada is largely confined to Chicago originating/destining traffic. In contrast, its competitors, United and American, can access traffic from other cities connected to the Chicago hub and carry them through Chicago to Toronto.

An important potential barrier to entry is *control of the distribution channel*. If incumbent firms have complete control over the marketing channel, then new entrants could be excluded from the channel and thus, not be able to effectively sell their services. In some countries, there may be a single travel agent network, controlled by the national airline, and this control and market power could significantly hinder the ability of Canadian carriers to make sales.

[110] This would be because fixed station costs can be spread out over more passengers, larger sized aircraft could be used, etc.

[111] See Levine (1987), pp. 412-413.

[112] "Air Canada Submission to House of Commons Special Committee on Canada-United States Air Transport Services," Montreal, 6 December 1990. See especially pp. 9-14.



*Travel agent commission overrides*, when used by dominant carriers, may be a barrier to entry. A recent study by the U.S. Department of Transportation found that agencies will tend to look favourably on a small override commission from a dominant airline, which accounts for say one-third of its total bookings, than on a high override commission paid by a small, entrant carrier.[113]

In Canada, there are a large number (4,300) of travel agents who act as intermediaries in selling airline services to retail customers.[114] On the surface, this might suggest that the two dominant air carriers would not be able to control the marketing channel. However, travel agents are strongly influenced in their choices by the *computer reservation systems* (CRS) which they use. The fact that travel agents rely on a single CRS service to provide information on airlines,[115] combined with the fact that the two dominant Canadian carriers control the dominant CRS system in Canada, suggest that there may be potential for these two carriers to prevent or hinder access to the distribution channel for new entrants. While the issue of CRS dominance in Canada was resolved by a consent order between the Bureau of Competition Policy and Gemini (the CRS vender jointly owned by Air Canada, CAI and the U.S. Covia Corporation - which owns the Appolo CRS system[116]), the potential for such abuse must be recognized when contemplating how Canadian carriers will fare in other countries.

*Code sharing* can also be a barrier to a new entrant. With code sharing, a flight from A to B on Carrier 1 is shown in the CRS as a flight on Carrier 2.

[113] U.S. D.O.T. (1990), p. 28.

[114] In Canada, 70% of airline tickets are sold by travel agents. Source: "Statement of Grounds and Material Facts for the Application by the Director of Investigation and Research under Section 64 of the Competition Act," 3 March 1987, application between Director and Gemini Group Automated Distribution Systems Inc., et al.

[115] It is too expensive for any but the largest travel agencies to have more than one CRS system.

[116] For example, schedule A of the 7 July 1989 Consent Order stipulates that Gemini "shall not discriminate in providing access to the system to any carrier willing to pay the non-discriminatory fee and comply with the system vendor's customary terms" (p. 9). There are many other additional pro-competitive provisions in the consent order.

This can be important when that flight is combined with a Carrier 2 flight from B to C. The code sharing arrangement shows the A-B-C flight as being a "single carrier" service, which gets a higher priority on the CRS display than an "interline" service. As was revealed in Section V.A, the higher priority is quite significant in influencing the consumer's choice.

Tretheway (1989) describes how *airline frequent flyer programs* can act as a *powerful* entry barrier. This is because it is much easier and cheaper for the large network airlines to provide these programs than it is for entrants. Here in Canada, Wardair had great difficulty offering a frequent flyer program which could compete with those of Air Canada and Canadian Airlines International. Their original attempt in 1988 was terminated, as Wardair found it too expensive to operate. Following this, they made repeated statements to the financial community that they were going to produce a new frequent flyer program. The program which they eventually introduced in October 1988, offered awards at roughly twice the frequency of Air Canada and CAI, and rewards were of greater value.[117] As an example of the latter, with the Wardair program popular flights and travel times were not blocked out from frequent flyer award usage. Gillen, Stanbury and Tretheway (1988) point out that frequent flyer programs are not quantity discounts but rather loyalty inducing incentives. They thus conclude that these programs are anti-competitive and should be terminated if competition is to be encouraged.

Another potential barrier to entry is sometimes referred to as *vertical integration*. In the case of air transport, this would involve acquiring supplies (and distributors) of services needed by a carrier and its rivals. By controlling up and downstream markets, a carrier could exclude a rival from a market, raise its costs,[118] or indirectly control its actions.[119] There are may up/downstream

[117] One problem Wardair faced was that there were no partners left to join their program. With the exception of City Express, all Canadian airlines of any importance had already been affiliated with either CAI or Air Canada.

[118] By setting up high prices for wholly owned suppliers, a carrier can raise costs of a rival who must use that supplier. The offending carrier is simply transferring money from one wholly owned entity (the airline) to another (the supplier).

[119] For example, a carrier which owns a monopoly ground handling services firm can cause a rival to reschedule a flight by instructing the handler to say it is not able to provide the service at the desired time.



firms which a carrier (or its shareholder government, in some cases) could seek to control for anticompetitive purposes. These include travel agents and computer reservation systems on the distribution side; and fuelling firms, caterers, ground handling services, etc, on the supplier side.

One controversial type of vertical integration is *control of feeder carriers*.[120] In an important sense, feeder carriers supply passengers to trunk carriers. If an airline (or group of airlines) obtains exclusive access to feed passengers in a region, then it will have a larger traffic base than a rival carrier. The latter would be confined only to origin/destination passengers at the city.

A variation of this "control" of feed traffic has been put forward as an argument as to why simply liberalizing cross border traffic between Canada and the U.S. would harm Canadian carriers. Because they control all domestic feed to U.S. hubs (either via feeder carriers or via their own flights), the U.S. carriers can confine Canadian airlines to only origin/destination traffic at the gateway U.S. cities. While Canadian carriers could do the same in their own home market, the impact is much smaller. This is because Canada is both smaller and more concentrated than the U.S.[121] The largest seven cities in Canada account for 42% of the nation's population, whereas the seven largest U.S. cities account for only 19%. A U.S. carrier would only need to serve a handful of Canadian cities to be able to access much of the total traffic. In contrast, a Canadian carrier would need to serve scores of U.S. cities in order to have a similar access. A U.S. carrier can bring large portions of the U.S.

[120] Air Canada and CAI have been successful in purchasing most of the feeder carriers in Canada. (City Express is aligned with U.S. carrier Continental, while Intair is unaligned. Both of the "free agent" Canadian carriers are in precarious financial positions.) By preventing their feeder subsidiaries from signing interlining agreements or putting in joint fares with other carriers, CAI and Air Canada could be excluding new Canadian entrants from the domestic trunk airline routes for important segments of trunkline markets. Just prior to Wardair's demise, it announced that it was going to pay feeder airline fares for its passengers, at great expense, in order to get access to this important segment of the scheduled airline market. See "Wardair to Pay Commuter Fares for some Connecting Passengers," Globe and Mail, 18 January 1989, p.B10.

[121] The share of total population accounted for by the largest metropolitan area is 14% for Canada versus 5% for the U.S. The proportions accounted for by the largest 2, 3 and 7 cities are:

| | largest | largest 2 | largest 3 | largest 7 |
|---|---|---|---|---|
| Canada | 14% | 25% | 30% | 42% |
| U.S. | 5% | 8% | 12% | 19% |

market to its hub and then on to Canada. The Canadian carrier has no equivalent access to this vast U.S. market. In contrast, the U.S. carrier can access much of the total Canadian traffic from a handful of Canada's concentrated points.

A similar type of entry barrier involves *access to public infrastructure: airports and airways*. In some nations, airport facilities might not be available to new carriers, and takeoff/landing slots may be restricted. A hypothetical example could involve negotiating the ability for a Canadian carrier to fly to a new Japanese city, in exchange for the Japanese right to operate to a new Canadian city. The Japanese carrier might launch service immediately, while its rival Canadian carrier, although authorized, finds itself unable to obtain ticketing, gate or office space in the Japanese airport, and/or unable to obtain takeoff/landing authorization at the desired time. The Japanese carrier, due to its large presence at the Japanese airport, has no similar trouble. It already has gate, office and ticketing space. It may be able to get an additional slot, or in the worst case, simply reallocate a slot from a low profit route.

While not exhaustive, this list of entry barriers is illustrative of the problems a Canadian carrier could face when entering a new foreign market.[122] Individually, each of these can be quite serious. What is more important, however, is the cumulative height of the entry barriers. When designing a new bilateral negotiating policy, care must be given to negotiating the conditions under which our carriers will operate. This section closes with a comment, which although unsubstantiated and potentially a figment of its author's prejudices, illustrates the type of problems a carrier can face when entering a new foreign market:

> "Not only would Braniff face incredible governmental harassment in places like Hong Kong and Singapore, but in Seoul, South Korea, it would be fighting a rear-guard action against an unfriendly government that thought little of threatening the government-monopoly

[122] It also may apply to a new carrier attempting to enter domestic Canadian markets.



> travel agency system in South Korea with dire action if they booked passengers on Braniff instead of Korean Air Lines, and directing a campaign of outright thievery against Braniff operations at Seoul's Kimpo Airport. For instance, Braniff's 747's, when cleaned by ground crews contracted from Korean Air Lines, would regularly be stripped of all the paper products (including toilet paper) from the aircraft."[123]

## C. Globalization

In the mid-1980s, a wave of mergers swept the U.S. airline industry, resulting in the formation of roughly eight "mega-carriers".[124] Shortly thereafter, consolidation came to Canada resulting in the duopoly consisting of Air Canada and Canadian Airlines International Limited (CAI). Some consolidation is also taking place in Europe, with the merger of British Caledonian into British Airways, and the proposed acquisition of Air Inter and UTA by Air France. BA and Air France have joined what had been an exclusively American $7 billion club.[125] The question now is whether this consolidation movement will cross international borders. Will truly global carrier systems emerge? If globalization does come, what form will it take? Will there be outright mergers, or will the consolidation take the form of strong or weak carrier alliances?

Section 3.D discussed why consumers prefer to patronize large, rather than small, carriers. Carriers with large networks make it easier for the consumer to gather information on available flights and fares. Large network carriers are perceived by many consumers as providing a higher quality of

[123] Nance (1984), p. 127.

[124] These are United (US$8.8 billion), American (US$8.6), Texas Air - now Continental Holdings Inc. (US$8.4), Delta (US$7.4), Northwest (US$5.6), Federal Express (US$5.8), USAir (US$5.2), and TWA (US$4.4). Pan Am (US$3.6) might also be included. Figures are 1988 revenues. Source is ATA (1989).

[125] In 1990 Canadian dollars, this would be roughly $9.5 billion.

service due to better timing of connecting flights, less opportunity for baggage to be lost, etc. In addition, artificial marketing incentives, such as frequent flyer programs induce the consumer to patronize large carriers. Section 6.C discussed the basic economics of the impact of feed traffic on air carrier profitability, and Section 6.D put this into the context of international air traffic. The net result of all of this is that carriers throughout the world are experiencing market forces inducing them to extend their reach to larger and larger portions of the globe. To some, this implies that the industry may eventually "globalize," just as a number of other industries such as energy, automobile production, etc., have switched from national to global orientation and operations. Here, the globalization concept is discussed further.

**What is a "Global" Carrier?** Before one can discuss globalization of the airline industry, the concept of a global carrier must be defined. Some carriers provide services on many continents, and might even completely circumnavigate the globe. Most of these are *international carriers*. They carry passengers between countries, but most of their customers originate from the carrier's home base. Some carriers, Pan Am for example, had fifth freedom rights allowing it to transport passengers between "foreign" countries. But again, if the passengers they carry are largely from the home country, perhaps it should not be considered as a global carrier. In this paper, the term international carrier will be used.

A few carriers go a step beyond in that they may primarily transport patrons from countries other than their home base. These are the *sixth freedom carriers*. They fly passengers from one "foreign" country to another, but via their home base. The Netherland's KLM is a good example. Its' home population is small, but by developing sixth freedom routes, it has been able to build a formidable traffic base. An example from the Asia Pacific region is Singapore Airlines.

The operation of a sixth freedom carrier is hub and spoke. However, the operation is of a single hub. Single hubs have a good ability to provide feed traffic into the system from medium and sometimes small communities which are short air distances from the hub. However, the further one gets from the hub,



the more likely it is that the carrier is transporting O-D passengers only:[126] they do not have the ability to collect "feed" traffic from the small and medium size communities around one of their spoke stations. British Airways may be effective in obtaining a share of Toronto originating passengers going to Europe (or beyond) on its own system. But it is not likely to pick up feed traffic in Toronto. Thus, sixth freedom carriers will tend to rely on O-D traffic the further a station is from its home base hub. BA's Toronto competitor, Air Canada, is more likely to pick up feed (from say Windsor or Timmins, ON), bring it to Toronto, and keep it on-line for the long haul to the European destination. Passengers going beyond an Air Canada European station would then connect to another carrier, with no particular carrier having a pronounced advantage in obtaining Air Canada's "feed."

The term *global carrier* should be reserved for an airline which can gather feed traffic from many widely separated points throughout the world, and channel that feed onto its long haul routes. Such a carrier would have the ability to carry on-line a passenger from origin to destination for a large portion of the world. An analogy with the U.S. domestic market may help clarify the concepts. A single hub carrier would be the domestic equivalent of a sixth freedom carrier. US Air's pre-merger single hub (Pittsburgh) operation would be an example.[127] (See **Figure 40.**) A full coverage multiple hub carrier, like American Airlines, would be the domestic equivalent of a global carrier.[128] (See **Figure 41.**) American has the ability to take a passenger from an awesome number of places in the U.S. and keep him/her on-line to the ultimate U.S. destination. The single hub carrier can serve a large number of major cities, but as shown in Figure 40, it is not likely to get traffic from the small and medium

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[126] O-D stands for origin-destination. O-D traffic differs from "connecting" traffic which travels through a station/airport, but originates/destines elsewhere. A Toronto resident travelling to London England would be a Toronto O-D passenger. A Timmins resident travelling to London via Toronto is not a Toronto O-D passenger.

[127] US Air subsequently developed other hubs and acquired hubs via acquisition of Piedmont and PSA.

[128] American operator hubs in Chicago (East-West northern tier), Dallas-Fort Worth (East-West southern tier), Raleigh-Durham (North-South east coast), Nashville (North-South midwest), and San Jose (North-South west coast). In addition it has a Caribbean hub in San Juan, and a developing hub in Miami which could feed the South American route system it hopes to purchase from Eastern Airlines.

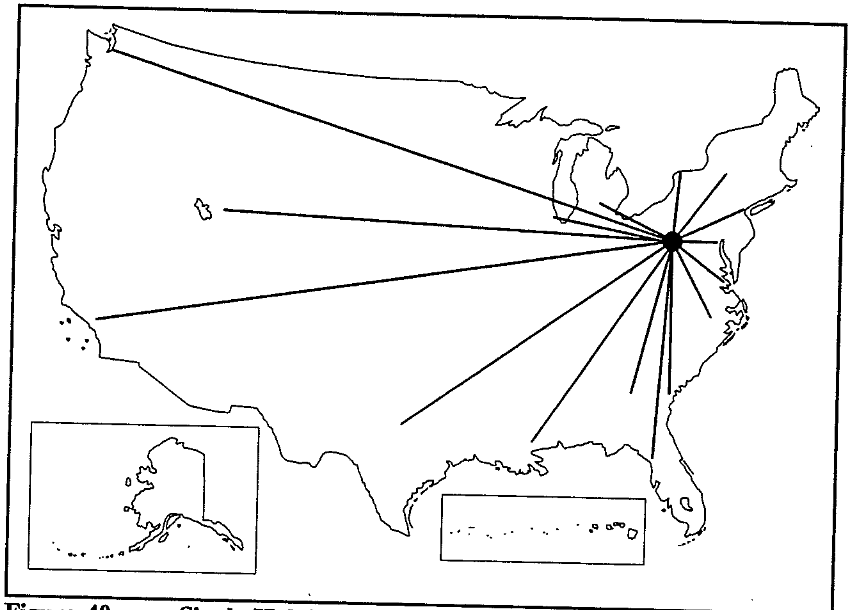

**Figure 40: Single Hub Network**

sized communities in the West. In contrast, the multiple hub carrier of Figure 41 has great potential to collect feed traffic from smaller communities near to its many hubs. In addition, it can carry traffic up and down the west coast, something which the single hub carrier of Figure 40 is not able to do.

A global carrier is one which operates hubs in several countries. It can gather short/medium haul traffic to each of these hubs, and connect them to other hubs where they can connect to outlying destinations. The global carrier reaches beyond the major cities of the world to access a much larger market -- and keep it all on-line. At present, no true global carriers exist in the world, although much talk has been heard recently about their potential emergence.

**Three Levels of Global Network Building.** What form would global consolidation take in this industry? This paper identifies three potential strategies. At one extreme carriers from different countries merge outright with



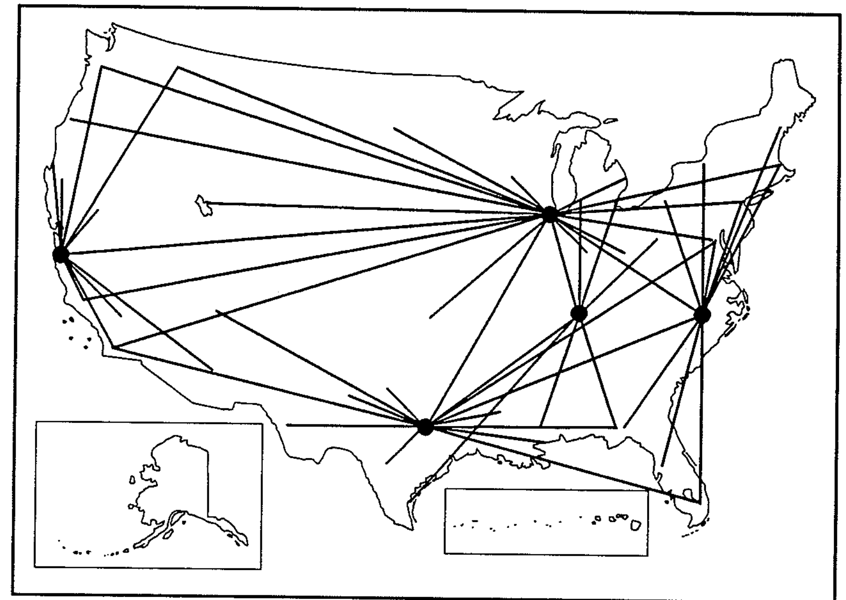

**Figure 41: Mutliple Hub Network**

a single surviving corporate identity. At the other extreme, carriers keep their unique identities but use simple marketing agreements to coordinate traffic flows. In between, there is a stronger form of marketing agreement, one which is solidified with an equity position but is not a merger. Each of these is discussed in turn.

***Corporate Merger.*** The most obvious way to build a global network is to buy airlines in various countries, and merge them into a single corporate entity. Some precedent exists for such multinational airlines. SAS is owned by government and private interests in Denmark, Norway and Sweden.[129] Air Afrique services 12 countries in Western Africa. While a few other examples can be found, all involve pooling the traffic generating ability of small countries

[129] Each country also has its own domestic carrier.

within a close geographic region. Some attempt has been made by airlines to purchase airlines of other countries. SAS, for example, bid for British Caledonian as well as Aerolineas Argentinas, but was unsuccessful in both attempts.

From an operational point of view, outright merger is the most desirable form of consolidation. It allows full advantage to be taken of fleet and crew utilization possibilities, amasses purchasing and borrowing power, allows the adoption of a single consumer identity, etc. International mergers, however, meet with many political obstacles. For example, Canada and the United States have laws limiting foreign ownership of their respective carriers to 25%.[130] For many countries, national identity is tied to the existence of a "flag" carrier. Many high skill managerial and technical jobs are linked to the city with the corporate headquarters. A merger could transfer such jobs from one country to another. For these and similar reasons, it is hard to envision outright mergers taking place, at least at present. Would the French (or any other) government allow Air France to disappear by being swallowed up by AMR Corp,[131] Lufthansa, or Japan Air Lines? While global merger may be attractive from the airline managers' point of view, it seems to be an idea whose time has not yet come.

***Simple Carrier Alliances.*** Simple carrier alliances involve "marketing agreements" between carriers of different countries for preferential exchange of traffic. Air Canada, for example, may sign an agreement with Cathay Pacific whereby it books Canadian travellers going to various Asia Pacific destinations on Cathay. Similarly, Cathay books passengers going to destinations east of Vancouver on Air Canada flights. Both carriers gain traffic which would have gone to rival Canadian Airlines International Ltd. (CAI) who serves both domestic Canada and the Asia-Pacific region, or to rival U.S. carriers serving both Asia and Canada.

[130] The U.S. is reviewing this policy. See "DOT Rules to Review Foreign Investment for Airlines," *Journal of Commerce*, 19 November 1990, p. 5B.

[131] AMR Corp. is the parent of American Airlines.



Marketing agreements may go further than this, specifying frequent flyer participation or code sharing. A travel agent in Seattle, for example, will see a British Airways flight to London listed on the Computer Reservation System (CRS). In fact it consists of a United Airlines flight from Seattle to Chicago (using BA's CRS "code"), connecting to a BA flight to London.[132] By being listed via code sharing as a single airline service, the flight will appear in the CRS display with a higher priority.[133] In addition a United Airlines patron may prefer this "BA" flight if it earns United Mileage Plus frequent flyer award credits for the entire journey.

While carrier agreements undoubtedly are effective marketing tools, they are limited in being easy to cancel. BA could easily switch to another carrier to provide feed to its Chicago-London flight. United could win (or purchase) rights to fly the route as well. A parallel for this volatility existed with the U.S. feeder carriers in the immediate post-deregulation years. Some trunk carriers lined up feeder service at various hubs, only to see the feeder switch its allegiance to a different trunk. The trunk carriers needed to stabilize their feeder arrangements, and did so by taking equity positions in the smaller carriers.

***Strong Airline Alliances Involving Equity Swaps.*** This strategy might be referred to as the "strong alliance" option. Carriers of different countries maintain their own corporate identity, but they are affiliated in order to provide a global service network. In order to take full advantage of the potential of the global network, the component carriers will need to engage in much coordination of their marketing efforts. This will include routing decisions, schedule timing, the establishment of joint fares, code sharing in CRS data bases, common frequent flyer programs (where allowed), some coordination of dynamic yield management decisions, etc. There could also be coordination on the cost side, with joint purchasing of fuel, catering services, and possibly

[132] BA operates non-stop Seattle-London service on some days. It code shares with United on alternate days in order to provide the Seattle consumer with what appears to be a daily service. A Canadian example is the code sharing between CAI and Lufthansa, which allows both carriers to give the semblance of offering daily services.

[133] In late 1990, United proposed purchasing Pan Am's right to fly from Chicago to London. If this transaction is approved, it could jeopardize BA's code sharing arrangement with United.

aircraft. Ground services would be rationalized. In order to take advantage of these benefits, the carriers will need to make substantial investments, or to reluctantly give up some previous functions (or routes) to the other carrier. Such undertakings are not easily made, and can only be justified when a strong commitment is given by all parties.

A logical form for this commitment involves an equity stake of one carrier in another, or possibly mutual equity stakes. There is precedence for this in the relationship between a trunk carrier and its turboprop feeder carriers. After experiencing problems in the early 1980s with feeder carriers changing which trunk they were affiliated with, the U.S. trunks took minority equity stakes in their feeders in order to make the relationship more permanent. In many cases, the more permanent relationship resulted in substantial investment and expansion by the regional carrier. The same procedure could be employed for alliances between trunk carriers of different countries. In some cases, it may be logical for the affiliated carriers to take equity stakes in each other. The intent of these equity positions is not so much for one airline to control another (which may not be permitted by one or both countries), but rather to solidify an operating relationship.

It should be pointed out that many of the benefits from building a global network depend on information systems (e.g., yield management, frequent flyer programs, establishment of joint fares, etc.). The core of all of these airline information technologies is increasingly becoming the computer reservation system (CRS). This suggests that affiliated carriers will all need to share the same CRS system. When this argument is carried to its most extreme, it suggests that global carrier networks will be built around the existing CRS systems.[134] Since both of Canada's airlines use the Covia system, does this imply that one but not the other will become part of a global carrier network?

***Interlining Versus Code-Sharing.*** Before closing this section, it should be pointed out that there are two possible forms for simple carrier alliances.

[134] The major North American systems are American Airlines' Sabre system, United Airlines' Covia CRS, Continental Holdings' SystemOne, and the proposed amalgamation of the TWA/Northwest PARS CRS with Delta's Soda system. Canada's Gemini CRs use the Covia technology and is partially owned by Covia.



One is referred to as interlining. Here, a Canadian carrier would strike a marketing agreement with a foreign carrier under which each would honour the others' bookings of passengers. Each carrier retains its own identity, and flight segments are clearly labelled as to which carrier is providing the service. There is no code sharing. In an interlining agreement, the carriers may establish a joint fare[135] and/or may attempt to coordinate their schedules in order to minimize connecting time for passengers. Interlining agreements are mutually beneficial and require little investment by the two air carriers.

A somewhat more committed relationship between air carriers involves code-sharing. In a code-sharing agreement, the consumer will perceive that one carrier is the carrier providing the entire service, even though two separate carriers may be involved. In an earlier example, a consumer in Seattle would perceive that they can book flights from Seattle to London via Chicago on British Airways. The computer reservation system and the printed ticket will indicate that both segments of the flight are operated by British Airways. In fact, the Seattle-Chicago segment is a United Airlines flight with the Chicago-London segment being a British Airways flight.

A code-sharing arrangement is a much higher level of commitment between the carriers. One of the carriers loses its market identity with the consumer. In code-sharing, one of the carriers may be required to make certain commitments or provide guarantees of certain levels of traffic to the other carrier. Typically, one of the carriers will have to agree to the other providing certain ground services and passenger handling functions. In general, it can be said that code-sharing agreements are less common and more stable than interlining agreements. The latter can be very transient, and are easily cancelled by one of the parties.

[135] A joint fare between points A and C is lower than the combined fare from A to B and B to C.

**Keys to Global Carrier Success.** There are three keys to whether or not a global carrier would have an advantage over present carriers for moving a passenger from origin to destination. The first is whether the global carrier can operate with significantly *lower costs* and thus sustain lower prices in the long run. Thus far the evidence seems to suggest this will not be the case. The second is whether passengers will be offered *more convenient service*. Here, a properly operated global carrier could offer some advantages. By coordinating flight schedules, passenger ground time for connections might be reduced. A key to a convenient operation will be ease of changing flights, including all the challenges of moving from one gate to another, passing through customs, no requirement for the passenger to retrieve and re-check baggage, etc. Also related here, is a requirement that the global carrier offer a minimum of backtracking or circuitous routing, in order to minimize travel times for the customer.

The third key to the success of a truly global carrier depends on building *customer loyalty*. A global carrier needs such loyalty to insure that a customer will choose it for all air travel, even if routings may be a bit circuitous at times. Perhaps one way to build loyalty is via superior service. However, the U.S. experience with frequent flyer programs suggests that they are more powerful in that they reward the passenger for loyalty. If carriers are thwarted in spreading frequent flyer programs worldwide, or if they are unable to design other loyalty inducing rewards, then perhaps globalization will never come about. However, a carrier which invents the right formula in this regard could reap enormous advantages and profits.

**Conclusion.** In conclusion, it can be observed that there are market forces inducing the airline industry toward increasing international airline connectivity. Consumers prefer to deal with a single large-network airline. Artificial incentives such as frequent flyer programs provide additional stimulus. There are a number of different levels or degrees to which this interconnectivity can take place. Simple carrier alliances are already taking place, as are code-sharing agreements. There are some moves to stronger carrier alliances involving minority equity stakes. We have not observed significant mergers of airlines of different nations, as yet.



## D. Airline Finance

It is beyond the scope of this paper to provide a detailed financial analysis of the airline industry. Nevertheless, it is important to appreciate a number of characteristics of this industry that have important financial implications.

**Seasonality.** The airline industry has a strong seasonality. Traffic peaks during the third quarter and has a trough during the fourth quarter. As can be seen in Figure 36, the trough month of November is only 50 percent of the peak in August.[136]

**Procyclical.** The airline industry is procyclical in the sense that its expansion and contraction is more pronounced than that of the economy as a whole. Income elasticities for this industry are approximately 2.0, indicating that for every one percent expansion in national income, air transport expands by two percent, and for every one percent contraction in national income, air transport contracts by two percent.[137] In the jargon of the financial industry, air transport has a high "beta" coefficient. This indicates that earnings in the airline industry are more volatile than earnings in the economy overall.

**High Operating Leverage.** Operating leverage is a measure of how earnings increase as output increases. In some industries, such as manufacturing, each additional unit of production is accompanied by a corresponding increase in costs of manufacturing. While profits rise with additional production, they do so proportionately. In the airline industry, the costs of providing services are somewhat fixed, in the sense that the carrier commits itself to operating a particular schedule of flights. Thus, if additional passengers choose to travel, the airlines might not have a corresponding increase in the cost of providing flights. They have already committed to providing a certain number of flights and thus, the additional revenues from these new passengers are reflected as profit to the carrier. This implies that whenever airline traffic increases above expectations, profits will soar. Similarly, when traffic falls below amounts which had been planned for, huge losses can be experienced.

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[136] 1982 data was used as it predates the era of widely available discount fares in Canada. Discounts are now used to induce some peak travellers to switch to off-peak times.

[137] See Gillen, Oum and Noble (1986).

| Airline | Financial Leverage |
|---|---|
| Continental | 40.3 |
| Singapore Airlines | 10.8 |
| United Airlines | 5.1 |
| British Airways | 4.7 |
| Japan Airlines | 4.2 |
| **Canadian Airlines Int'l** | **4.2** |
| **Air Canada** | **3.4** |
| American Airlines | 3.4 |
| KLM | 3.3 |
| USAir | 2.6 |
| Delta Airlines | 2.5 |
| Northwest | 2.2 |
| * Source: Carrier Annual Reports. | |

**Table 4: Financial Leverage
Selected Carriers, 1988 (Total Liabilities Divided by Shareholder Net Worth**

**Moderately High Financial Leverage.** Financial leverage is the relationship between debt and equity financing for a firm. A firm is said to be highly levered when it has large amounts of debt relative to the stockholders' equity. In such a situation, small increases in net profit can be magnified into very large increases in return for the shareholder. Similarly, small losses will be magnified into very poor returns for the shareholder. The airline industry has relatively high financial leverage, although not as high as in some industries, such as the financial sector. Within the airline industry, there is considerable variation in the degree of financial leverage. Typically, liabilities represent two to four times the value of shareholder net worth. However, some carriers, such as Continental Airline Holdings, have ratios which are very high. **Table 4** gives an example of the financial leverage of a sample of air carriers.



| Airline | Asset Turnover |
|---|---|
| **Canadian Airlines** | **1.3** |
| Delta | 1.3 |
| United | 1.4 |
| Continental | 1.2 |
| Northwest | 1.2 |
| USAir | 1.2 |
| **Air Canada** | **1.0** |
| American | 1.0 |
| KLM | .6 |
| * Source: Carrier Reports. | |

**Table 5: Asset Turnover
(Operating Revenues Divided by Total Assets)
Selected Airlines
1988**

**Asset Turnover of Unity.** Asset turnover is the ratio of the value of a firm's annual revenues to the value of its assets. Industries such as retail and wholesale trade have asset turnovers typically between two and ten times per year. Manufacturing industries generally have asset turnovers between one and two. The airline industry tends to have asset turnovers of approximately unity. This means that the revenues received each year are roughly equal to the value of assets used to provide services to its customers. Table 5 gives asset turnover ratios for selected carriers.

**Changing Cash Flow Relationship.** Traditionally, airlines owned their own aircraft. Because aircraft were purchased with cash and depreciated over the life of the aircraft, airlines had very positive cash flows in most years. This was because part of the revenue collected from customers was used to cover depreciation of the aircraft. However, depreciation is an accounting charge and does not require the actual outlay of cash. Thus, even when carriers were suffering losses, the cash coming in usually exceeded the cash going out.[138]

In recent years, this cash flow relationship has changed dramatically. Whereas in 1961 three percent of aircraft were leased, by 1988, 42 percent of aircraft were leased.[139] With an aircraft lease, the airline does not lay out cash up-front when the aircraft is acquired. Instead, cash is laid out throughout the lifetime of the aircraft. With the adoption of leasing by airlines, carriers are now experiencing required annual cash outlays roughly equal to their cash inflows. Because of this, when difficult times are experienced--such as a recession or fuel crisis, carriers can experience negative cash flows. As a result, airlines are more likely to experience bankruptcy.

[138] The exception would be when carriers were taking delivery of (and paying cash for) new aircraft.

[139] Source: *Air Transport World*, June, 1989.



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