Chapter 6

The Airline Planning Process

Learning Objectives:

**Student will learn these FACTS**

1. Three airline planning decisions: (1) Fleet, (2) Route, and (3) Schedule
2. Aircraft Technical Performance
3. Fleet Selection Trade-off
4. Hub-and-Spoke versus Point-to-Point Airline Networks
5. Route Profitability Analysis
6. Schedule Development processes (4)

**Student will learn these SKILLS**

1. Interpret Aircraft Payload-Range Capability Chart
2. Perform a Route Profitability Analysis
Chapter 6

The Airline Planning Process

1. Draw a Hierarchy Map of Chapter 6

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Airline Planning Process

Fleet Planning (6.1)  Route Planning (6.2)  Schedule Development (6.3)  Integrated Airline Planning (6.4)
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2. Name and describe the three categories of airline planning *decisions*:

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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<td>3.</td>
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</table>
FLEET PLANNING

1. An airlines fleet is described by:
   a. ____________________________________________________________
   
   b. ____________________________________________________________

2. The most important characteristic of technical performance of an airplane is:
   ______________________________________________________________
   ______________________________________________________________

3. Decisions made by an airline to acquire new aircraft or retire aircraft in it’s fleet have direct impact on:
   a. ____________________________________________________________
   
   b. ____________________________________________________________
   
   c. ____________________________________________________________

4. In 2008 dollars the price of the following aircraft are:

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Twin Engine, Narrow body, 150 seats, short/medium haul</td>
<td></td>
</tr>
<tr>
<td>Long-range, wide body, +400 seats</td>
<td></td>
</tr>
<tr>
<td>Long-range, wide-body, +600 seats</td>
<td></td>
</tr>
</tbody>
</table>

5. The typical life-span of a commercial airplane is:
   ______________________________________________________________

7. The major technical performance characteristics of an airplane are:

<table>
<thead>
<tr>
<th>Technical Performance Characteristic</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
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<td>2.</td>
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</tbody>
</table>

8. Figure 6-1 (page 156) plots the size versus range capabilities of different commercial aircraft.

   a. Which part of the state-space exhibits the most competition?

   b. What has happened to the range of the largest aircraft over time?
10. What is “fleet commonality” and why is it important to the airlines?

______________________________________________________________________________

______________________________________________________________________________

11. Figure 6-2 (page 157) is the Payload-Range curve for the B767-300ER. The curve has 3 linear segments. What is traded-off in each segment? Explain.

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________
NOTES ON RANGE

Range is the maximum distance that an aircraft flies without refueling.
Range is a tradeoff between distance and payload.
Range is estimated using Breguet Range equations as follows:

1. Additional distance flown (dR) is derived from the Velocity (V) over the incremental period of time (dt).
   \[ dR = V \times dt \]

2. As aircraft flies it burns fuel and loses significant weight. The change in weight (dW) over time (dt) is a product of the Specific Fuel Consumption (SFC) and the Thrust (T) required to maintain constant velocity at Cruise Flightlevel
   \[ dW/dt = SFC \times T \]

Notes on SFC:
SFC = lbs/hr/lbf = pounds per hour per pound of force produced.
Varies with altitude and speed.
SFC for Pratt & Whitney engine 4806 on Boeing 777 at 0.8M at 11,000m = 0.6 lb/hr/lbf.

3. Specific Air Range (SAR) is a measure of the efficiency of an aircraft = ratio of distance flown per unit of fuel consumed
   \[ dR/dW = V/SFC \times T \]

4. Breguet Range Equation:

   \[ R = (V/SFC) \times (Lift/Drag) \ln(\text{Initial Weight at start of Cruise} / \text{Final Weight at end of Cruise}) \]

How to derive Breguet: Start with SAR equation, replace Thrust with estimate based on Lift and Weights, integrate dR over weight range.

NOTE: Range is a function of Weight
**Notes on Payload-Range Diagrams**

### 767-200ER/300ER Payload-Range Capability

*General Electric Engines*

![Diagram of Payload-Range Capability](image)

MTOW = Maximum Take Off Weight

Three corner points represent combinations of range and payload.
- **Point 1:** aircraft carries its maximum load (i.e. departs with maximum takeoff gross weight). Corresponding range is limited.
- **Point 2:** compromise between payload and range. Aircraft departs with full fuel load, but limits passenger and cargo weight to provide extended range.
- **Point 3:** maximum range. Aircraft departs with full fuel load and no passengers or cargo. Typically a ferry/delivery mission.

Limitations of Payload-Range Diagrams applicable for only:
- zero wind conditions
- 0.84 Mach
- Standard day conditions (e.g. standard atmosphere)
- Fuel reserves for additional 1.25 hours
12. There are two ways airlines acquire aircraft. Identify and describe the advantage/disadvantages of each one.

______________________________________________________________________________

______________________________________________________________________________

13. When the airline purchases an aircraft, full payment to the manufacturer is required at time of aircraft delivery. Name 4 sources of capital.

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

14. In addition to the purchase price, initial costs for a new aircraft include:

______________________________________________________________________________

______________________________________________________________________________
15. Complete the table below to describe the tradeoff in purchasing a new aircraft (as opposed to using existing fleet)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Dis-advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Appease political pressure</strong></td>
<td></td>
</tr>
</tbody>
</table>
ROUTE PLANNING

The choice of aircraft and fleet plan determines the availability of the aircraft with different capacity and range characteristics. The next step in the airline planning process is to determine the specific routes to be flown.

1. Economic considerations and expected route profitability determine the routes serviced by the airline. Route profitability estimates require forecasts of:

   a. ________________________________

   b. ________________________________

2. Provide definitions for the following terms:

   a. O-D Passengers ________________________________________________________

   b. O-D Markets __________________________________________________________

   c. Hub-and-Spoke Network _______________________________________________

   d. Connecting bank ______________________________________________________

   e. Schedule Displacement ________________________________________________

   f. Demand-drive-dispatch ________________________________________________

3. What are the advantages of a hub-and-spoke network, over a complete point-to-point network (in terms of O-D markets served, aircraft, ASMs, and operating costs).

   _______________________________________________________________________

   _______________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________
4. Consider a simple connecting hub with 20 arriving flights and 20 departing flights
   
   a. How many O-D markets are served by this network ______________________
   
   b. How many flight legs are required _________________________________
   
   c. How many aircraft are required _________________________________
   
   d. How many flight legs would be required by point-to-point airlines to service the same number of O-D markets

5. Explain how a hub-n-spoke network enables service to low-demand O-D markets?

   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________

6. In terms of “total trip time” and “schedule displacement”, how does increased number of connecting banks provide an advantage to hub-n-spoke carriers (over point-to-point carriers).

   _______________________________________________________________
   _______________________________________________________________

7. In terms of “market share”, how does increased number of connecting banks provide an advantage to hub-n-spoke carriers (over point-to-point carriers).

   _______________________________________________________________
8. List the operational and cost advantages to an airline of consolidating operations at a large hub airport
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________
   d. __________________________________________
   e. __________________________________________
   f. __________________________________________

9. List the incremental costs to an airline of consolidating operations at a large hub airport
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________
   d. __________________________________________
   e. __________________________________________
10. Route Profitability Analysis

**ROUTE PROFITABILITY ANALYSIS**

<table>
<thead>
<tr>
<th>Demand and Airfare Estimates for One Year</th>
<th>Annual Demand</th>
<th>Prorated Average One-way Revenue</th>
<th>Total Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total YUL-ROM local Passengers (both directions)</td>
<td>10000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected market share for one daily flight (%)</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local YUL-ROM passengers on new flight</td>
<td>71400</td>
<td>$450</td>
<td>$32,130,000</td>
</tr>
</tbody>
</table>

**Additional Traffic**

| Connections behind YUL to/from ROM | 24000          | $425                            | $10,200,000   |
| Connections to/from YUL beyond ROM  | 12000          | $400                            | $4,800,000    |
| Connections behind YUL to/from destinations beyond ROM | 4500          | $375                            | $1,687,500    |

Total Passengers all Directions | 111900          |                                 | $48,817,500   |

Additional Cargo Revenue (=10% of pax revenue) |                                 | $4,881,750 |

**TOTAL REVENUES**

$53,699,250

**Inputs and Assumptions**

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>B767-300ER</th>
<th>Annual Flights</th>
<th>716</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Seats</td>
<td>210</td>
<td>Annual Block Hours</td>
<td>6086</td>
</tr>
<tr>
<td>Total Annual Flights each direction (=98% completion of daily schedule)</td>
<td>358</td>
<td>Avg Pax per Flight</td>
<td>156.2849162</td>
</tr>
<tr>
<td>Block Hours YUL to ROM</td>
<td>8:00</td>
<td>RPMs</td>
<td>457,223,400</td>
</tr>
<tr>
<td>Block Hours ROM yo YUL</td>
<td>9:00</td>
<td>Passenger Yield</td>
<td>0.10676947</td>
</tr>
<tr>
<td>Non-stop miles (YUL to ROM)</td>
<td>4086</td>
<td>ASMs</td>
<td>614,370,960</td>
</tr>
<tr>
<td>Aircraft Operating Costs per Block Hour</td>
<td></td>
<td>Seat Departures</td>
<td>150,360</td>
</tr>
<tr>
<td>Crew Costs</td>
<td>$890</td>
<td>Passengers Enplaned</td>
<td>111,900</td>
</tr>
<tr>
<td>Fuel/Oil</td>
<td>$3,280</td>
<td>Average Load Factor</td>
<td>0.744213887</td>
</tr>
<tr>
<td>Ownership</td>
<td>$870</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14
<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Unit</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIRECT OPS COSTS</td>
<td>$34,994,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INDIRECT OPERATING COST</td>
<td>$0.02</td>
<td>per RPM</td>
<td>$6,858,351.00</td>
</tr>
<tr>
<td>TRAFFIC SERVICING</td>
<td>$22</td>
<td>per Enplanement</td>
<td>$2,461,800</td>
</tr>
<tr>
<td>AIRCRAFT SERVICING</td>
<td>$1,800</td>
<td>per Departure</td>
<td>$1,288,800</td>
</tr>
<tr>
<td>PROMOTIONS AND SALES</td>
<td>9.00%</td>
<td>of Passenger Revenues</td>
<td>$4,393,575.00</td>
</tr>
<tr>
<td>G&amp;A</td>
<td>$0.002</td>
<td>per ASM</td>
<td>$1,228,741.92</td>
</tr>
<tr>
<td>OPERATING COSTS</td>
<td>$51,225,768</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPERATING PROFIT</td>
<td>$2,473,482</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPERATING MARGIN (%)</td>
<td>4.83</td>
<td></td>
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**AIRLINE SCHEDULE DEVELOPMENT**

Identify and describe each of the 4 tasks associated with Schedule Development

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Time Frame before Departure</th>
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