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 Analsysi

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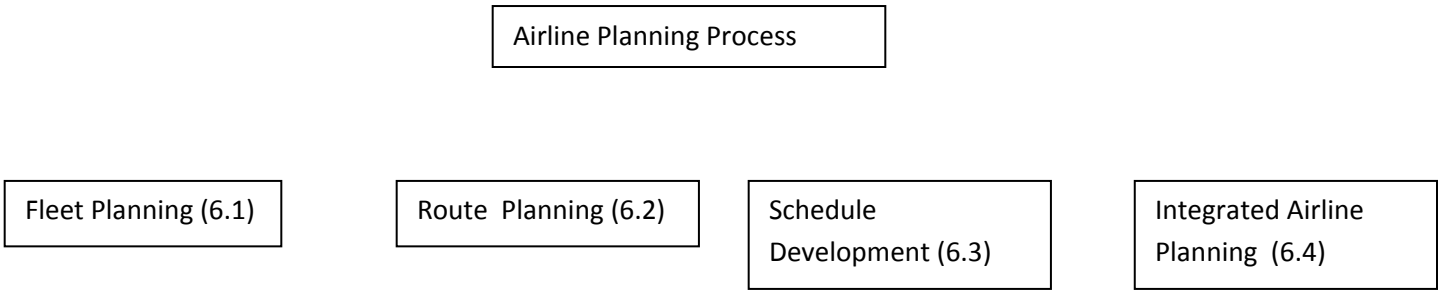
1. Draw a Hierarchy Map of Chapter 6



2. Name and describe the three categories of airline planning *decisions*:

Category	Description
1.	
2.	
3.	

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:

Aircraft Type	Price
Twin Engine, Narrow body, 150 seats, short/medium haul	
Long-range, wide body, +400 seats	
Long-range, wide-body, +600 seats	

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

   _____

6. Why does the life-span of a commercial airplane create difficulties for fleet planning. Explain.

_____

_____

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

Technical Performance Characteristic	**Description**
1.	
2.	

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 * 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 * 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*T
4. Breguet Range Equation:

   R = (V/SFC) (Lift/Drag)ln(Initial Weight at start of Cruise/Final Weight at end of Cruise

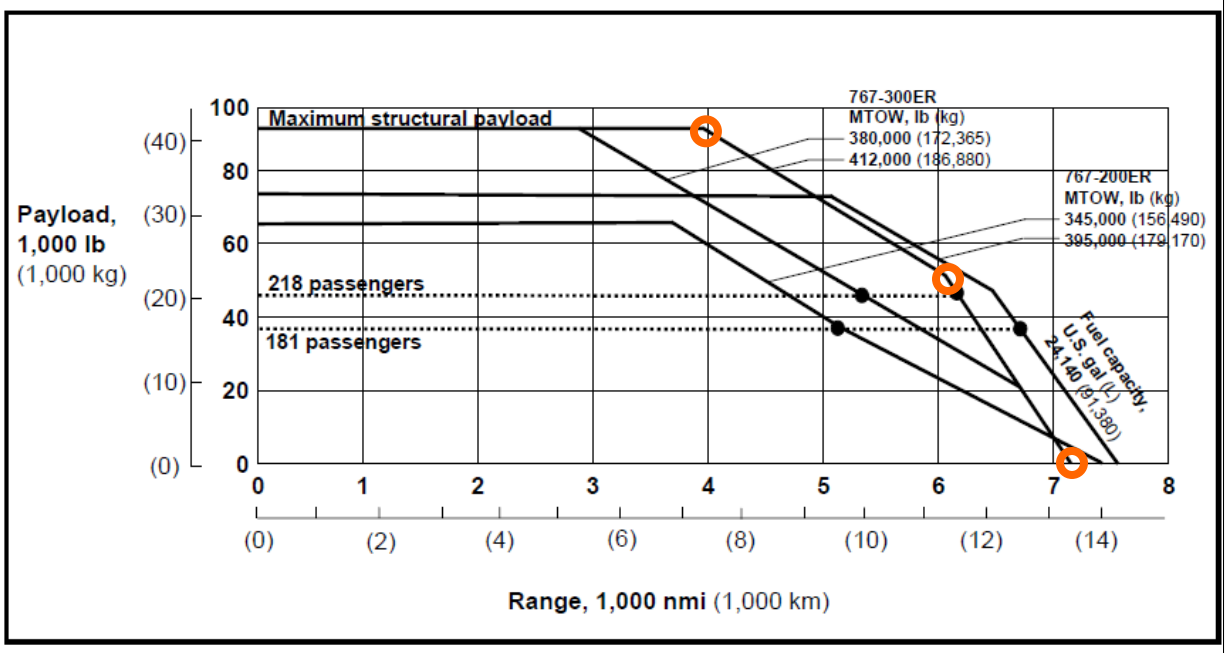
   How to derive Breguet: Start with SAR equation, replace Thrust with estimate based on Lift and Weights, integrate dR over weight range.

NOTE: Range is a function of <u>Weight</u>

Notes on Payload-Range Diagrams

767-200ER/300ER Payload-Range Capability

General Electric Engines



- Three-class interiors
- Typical mission rules
- Passengers at 210 lb (95 kg) (passenger + baggage)

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 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)

Advantages	Dis-advantages
Appease political pressure	

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 PROFITABILIUTY ANALYSIS	Annual Demand	Prorated Average One-way revenue	Total Revenue
DEMAND AND AIRFARE ESTIMATES FOR ONE YEAR			
Total YUL-ROM local Passengers (both directions)	102000		
Expected market share for one daily flight (%)	70		
Local YUL-ROM passengers on new flight	71400	$450	$32,130,000
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	
Aircraft Type	B767-300ER
Number of Seats	210
Total Annual Flights each direction (=98% completion of daily schedule))	358
Block Hours YUL to ROM	8:00
Block Hours ROM yo YUL	9:00
Non-stop miles (YUL to ROM)	4086
Aircraft Operating Costs per Block Hour	
Crew Costs	$890
Fuel/Oil	$3,280
Ownership	$870

CALCULATIONS	
Annual Flights	716
Annual Block Hours	6086
Avg Pax per Flight	156.2849162
RPMs	457,223,400
Passenger Yield	0.10676947
ASMs	614,370,960
Seat Departures	150,360
Passengers Enplaned	111,900
Average Load Factor	0.744213887

Maintenance	$710			
Total per Block Hour	**$5,750**		DIRECT OPS COSTS	$34,994,500
Indirect Operating Cost	$0.02	per RPM	PAX SERVICE	$6,858,351.00
Traffic Servicing	$22	per Enplanement	TRAFFIC SERVICE	$2,461,800
Aircarft Servicing	$1,800	per Departure	AIRCRAFT SERVICE	$1,288,800
Promotion and Sales	9.00%	of Passenger Revenues	PROMOTIONS AND SALES	$4,393,575.00
G&A	$0.002	per ASM	G&A	$1,228,741.92
			OPERATING COSTS	$51,225,768
			OPERATING PROFIT	$2,473,482
			OPERATING MARGIN (%)	4.83

AIRLINE SCHEDULE DEVELOPMENT

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

Task	Description	Time Frame before Departure