Airline Fleet Planning Models

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Dr. Peter P. Belobaba
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Lecture Outline

• Fleet Planning as part of Strategic Planning Process
  – Airline Evaluation Process

• Approaches to Fleet Planning
  – “Top-down” Capacity Gap Analysis
  – “Bottom-up” Detailed Analysis

• Airline selection criteria for aircraft acquisition
  – Technical/performance characteristics
  – Economic and financial impacts
  – Environmental regulations and constraints
  – Marketing considerations
  – Political realities
Airline Fleet Composition

• Fleet composition is critical long-term strategic decision for an airline.
  – Fleet is the total number of aircraft that an airline operates, as well as the specific aircraft types that comprise the total fleet.
  – Each aircraft type has different technical performance characteristics e.g. capacity to carry payload over a maximum flight distance, or “range.”
  – Affects financial position, operating costs, and especially the ability to serve specific routes.

• Huge capital investment with a long-term horizon:
  – US $40-60 million for narrow-body 150-seat airplane
  – $180+ million for wide-body long-range 747-400
  – Depreciation impacts on balance sheet last 10-15 years
  – Some aircraft have been operated economically for 30+ years
Fleet Planning Process

• Fleet planning requires an evaluation process for assessing the impacts of new aircraft (see next slide):
  – Traffic and yield forecasts used to estimate revenues
  – Planning ALF determines ASMs and number of aircraft required
  – Aircraft acquisition has financial impacts in terms of investment funding, depreciation, and interest expenses
  – Operating cost and revenue forecasts provide profit projections
  – Used to predict effects on balance sheet, cash flow, and debt load

• This planning process is ideally an ongoing effort that requires input from many sources within the airline:
  – A critical component of a long-term strategic planning process
Airline Fleet Planning Evaluation Process

- Traffic Forecast
- Load Factor
- ASM Requirement
- Airplanes Required (by type)
- Investment Required
  - Depreciation
  - Operating Lease Insurance
- Airplane Operating Cost Analyses
- Operating Profit Targets
- Operating Cost Forecast
  - Interest Cost
  - Sale of Equipment
  - Other Income/Expense
- Non-Operating Income/Expense Forecast
  - Net Income Before/After Tax Forecast
  - Cash Flow Forecast
  - Loan Repayment
  - Debt to Equity Forecast

Input to Traffic Forecast
Input to Yield Forecast Process
“Top-Down” (Macro) Approach

• Aggregate demand and cost spreadsheets used to evaluate financial impacts of aircraft options for a defined sub-system, region, or route:
  – “Planning Load Factor” establishes ASMs needed to accommodate forecast RPM growth (e.g., 70% planned ALF)
  – “Capacity Gap” defined as required future ASMs minus existing ASMs and planned retirements
  – Assumptions about average aircraft stage length and daily utilization determine “aircraft productivity” in ASMs per day, used to calculate number of aircraft required
  – Estimates of aircraft operating costs can then be used to compare economic performance of different aircraft types
Capacity Gap Analysis

Available Seat Miles

ASM Forecast

Type 1

Type 2

Type 3

Current Fleet – Retirements

Year

Capacity Gap
“Bottom-Up” (Micro) Approach

• Much more detailed evaluation of routes and aircraft requirements allows “what-if” analysis, but requires detailed future scenarios:
  – Future route networks and schedules must be generated, and airline’s share of total market demand is assumed
  – Forecasts of demand and revenues by origin-destination market are then allocated to each future flight

• With more detailed inputs, bottom-up approach provides much more detailed outputs:
  – Aircraft assignments and operating statistics by route
  – Complete projection of financial results under different fleet plans
Top-down vs. Bottom-up Fleet Planning

• Top-down approach allows for rapid evaluation of new aircraft types, given high-level assumptions about:
  – Changes in traffic forecasts and/or operating costs (e.g., fuel price)
  – Airline structural changes (e.g., average stage length of flights)

• Bottom-up approach provides substantially more detail:
  – Changes to individual route characteristics can be evaluated
  – But, very difficult to incorporate future competitors’ strategies

• Simpler top-down approach is commonly used, since detailed 10-15 year scenarios are highly speculative:
  – Likely to be inaccurate in face of changing market conditions
  – Political decisions can overrule “best” analysis of options
Financial Evaluation of Aircraft Alternatives

• Comparisons of aircraft economic performance based heavily on DOC (cash flow) analysis
  – Profit/loss approach includes aircraft depreciation
  – Averages training, financing, maintenance costs over aircraft life

• Net Present Value (NPV) analysis can be used to incorporate time value of money
  – Depends on discount rate assumptions: Tendency is to assume too low for government-supported airlines; assume too high by private airlines trying to compensate for anticipated industry volatility

• Cash flow NPV models combined with Monte Carlo simulation of uncertain variables
  – Probability distributions of fuel prices, exchange rates, traffic growth and yield assumptions
  – Result is a range of possible outcomes and expected value NPV
Aircraft Categories

• Commercial aircraft are most commonly defined by their range and size:
  – The “range” is the maximum distance that it can fly without stopping for additional fuel, while still carrying a reasonable payload of passengers and/or cargo.
  – The “size” of an aircraft can be represented by measures such as its weight, its seating or cargo capacity, as indicators of the amount of payload that it can carry.

• Broad categories such as “small, short-haul” or “large, long-haul” aircraft can include several different aircraft types by different manufacturers.
  – Aircraft with similar capabilities are regarded as “competitors” in the airline’s fleet planning decisions.
  – For example, the Airbus A320 and Boeing 737-800 are competing aircraft types, as they are both new generation aircraft with approximately 150 seats with similar range capabilities.
Figure 2.3: Market Categories

- **Number of Seats** vs. **Range Capability (Nautical Miles)**

- **Legend**:
  - ◦ Regional, 1 class
  - ★ Short Range, 2 class
  - ▲ Medium Range, 2 class
  - ● Medium Range, 3 class
  - × Long Range, 3 class

- **Data Points**:
  - 747-400, 747-400LR
  - 777-300
  - 777-300ER, A340-600
  - 747-200ER, 777-200ER
  - A340-500, A340-200
  - 737-900, A321
  - 737-800, A320
  - 737-700, A319
  - 737-600
  - RJs
Aircraft Categories - Trends

• Historically, largest aircraft were designed for routes with the longest flight distances.
  – Relationship between aircraft size and range was almost linear.
  – Airlines wishing to serve a very long-haul non-stop route had to acquire the Boeing 747.

• Airlines now have a much wider choice of products by range and capacity in each category:
  – Range of new aircraft in the “small” category (100-150 seats) has increased dramatically.
  – US transcontinental routes are now being flown with Boeing 737 and Airbus 320 series aircraft.
  – Sizes of new “long-range” aircraft have decreased substantially.
  – Airlines even now serve certain low-demand long-haul non-stop international routes with Boeing 757 (180 seats) e.g., Newark to Lisbon, and Los Angeles to Maui.
Aircraft Selection Criteria

• Fleet composition is an optimal staging problem:
  – Number and type of aircraft required
  – Timing of deliveries and retirement of existing fleet
  – Tremendous uncertainty about future market conditions
  – Constrained by existing fleet, ability to dispose of older aircraft, and availability of future delivery slots

• Aircraft evaluation criteria for airlines include:
  – Technical and performance characteristics
  – Economics of operations and revenue generation
  – Marketing and environmental issues
  – Political and international trade concerns
Technical/Performance Characteristics

“Payload/range curve” is most important (next slide):

- Defines capability of each aircraft type to carry passengers and cargo over a maximum flight distance.
- Affected by aerodynamics, engine technology, fuel capacity and typical passenger/cargo configuration
- Typical shape of curve allows trade-off of payload for extra fuel and flight range, before maximum operational range is reached

Other important technical factors include:

- Maximum take-off and landing weights determine runway length requirements and feasible airports
- Fleet commonality with existing airline fleet reduces costs of training, new equipment and spare parts inventory for new types
767-200ER/300ER Payload-Range Capability

General Electric Engines

<table>
<thead>
<tr>
<th>MTOW, lb (kg)</th>
<th>767-200ER</th>
<th>767-300ER</th>
</tr>
</thead>
<tbody>
<tr>
<td>345,000 (156,490)</td>
<td>380,000 (172,365)</td>
<td>412,000 (186,880)</td>
</tr>
<tr>
<td>395,000 (179,170)</td>
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</tbody>
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- Maximum structural payload
- U.S. gal (L)
- Fuel capacity
- 218 passengers
- 181 passengers
- Passengers at 210 lb (95 kg) (passenger + baggage)
- Three-class interiors
- Typical mission rules
Financial/Economic Issues

• **Required financing from internal or external sources:**
  - Cash on hand, retained earnings, debt (loans) or equity (stocks) for aircraft purchases
  - Leasing rate can be more expensive, but more flexible, allowing for more frequent fleet renewal and requiring less up-front capital
  - Typical operating leases 3-7 years long, with or without options to extend, can include sub-leasing rights
  - Leases provide flexibility for an airline introducing a new aircraft type, or help with exit strategy for a given type

• **Financial evaluation to determine costs and revenues:**
  - Up-front costs include purchase price, spare engines and parts, ground equipment, training
  - Newer aircraft offer lower operating costs at higher initial purchase price (vs. older aircraft that have been depreciated)
  - Increased revenue potential from larger and/or newer aircraft
Other Aircraft Selection Criteria

• **Environmental factors:**
  – Noise performance has become a major concern (Stage 3 noise requirements and airport curfews on louder aircraft)
  – Air pollution regulations likely to ground older aircraft

• **Marketing advantages of newer aircraft:**
  – Typically, most consumers have little aircraft preference
  – However, first airline with newest type or airline with youngest fleet can generate additional market share

• **Political and trade issues can dominate fleet decisions:**
  – Pressure to purchase from a particular manufacturer or country, especially at government-owned national airlines