Evaluation of Alternative Aircraft Types

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Lecture Outline

- **Fleet Planning Evaluation Process**
  - Top-down approach to capacity gap analysis
  - Bottom-up micro approach

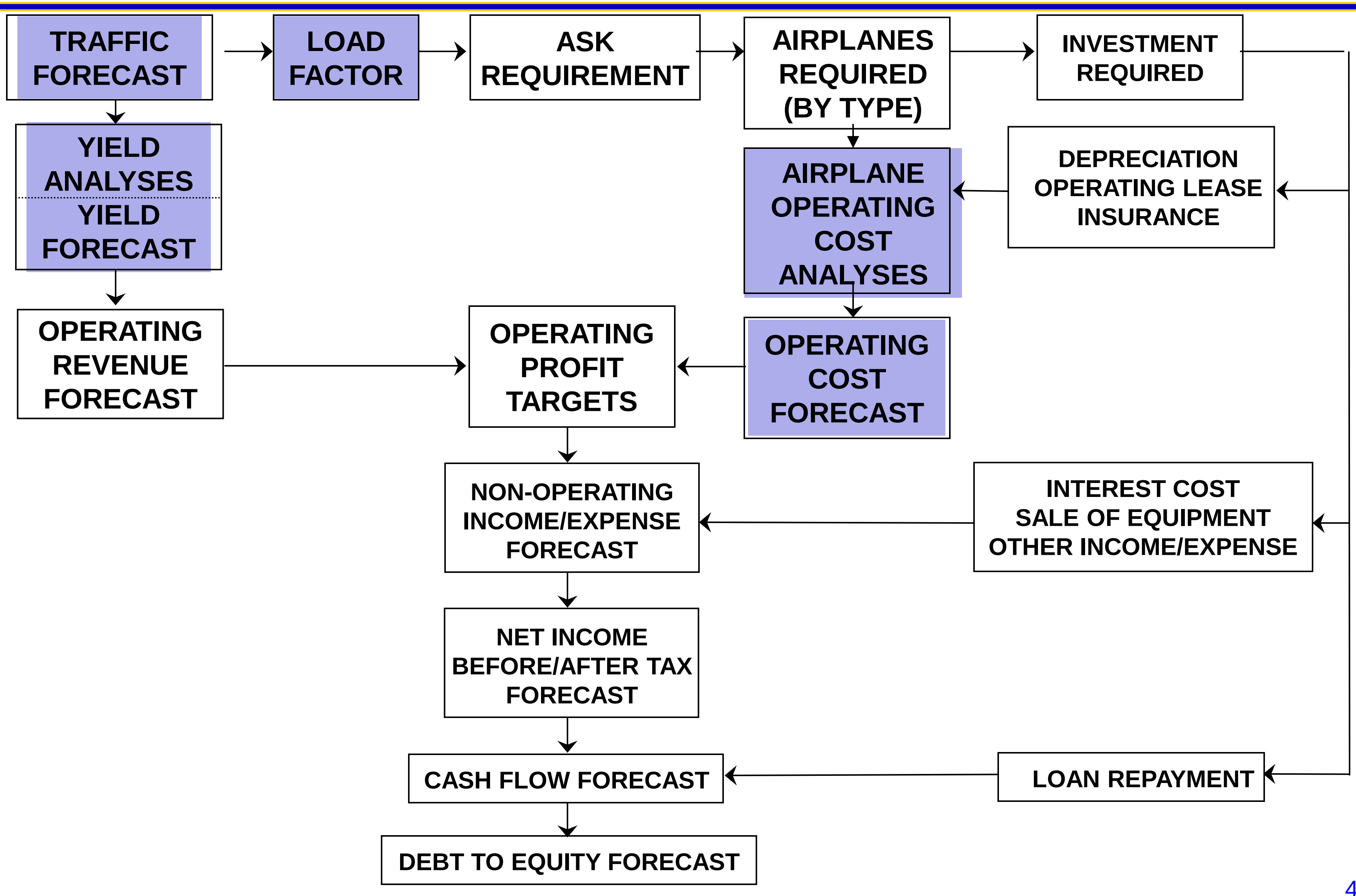
- **Aircraft Selection Criteria**
  - Technical and performance characteristics
  - Economics and finances
  - Environmental, marketing and political issues

- **Financial Evaluation of Aircraft Alternatives**
  - Review: NPV analysis and example

Fleet Planning Evaluation 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:**
  - A critical component of a long-term strategic planning process

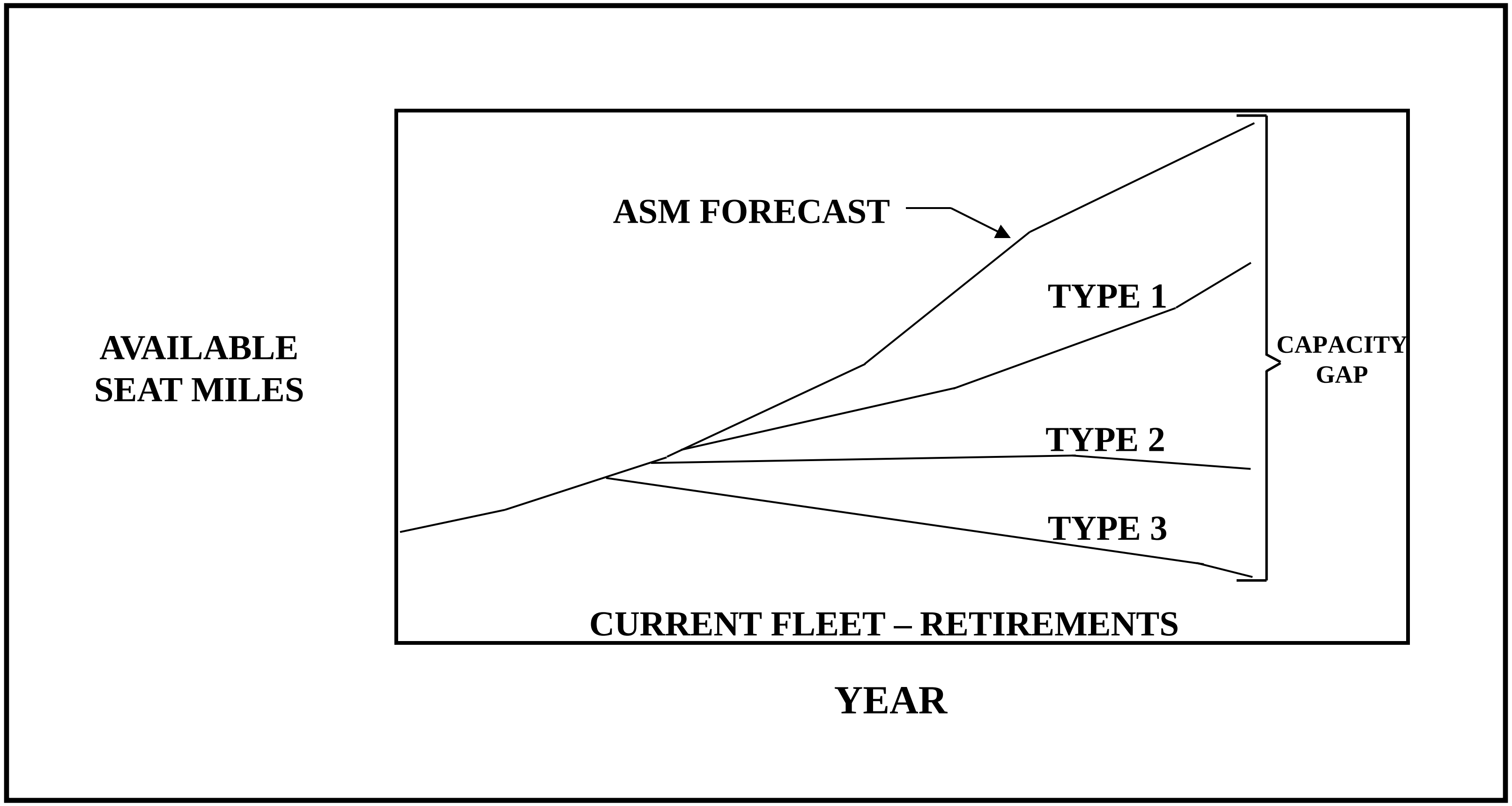
Fleet Planning Evaluation Process



"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



"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:**
  - 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 uses 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

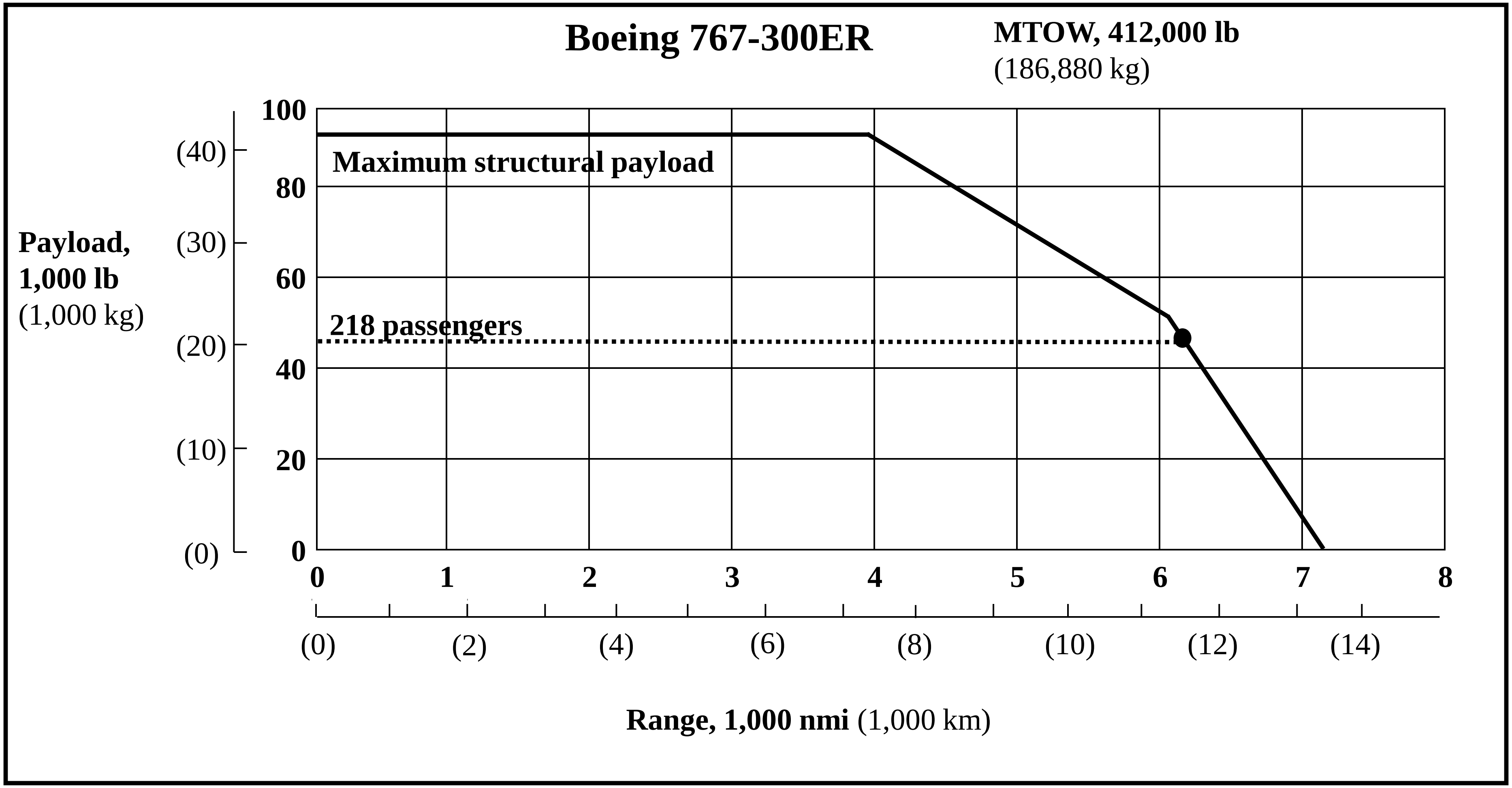
Aircraft Selection Criteria

- **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

767-300ER Payload-Range Curve
General Electric Engines



B767-300ER Performance Summary

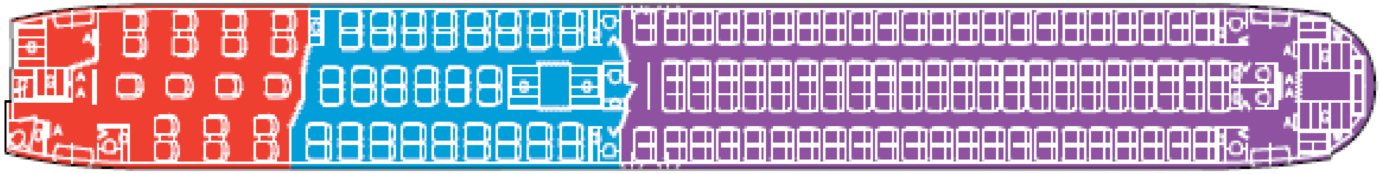
		General Electric	
		CF6-80C2B4F Basic	CF6-80C2B7F Maxim[illegible]
Sea-level takeoff thrust*/flat-rated temperature	lb/°F	56,500/90	62,10[illegible]
Maximum taxi weight	lb	381,000	413,0[illegible]
Maximum takeoff weight	lb	380,000	412,0[illegible]
Maximum landing weight	lb	320,000	320,000
Maximum zero fuel weight	lb	295,000	295,000
Operating empty weight	lb	199,700	199,700
Fuel capacity	U.S. gal	24,140	24,140
Passengers, 18 FC, 46 BC, 154 TC		218	218
Cargo	pallets/containers	4/14	4/14
Design range, MTOW, full passenger payload	nmi	5,225	6,15[illegible]
Cruise Mach		0.80	0.8[illegible]
Takeoff field length, SL, 86°F, MTOW	ft	8,300	8,8[illegible]
Initial cruise altitude, MTOW, ISA + 10°C	ft	35,100	33,400
Engine-out alt. cap., MTOW, ISA + 10°C	ft	14,800	12,900
Landing field length, MLW	ft	5,200	5,200
Approach speed, MLW	kn	145	145
Approach speed, 3,000-nmi mission	kn	129	129
Fuel burn/seat, 3,000-nmi mission	lb	295.6	295.6

Reduced at higher altitudes or temperatures

Can rule out operations to certain airports

Source: Boeing Commercial Airplanes

Cabin Configurations for B767-300

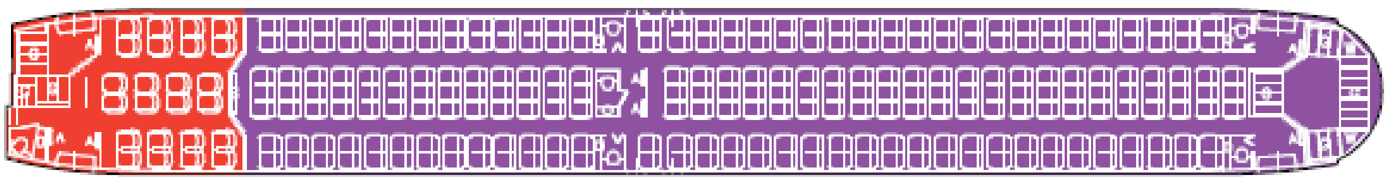


18 first
60-in pitch

46 business
38-in pitch

154 premium
32-in pitch

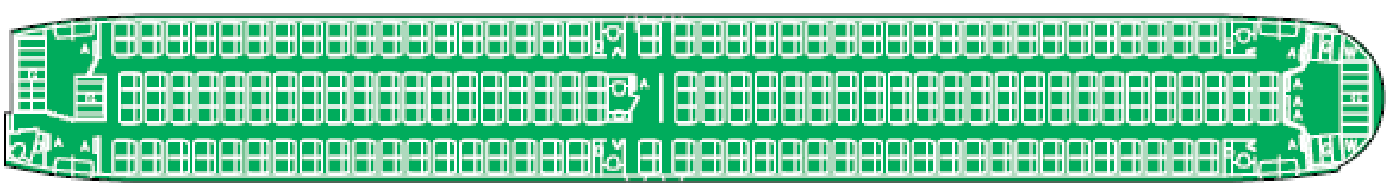
218 passengers



24 first
38-in pitch

245 premium
32-in pitch

269 passengers

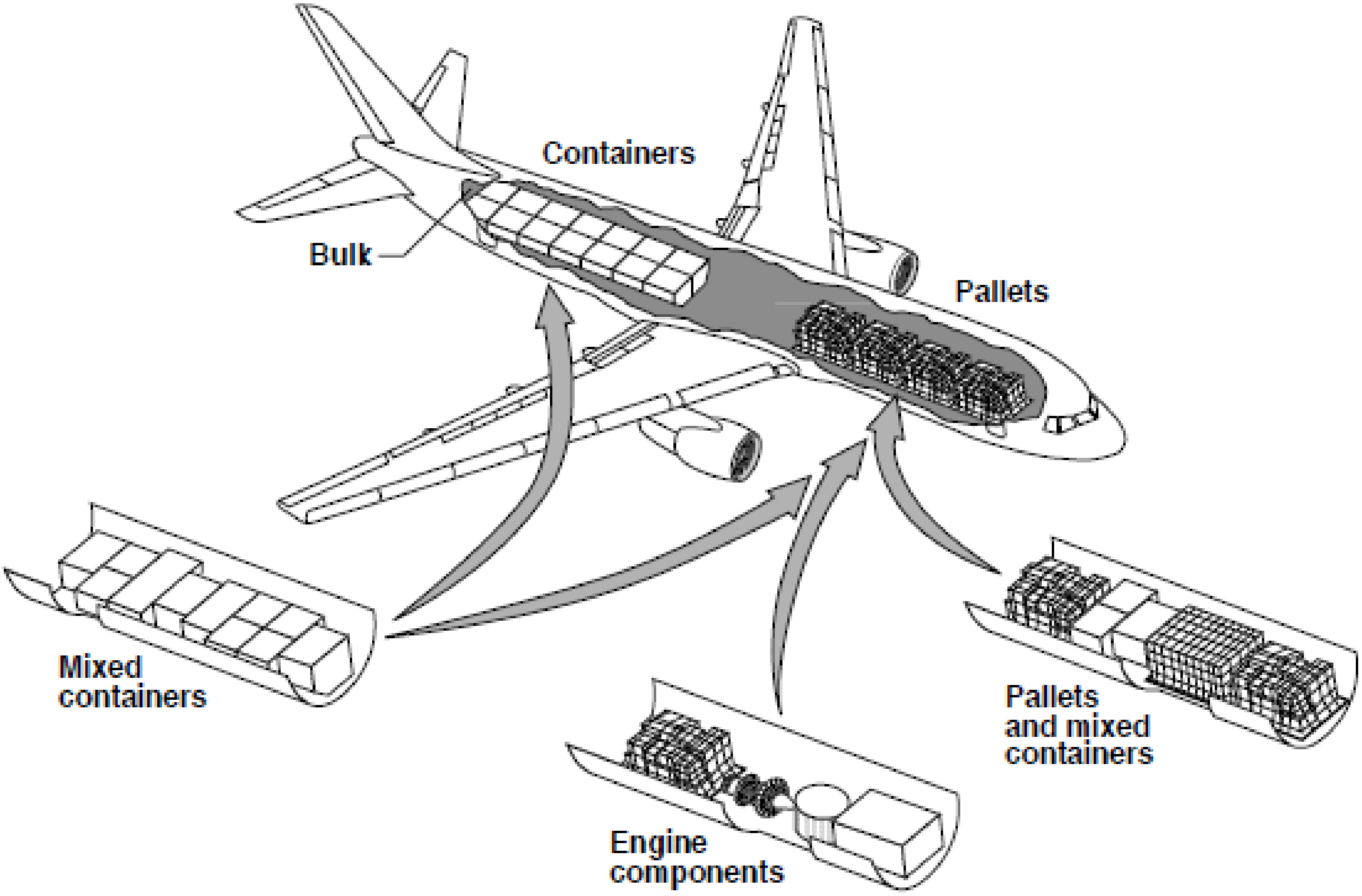


32-in pitch

286 passengers

Source: Boeing Commercial Airplanes

Flexibility of Cargo Payload Capacity



Source: Boeing Commercial Airplanes

Financial/Economic Issues

- **Required financing from internal or external sources:**
  - Cash on hand, retained earnings, debt (loans) or equity (stocks) for aircraft purchases
  - Leasing can be more expensive, but also more flexible, allowing for more frequent fleet renewal and requiring less up-front capital
- **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

Objective: Maintain Fleet Flexibility in the Face of Uncertainty

- **Massive uncertainty over 5-30 year time horizon**
  - Estimates of economic growth, passenger and cargo, competition, revenues and costs all subject to error
  - Detailed route/market forecasts not appropriate, use of scenario evaluation and sensitivity analysis instead
- **Fleet plans try to maximize future airline flexibility**
  - Increase use of leasing (vs. owning) aircraft can provide greater fleet flexibility (but higher costs)
  - Fleet retirement plans can be adjusted with changing fuel prices
  - Orders of multiple types in common rated family
  - Negotiations with manufacturers to minimize firm orders and increase future options with alternative types

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 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

Review: NPV Analysis for Evaluation of Capital Investments over Time

- **Most capital investments accrue benefits and/or costs over a multiple-year time period:**
  - Net Present Value analysis applies a "discount" to both benefits and costs expected in future years
  - Discount rate captures uncertainty of future gains/losses as well as opportunity cost of alternative investments

- **Evaluation of aircraft options is a good example:**
  - Initial up-front capital investment, followed by many years of higher revenues, lower operating costs, etc.

Example: NPV Analysis

The basic question: How can we compare two alternative aircraft?

The basic answer: By weighing the value each aircraft provides.

We measure the earning power of a capital asset such as a commercial airplane by estimating its future cash flows and discounting them back at the airline's cost of capital.

787-8

Versus

767-300ER

Source: Boeing Commercial Airplanes

Example: NPV Analysis

10-year study

10% discount rate

Pretax analysis

7,480-km average trip length

625 trips per year

Number of seats

• 787-8	224 seats
• 767-300ER	218 seats

Age of aircraft

• 787-8	new
• 767-300ER	new

Aircraft will be leased

• 787-8	$1,000,000 per month
• 767-300ER	$650,000 per month

Source: Boeing Commercial Airplanes

Example: NPV Analysis

Passenger Revenue

6 more seats → *despill* → 1.9 more passengers

↓ *$.082 yield,*

$1,168 more net revenue per trip

← *625 trips*

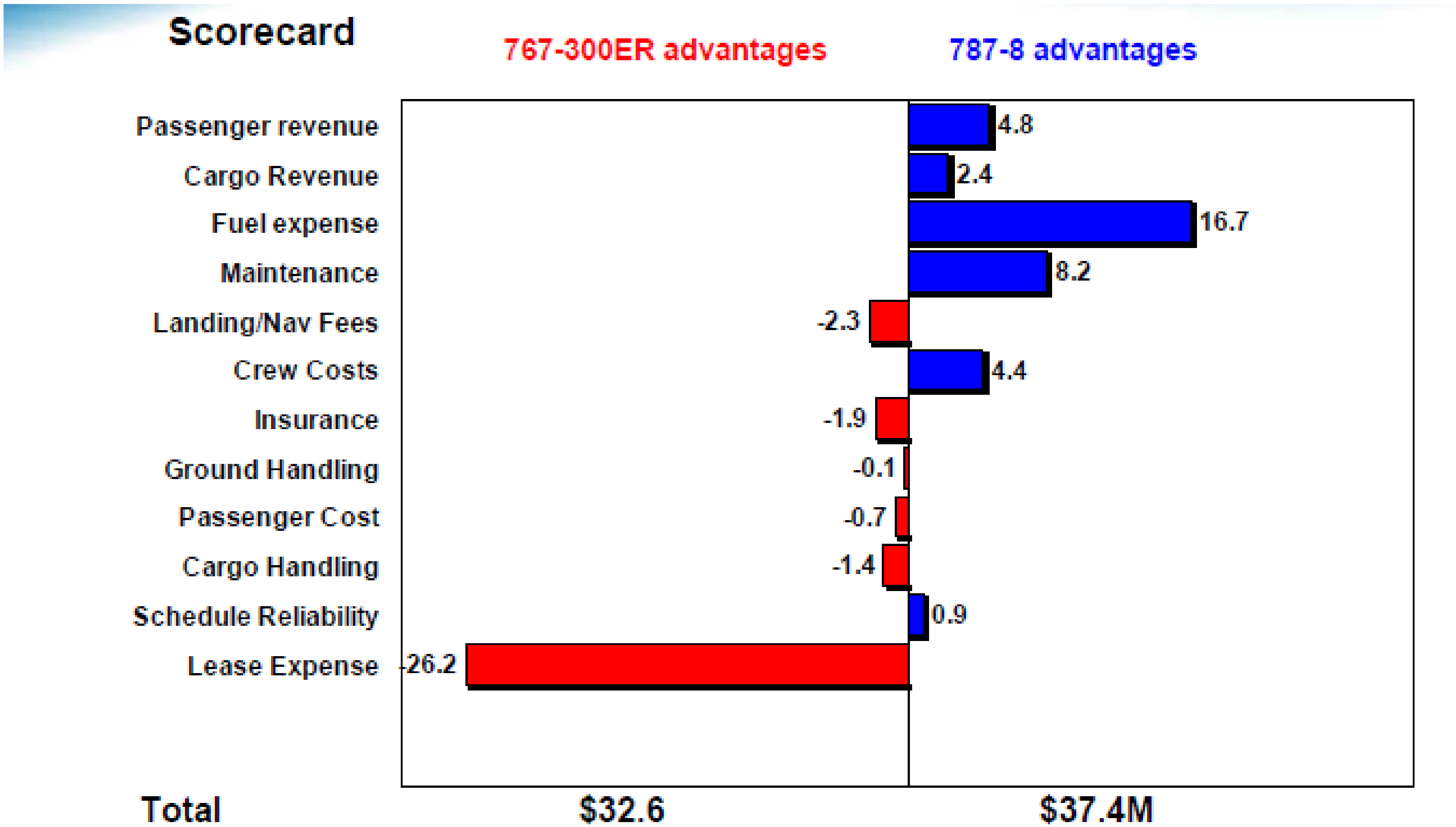
$730K more net revenue per year

← *10 years, 10% discount, 2% esc*

$4.8m NPV

Source: Boeing Commercial Airplanes

Example: NPV Analysis



Source: Boeing Commercial Airplanes