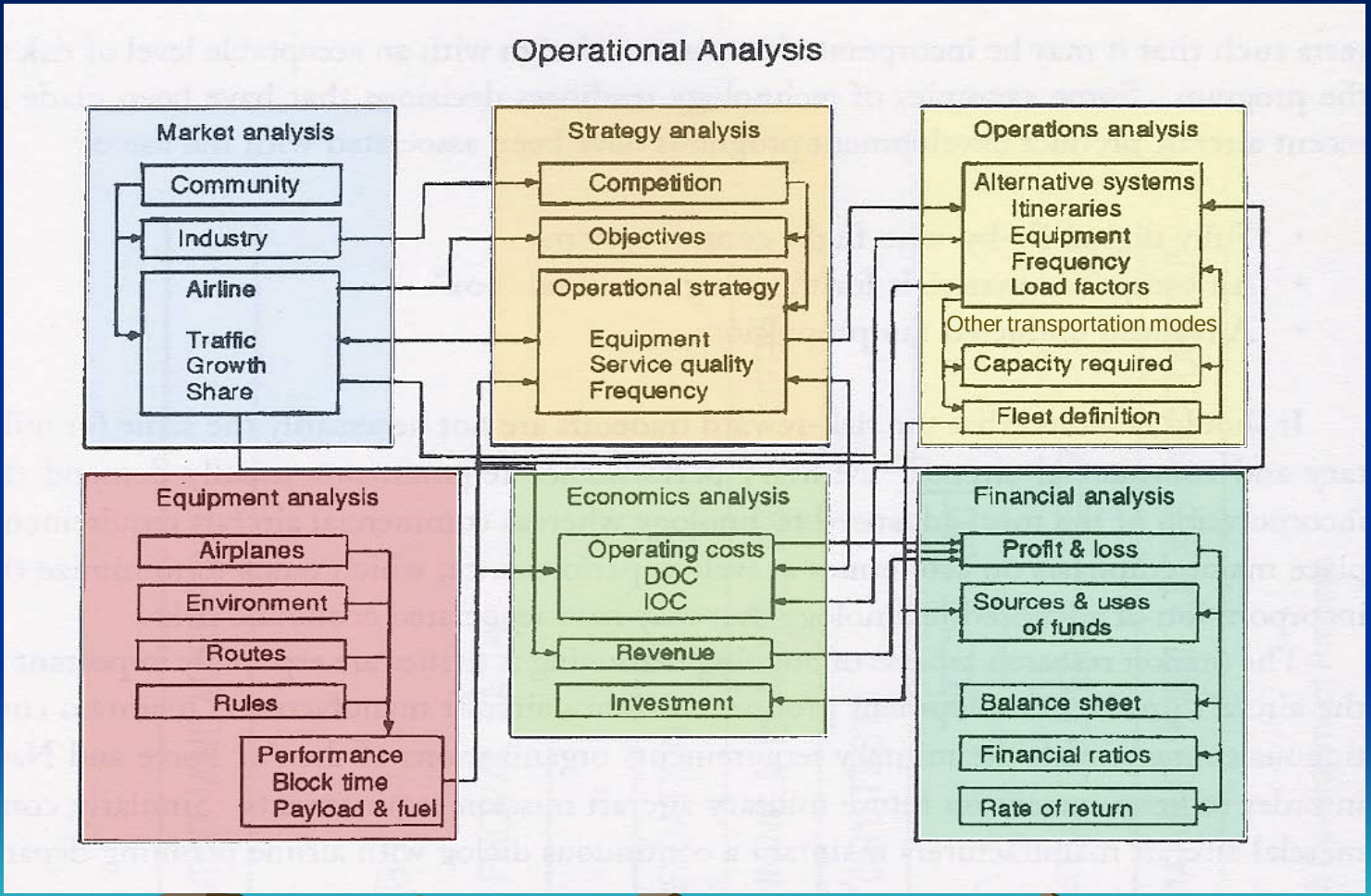
2 Market Requirements

2A Commercial Aviation Market

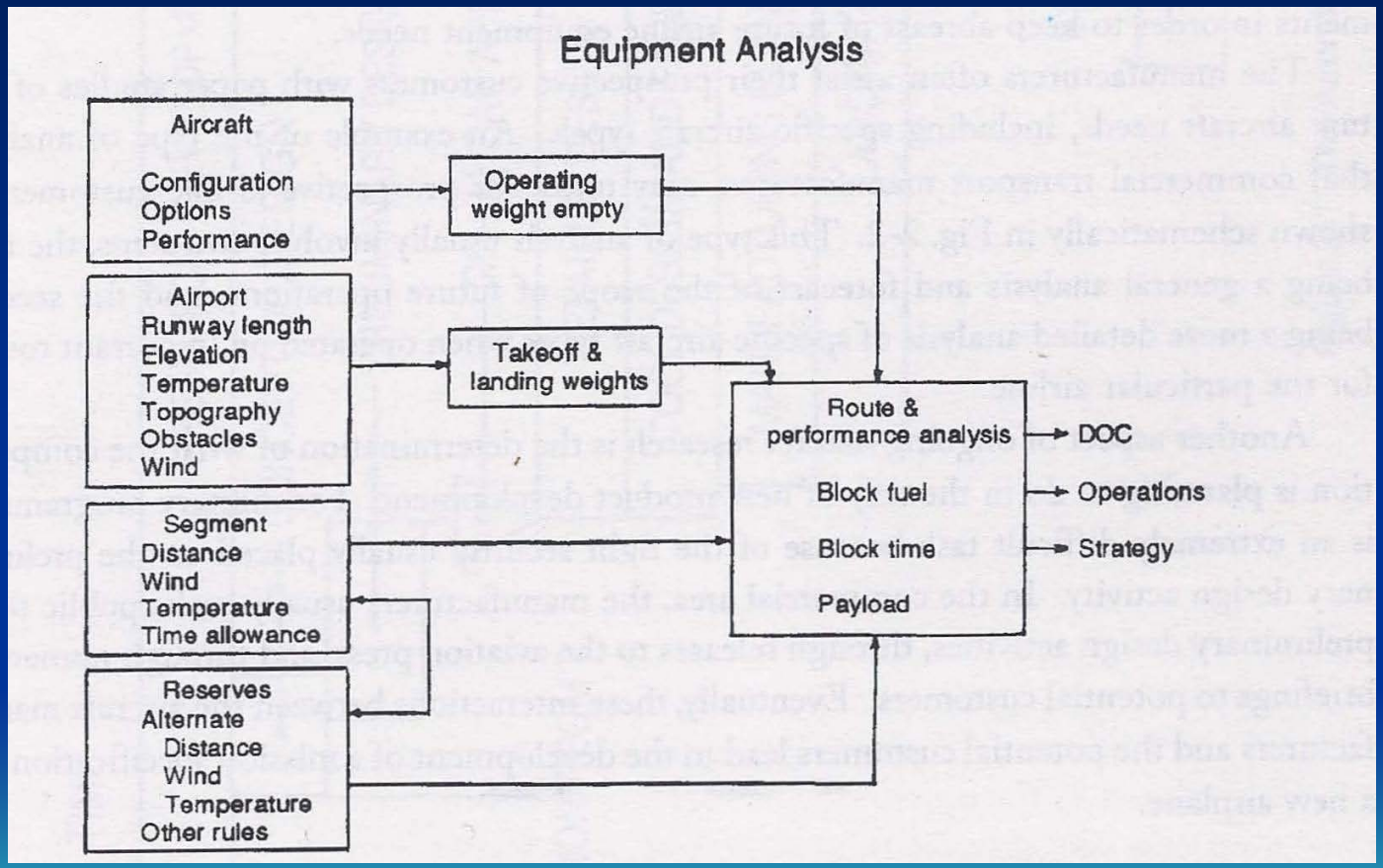
Commercial Requirements

- More collaborative approach than military
- Specifications may be developed in collaboration with one or more launch customers, e.g.
  - B.747 Pan Am
  - B.777 United Airlines
  - B.787 All Nippon Airways
  - A380 Six launch customers

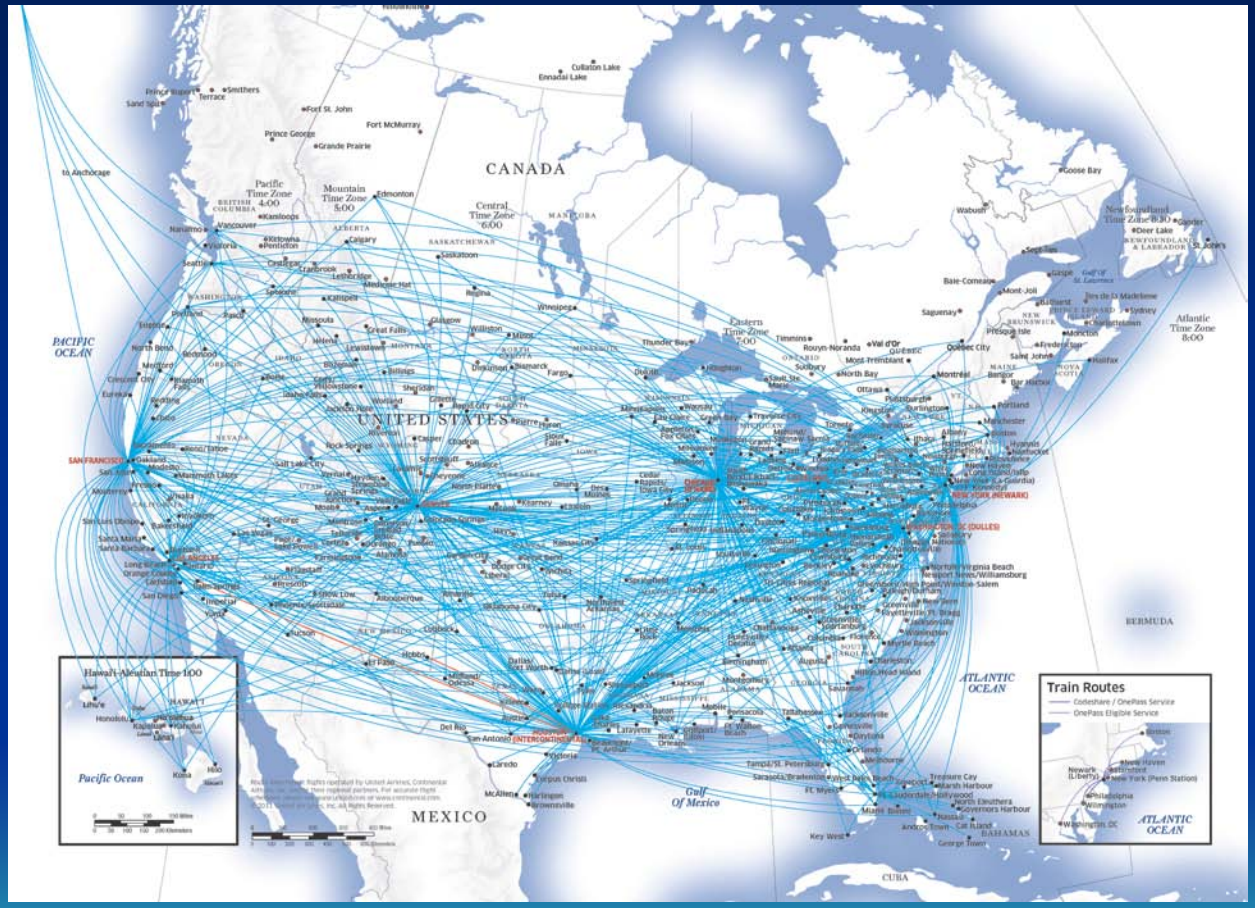
Operational Analysis



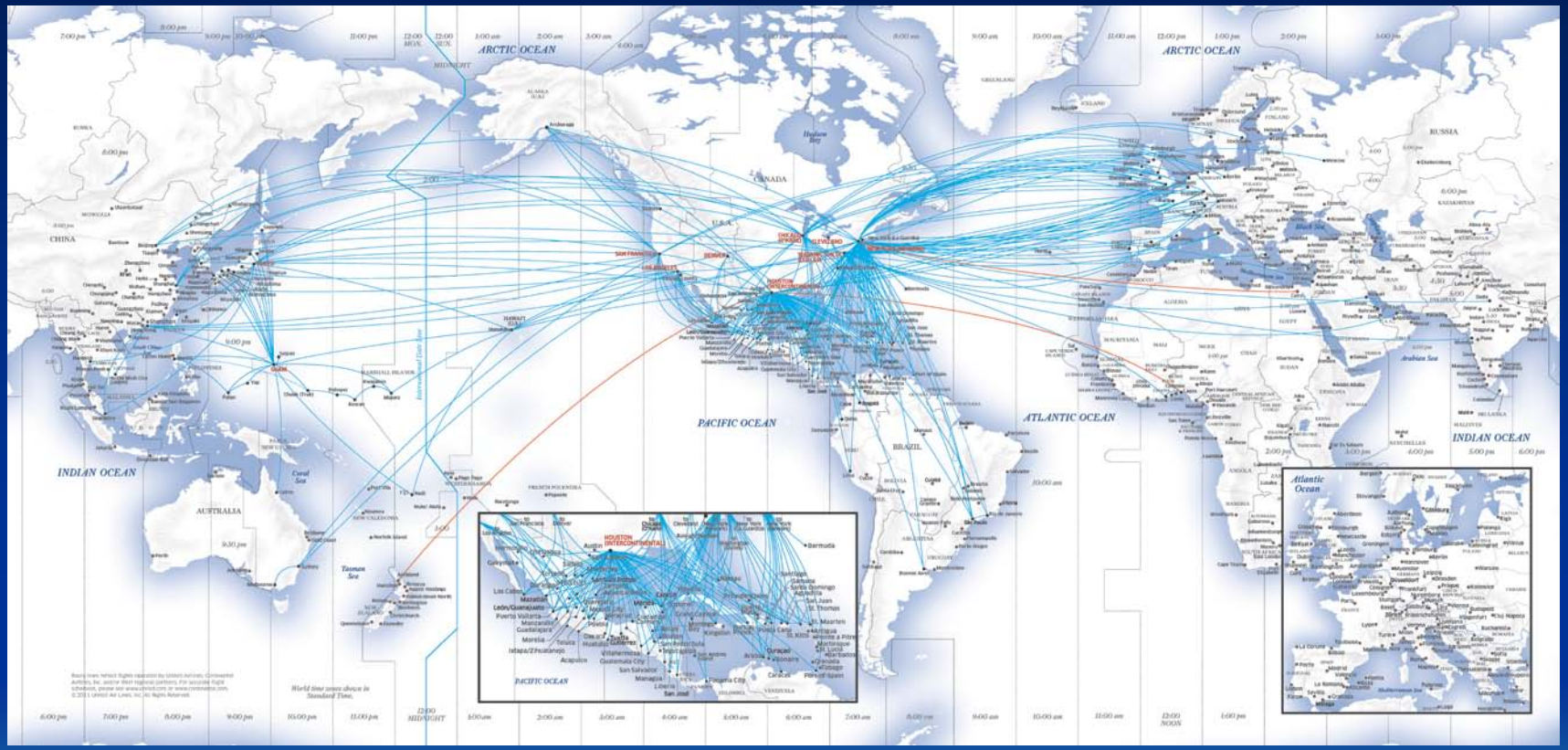
Equipment Analysis



UAL North American Route Map

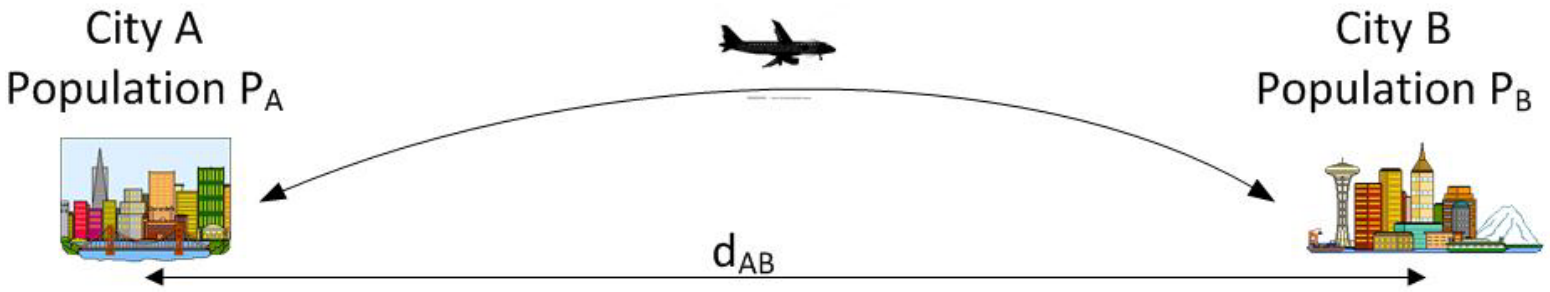


UAL International Route Map



United Airlines International Routes

Gravity Model



Traffic Volume V calculated as $V = k \frac{P_A P_B}{d_{AB}^2}$

where k is an empirical constant

Gravity Model

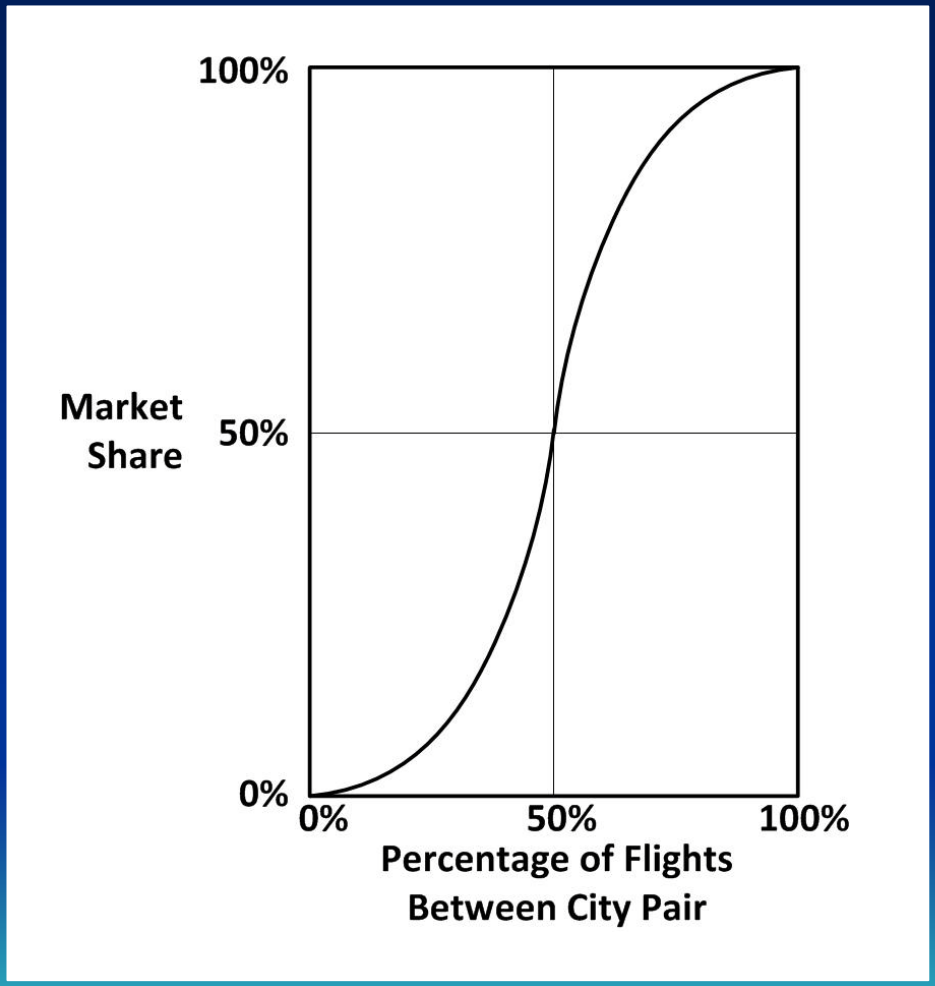
- Empirical factor, k, is a function of variables such as
  - Trade between city pair
  - Income levels
  - Ethnic associations
- Exponent on distance may also need to be empirically adjusted.

Frequency of Flights

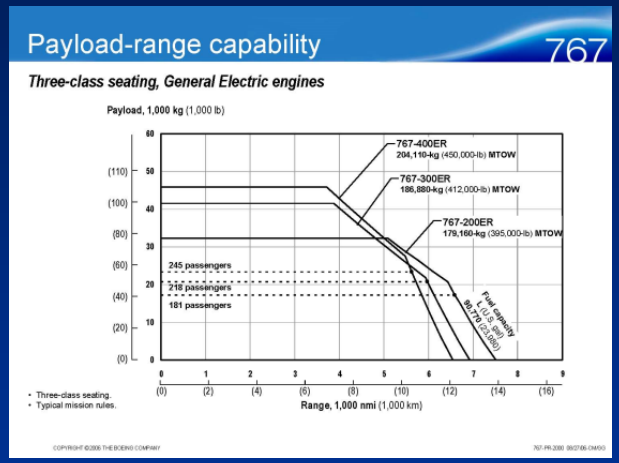
- Would like to have interval between flights to be less than flight time
- In practice, limited by
  - Insufficient traffic
  - Competing travel modes (high-speed rail, auto)
  - Takeoff and landing curfews
  - Connecting flight schedules.

City Pair Market Share

- Increasing percentage of flights in competitive market gives disproportionate increase in market share

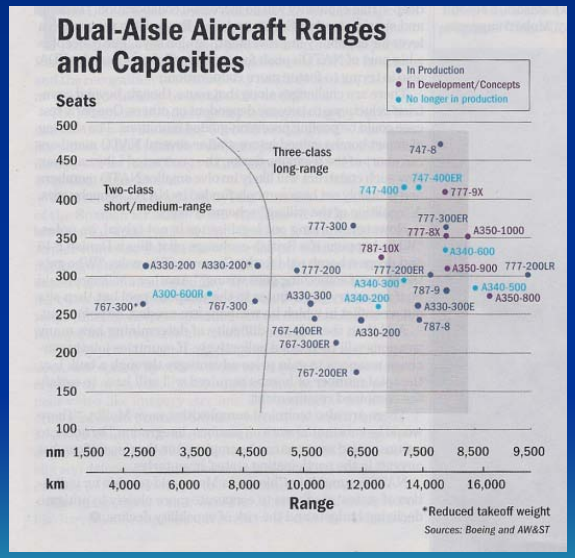


Compare Traffic Forecast to Existing Aircraft Types



Source: Boeing

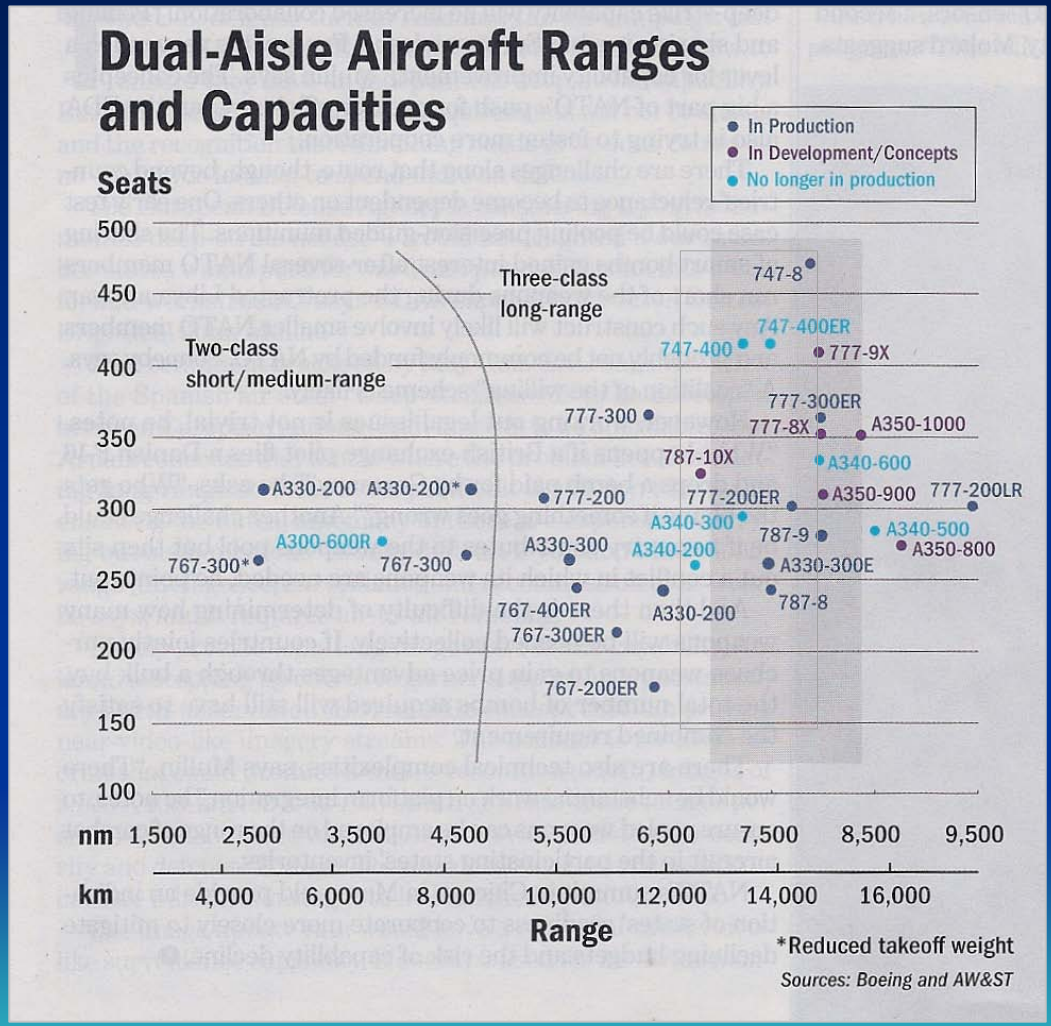
- Identify spaces in aggregated payload-range plot that will satisfy future demand



Source: AW&ST

Point-Design Payload-Range Data

- Differentiate product from others in market
- Satisfy demand based on market analysis



Source: AW&ST

Examples

- PSA purchase of L-1011
  - Good DOC per seat mile
  - Would satisfy market with too few flights per day
- UA delay on implementing LAX-PVG flights
  - Allowed AA to enter market
  - Both airlines now competing on route

2B Military Aviation Market

Development of Military Requirements

- Description of capability needs defined in the Initial Capabilities Document
- Industry is invited to respond through a Request For Information (RFI)

Military Requirements

- Draft Request For Proposal (RFP) is an informal document. Government invites comments from potential bidders.
- RFP is a formal document stating government requirements. Once issued, all informal contact between government and bidders ends.

Military Requirements

- RFP is sent to qualified bidders and requests information which includes
  - Technical proposal
  - Recent government contracts
  - Senior personnel who will work on the contract
  - Facilities

Military Requirements

- Request For Quotation (RFQ) requests a detailed cost and schedule to perform the contract.
- Tasks are broken down into elements using a hierarchical Work Breakdown Structure (WBS).
- Engineers estimate hours to perform each task element.

Military Requirements

- Hours are factored by labor cost plus overhead.
- Use project management software (e.g MS Project, but many others are available.)

U.S. Department of Defense

- Airplanes (or any air vehicle systems) are sold directly to
  - Air Force
  - Navy
  - Army
  - Marines
  - Coast Guard
- Combat air vehicle systems can be evaluated using combat simulation software such as THUNDER

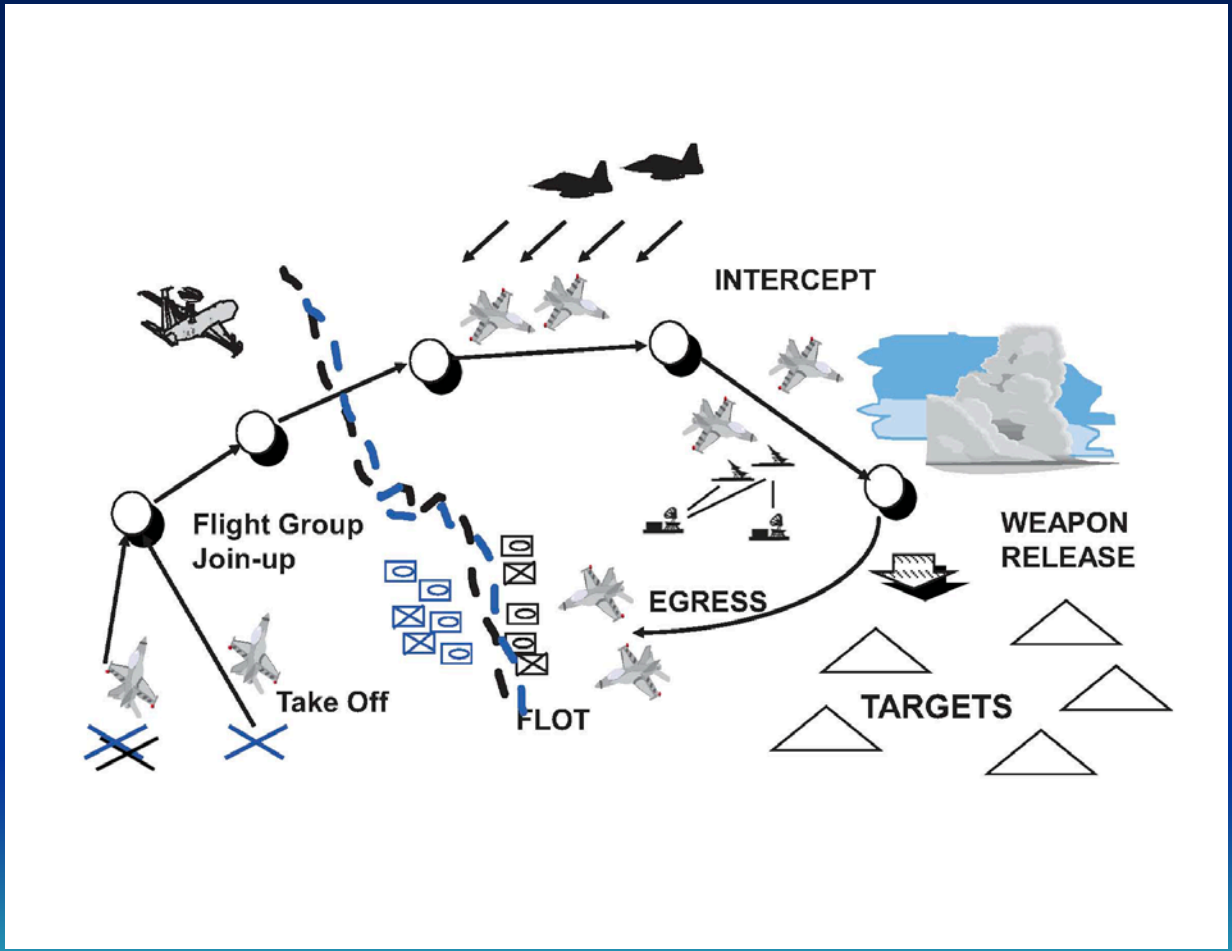
Foreign Government Sales

- Government to government sale
- Contractor to foreign government sale

THUNDER

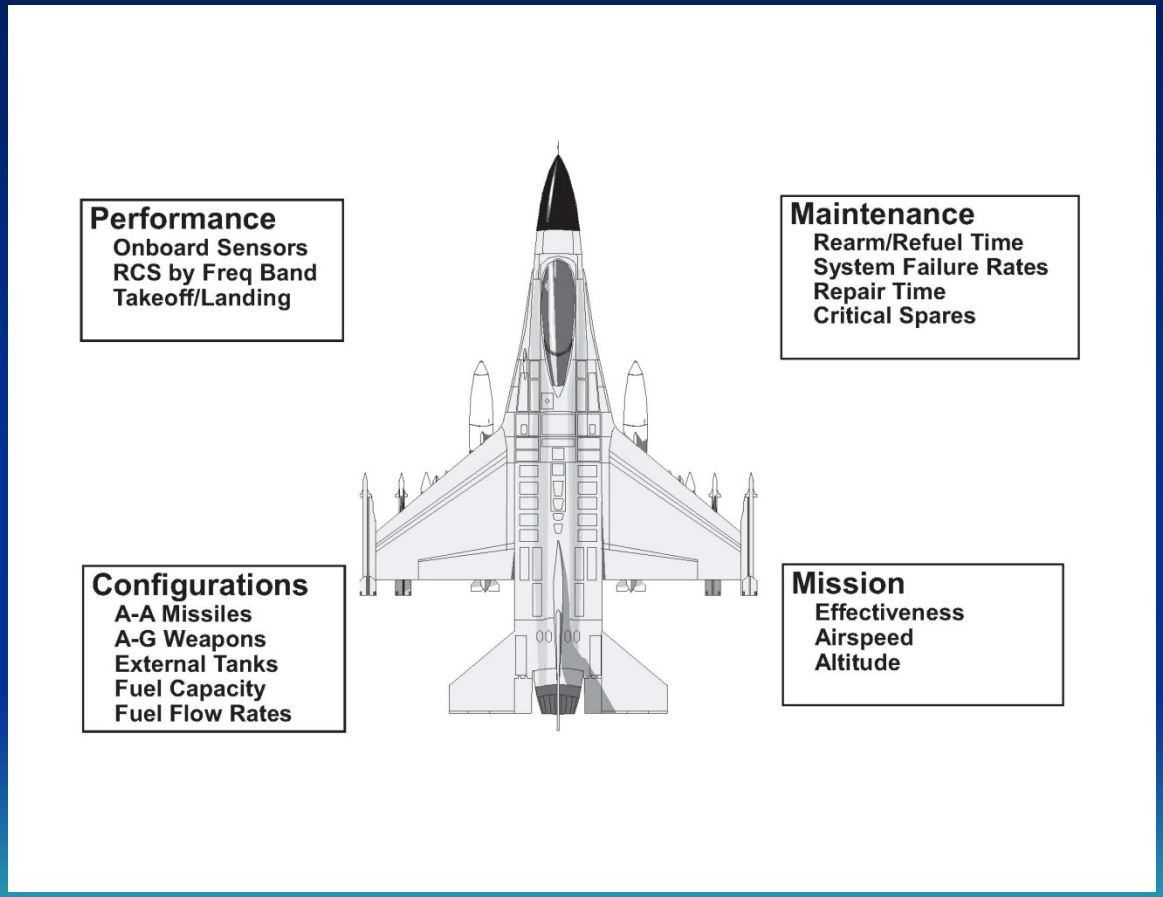
- Purpose
  - Provide detailed analysis to investigate the effects on the combat outcome at the theater level of changes in
    - Plans
    - Tactics
    - Force structures
    - Weapon, munition and sensor systems

Battlefield Model



Source:C.Thomas/R.Hodgkins/V.Duncan

Air Vehicle System



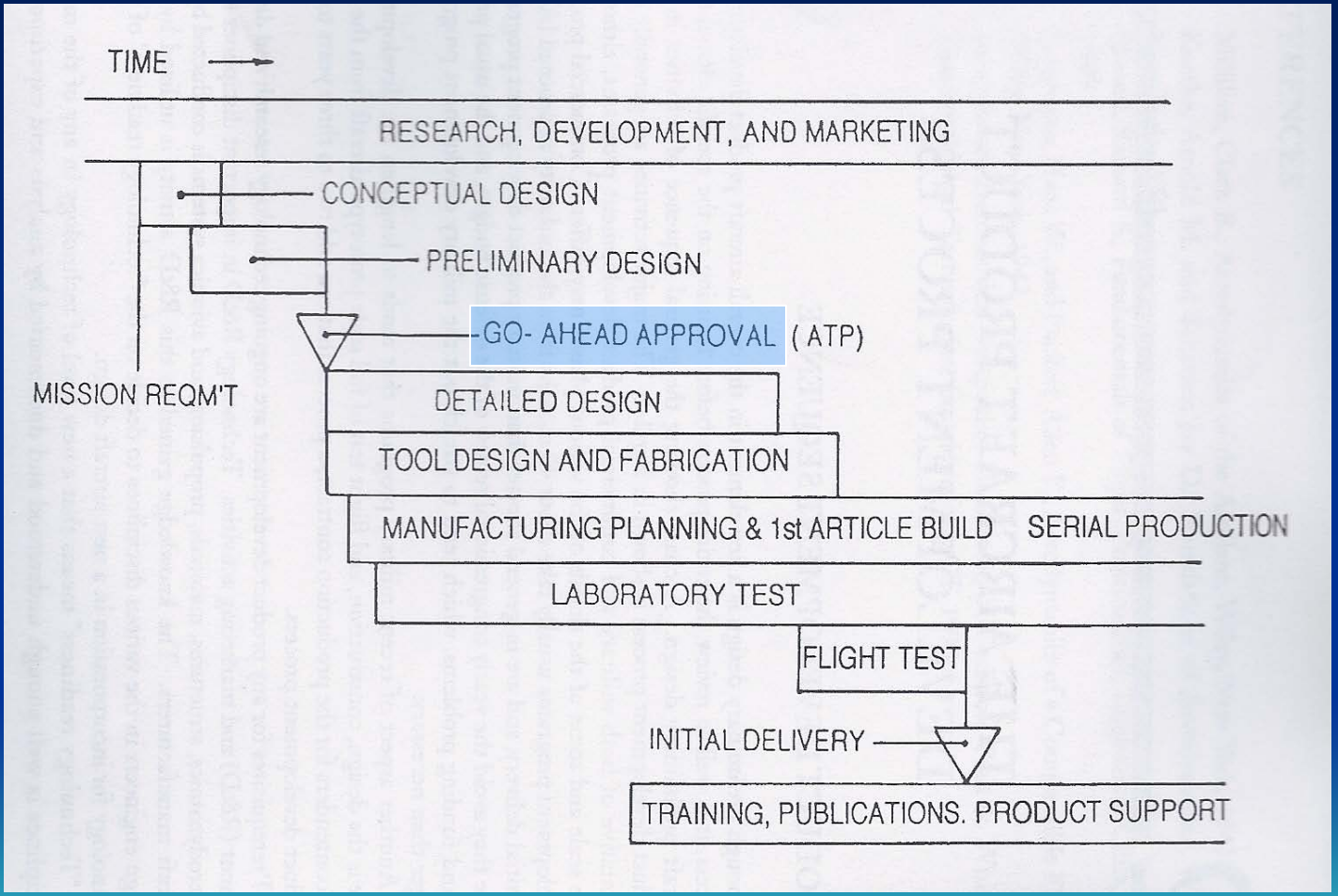
Source:C.Thomas/R.Hodgkins/V.Duncan

3 Risk Analysis

Risk Analysis

- Technical risk
  - Not developing product to specification and schedule
  - Team member or subcontractor not delivering product to specification and schedule
- Economic risk
  - Depression - traffic does not meet forecast
  - Fuel price
  - Exchange rates
  - Inflation
- Political risk

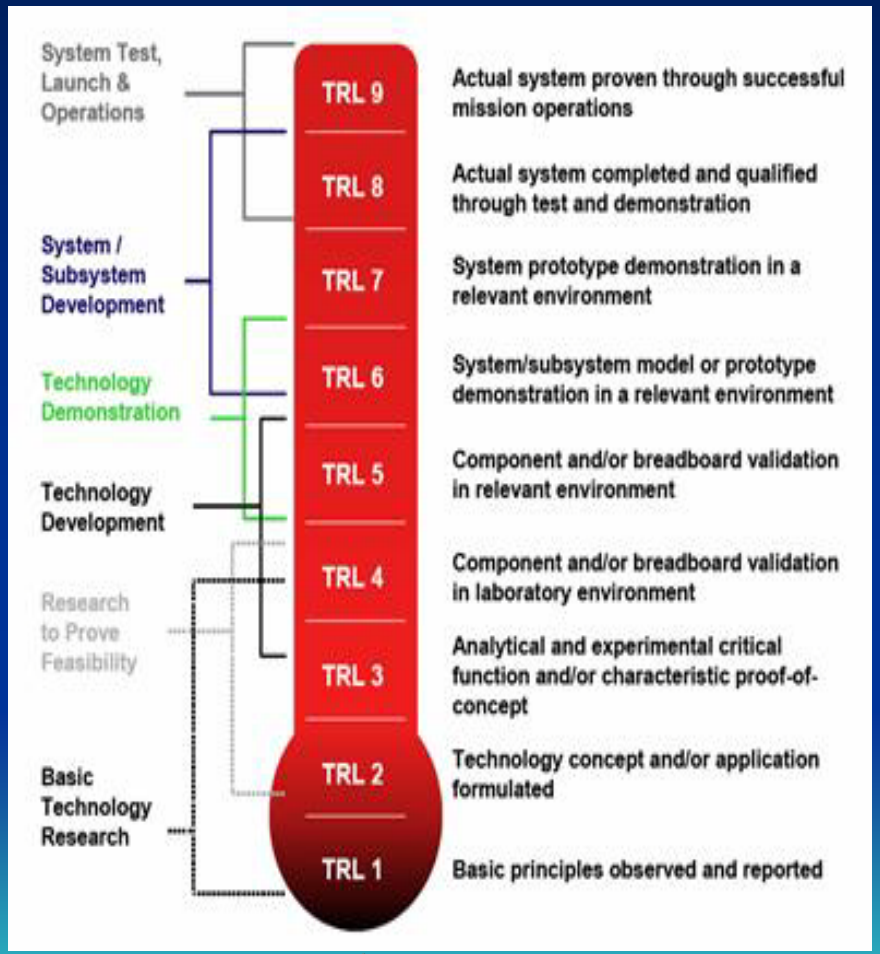
Commercial Development Schedule



Source: Schaufele

Technology Readiness Levels

- At project go-ahead, every system should be at TRL 8 or above for commercial aircraft, TRL 6 or above for military



Risk Analysis

- Examples of failure
  - Hyfil blades for R-R RB.211
  - Europrop TP400-D6 engines for A400M
  - Large scale composite manufacturing for B787.

History behind Rolls-Royce Downfall

CX-LHS Program (1963)

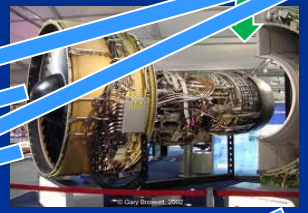
Boeing CX-LHS

Douglas CX-LHS

Lockheed C-5A

GE TF-39

P&W JT-9D



GE CF-6

Boeing 747-100

Douglas DC-10

Lockheed L-1011

Airbus A300

(UK-France MOU signed 1967)