

# Air Transport Systems Cost and Weight Analysis

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# Outline

- Weight Estimation
  - Effect on Design
  - Methods
- Cost Estimation
  - Standard Breakdowns
  - Methods
  - Cost Reduction
- Integration

# Weight Breakdown in Design

- Weight prediction will highlight effect of fuel savings
- 1 lb less fuel is  $X$  lb less structure, which was hauled by more fuel which, etc
  - So, in current A/C, fuel savings opens up more range, other missions.
  - In design of new A/C, fuel savings can change size/weight/cost/configuration of aircraft.

# Weight Prediction Methods

- Analytical Methods
  - Analysis of structural needs produces component weights (need detailed aircraft data)
  - Add systems/payload weights (avionics, seats, cargo handling equip, hydraulics, etc)
- Empirical Methods
  - Statistics from other aircraft used to predict weight of various components (fewer details needed)

# Cost Breakdown for Air Transport

- Manufacturer

- Eng/Development
- Tooling
- Flight Test
- QA
- Manufacturing

- Operator

- Fuel
- Crew
- Capital
- Maintenance
- Support

# Costing Methods

- Parametric Cost Estimating
  - RAND-DAPCA IV
    - Statistical fit of aircraft development, production, operational costs
- Markish Valuation Techniques
  - Per-Lb breakdown of aircraft design program costs by component and source (engineering, tooling, etc)

# Parametric Cost Estimating

- Especially useful in military market analysis
  - Can separate RDT&E costs
  - Can give cost/airframe all inclusive
  - Allows comparison with existing systems for cost, performance benefits
  - Developed using military aircraft as input data

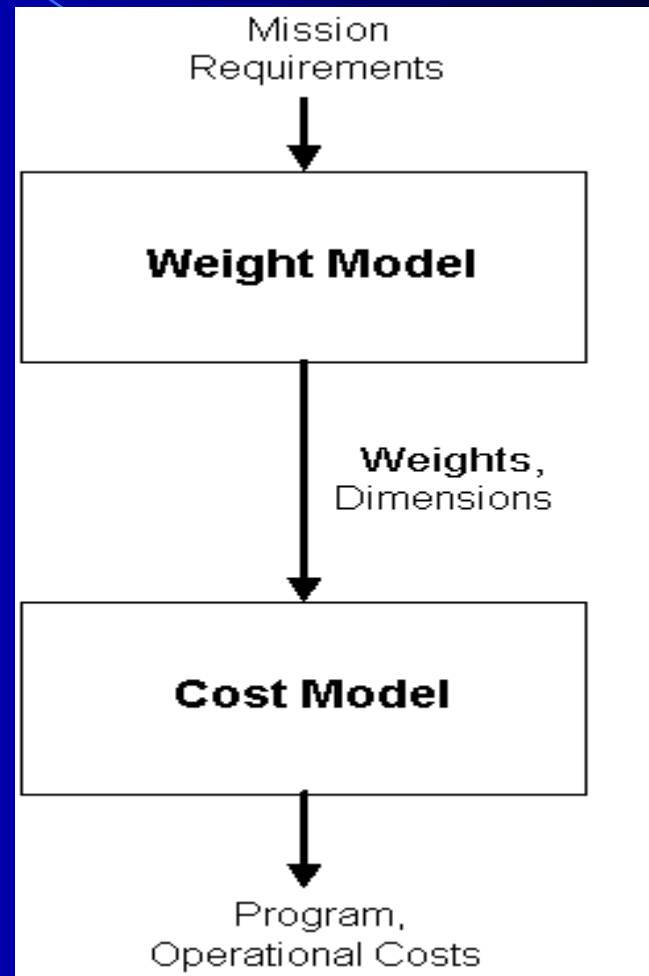
# Cost Reduction

- Must model proposed cost reduction techniques
  - MDO in conceptual phase
    - Reduced engineering hours
  - Lean manufacturing
    - Reduced manufacturing costs, higher learning rate
  - Autonomy (?)
    - Reduced crew costs, increased avionics costs
  - Operational changes
    - Reduced fuel costs



# Integration

- **Weight Models:**
  - Translate mission reqs into corresponding A/C dimensions, weight
- **Cost Models:**
  - Translate A/C dimensions, weights into corresponding program/oper costs



Questions?

# References

- Raymer, Daniel P. 1999, *Aircraft Design: A Conceptual Approach*, AIAA
- Markish, J., “Valuation Techniques for Commercial Aircraft Program Design,” MIT Masters Thesis, 2002
- Liebeck, R.H., “Aircraft Sizing,” Notes from 16.885J, 2002