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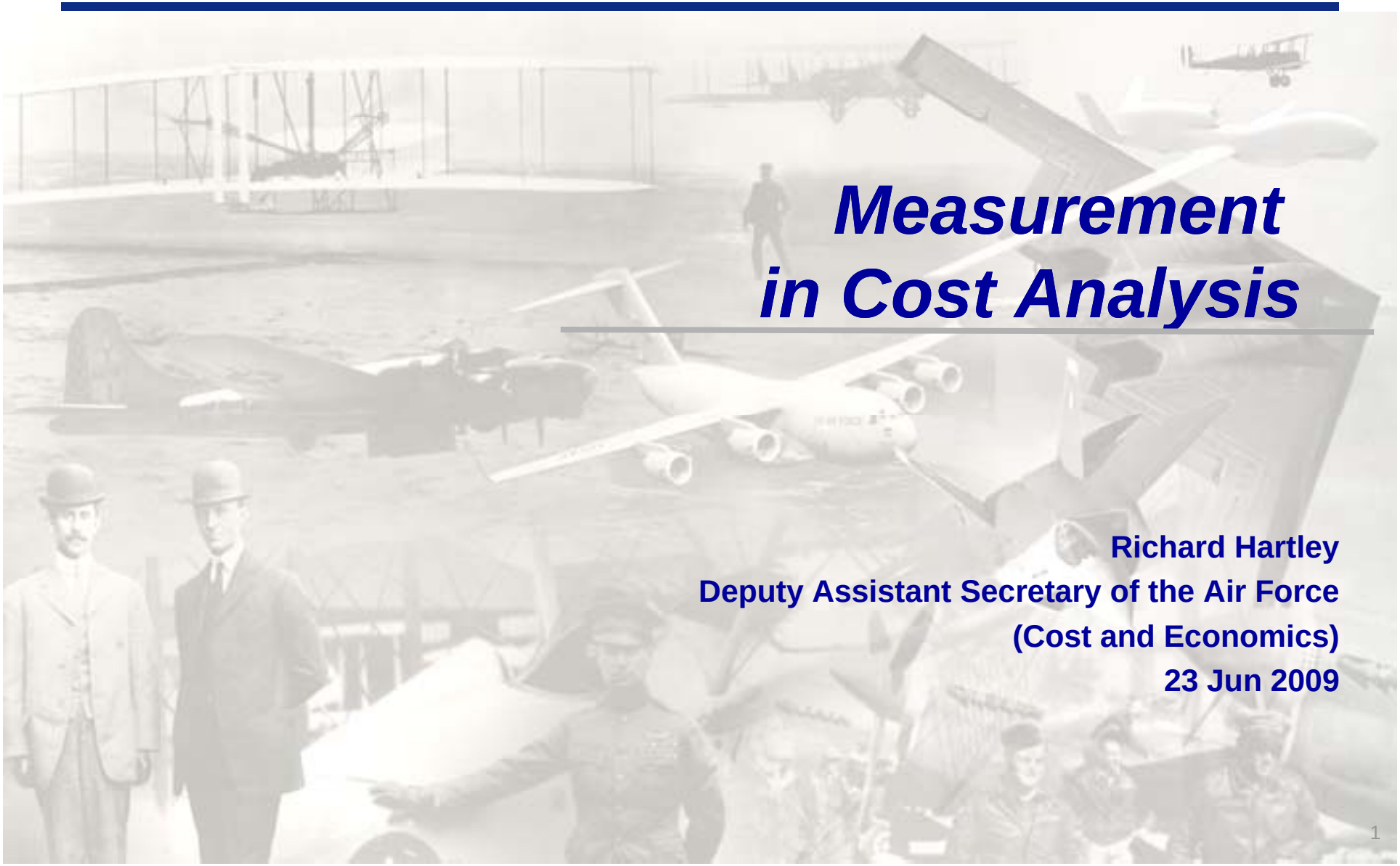

# *Measurement in Cost Analysis*

**Richard Hartley**
**Deputy Assistant Secretary of the Air Force**
**(Cost and Economics)**
**23 Jun 2009**

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# Tough Choices

***"It is one thing to speak broadly about the need for budget discipline and acquisition reform. It is quite another to make tough choices about specific weapon systems and defense priorities based solely on national interests. And then to stick to those decisions over time. The president and I need your help as all of us together do what is best for America as a whole in making those decisions."***

**- Secretary Gates, January 27, 2009**

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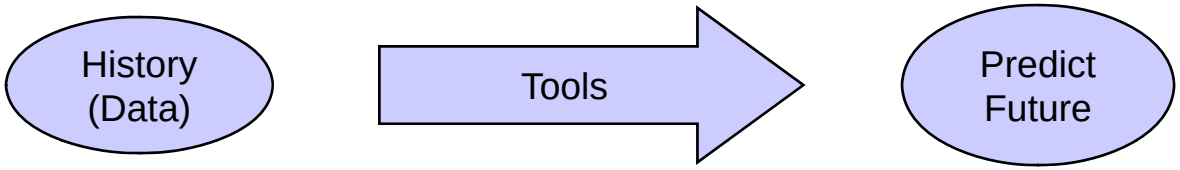
# Fundamental Principles

## Cost Analysis

- Credible Estimates Always Based On History… Else They Are Mere Guesses!




- Challenge: Make the Historical Data as Applicable to Future System as Possible (Using Quantitative Analysis)
- Cost Analysts Are:
  - Engineers, mathematicians, operations research analysts, accountants, business majors, statisticians, scientists, etc.

***Much More Than Simple Math, Not Just a Pricing Computation!***

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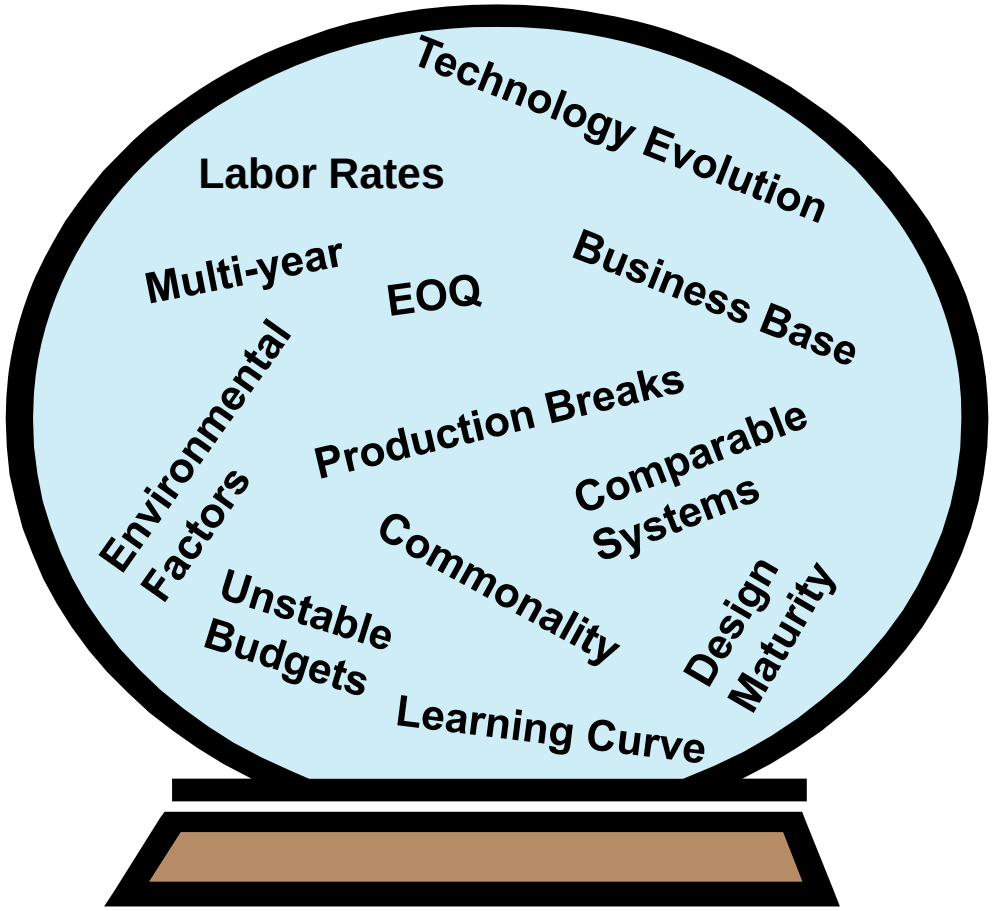
# Why Is It So Hard?

COMPLEX PROGRAM/ESTIMATING CONSIDERATIONS




COMBINE WITH:

Data Challenges

Optimism


# MEASUREMENT IS DATA!

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# *Predicting the Future*

## *Requires Measurement*

- Past Performance – Actuals
- Current and Past Trends – Looking Beyond the Data Range
- Model Calibration
- Adjustments (Complexity, Economics, etc.)

***Analogy, Parametric, and Buildup Techniques Require Cost, Technical and Schedule "Measurement"***

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# Why Is It So Hard?

## Measurement

- Lack of Data
  - Actual cost of completed programs
    - ✓ At right level of detail, in appropriate categories
  - Difficult to garner support for data requirements
    - ✓ Perceived cost of data deliverables, proprietary data restrictions, protecting competitive advantage, etc.
  - Also need technical and programmatic data
    - ✓ More than just cost data
- Poor Data Quality
  - Validated? Accurate? Reliable?
    - ✓ Normalization, interpretation
    - ✓ Content, completeness

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# Measurement

## Data - Red Flags

- "Piecemeal" or Partial Data
  - Errors of omission and double counting – content uncertainty
  - Traceability to reliable source
  - "Cherry picking"
- Lack of Traceability to Published Source at the Total Program Level
- Questionable Adjustments
- Lack of, or Improper, Normalization

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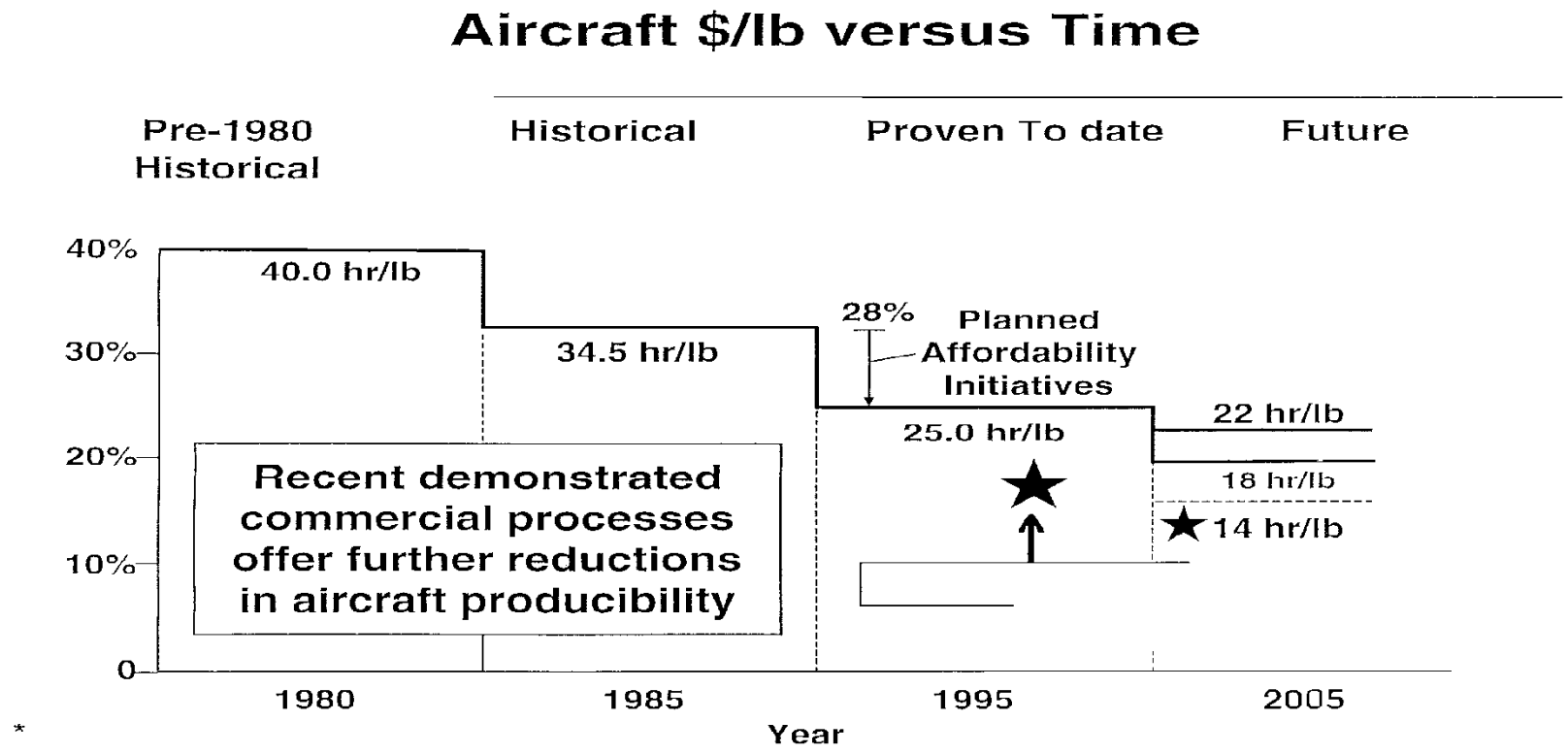
# Bad Data

## An Example




***This is Not Data,***
***If You Experience This, Please Consult Your Cost Estimator***

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# Execution
## Requires Measurement

- Earned Value Management (EVM) and Trip Wires
- Updating Estimates at Completion (EACs)
- Negotiating, Determining Incentives/Awards
- Running Excursions, Trades, etc.

***Metrics are Key to Performance Evaluation, Help Maintain Awareness, Influence Behavior, Take Corrective Action***

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# Root Cause Analysis
## Requires Measurement

- Performance Eval and Process Impvt Require Good Knowledge of Past Performance
- Knowledge Requires Valid Data and Reliable Analysis
  - Counteracts finger pointing, speculation and flawed intuition, etc.
  - Critical in production line continuous process improvement – why not in cost estimating and acquisition

***SAF/FMC Implementing Cost Estimating Performance Metric!***

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# THE CURRENT ENVIRONMENT

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# Performance

## Cost Growth Analysis

Historical Cost Growth for Completed SAR Programs
Actual vs. MS II Baseline, **1968-2006**

| | @ completion | @ 5 yrs past MS II |
|---|---|---|
| Total Program | 54% | 35% |
| Development | 67% | 41% |

**Ongoing programs, avg 47% complete**

| | Projected at completion* | 5 yrs past MS II | Growth to date |
|---|---|---|---|
| Total Program | 114% | 52% | 97% |
| Development | 85% | 54% | 96% |

**Ongoing Programs Begun this Decade**

| | Projected at completion | 5 yrs past MS II |
|---|---|---|
| Total Program | 195% | 89% |
| Development | 132% | 84% |

* Historical growth beyond 5 year point

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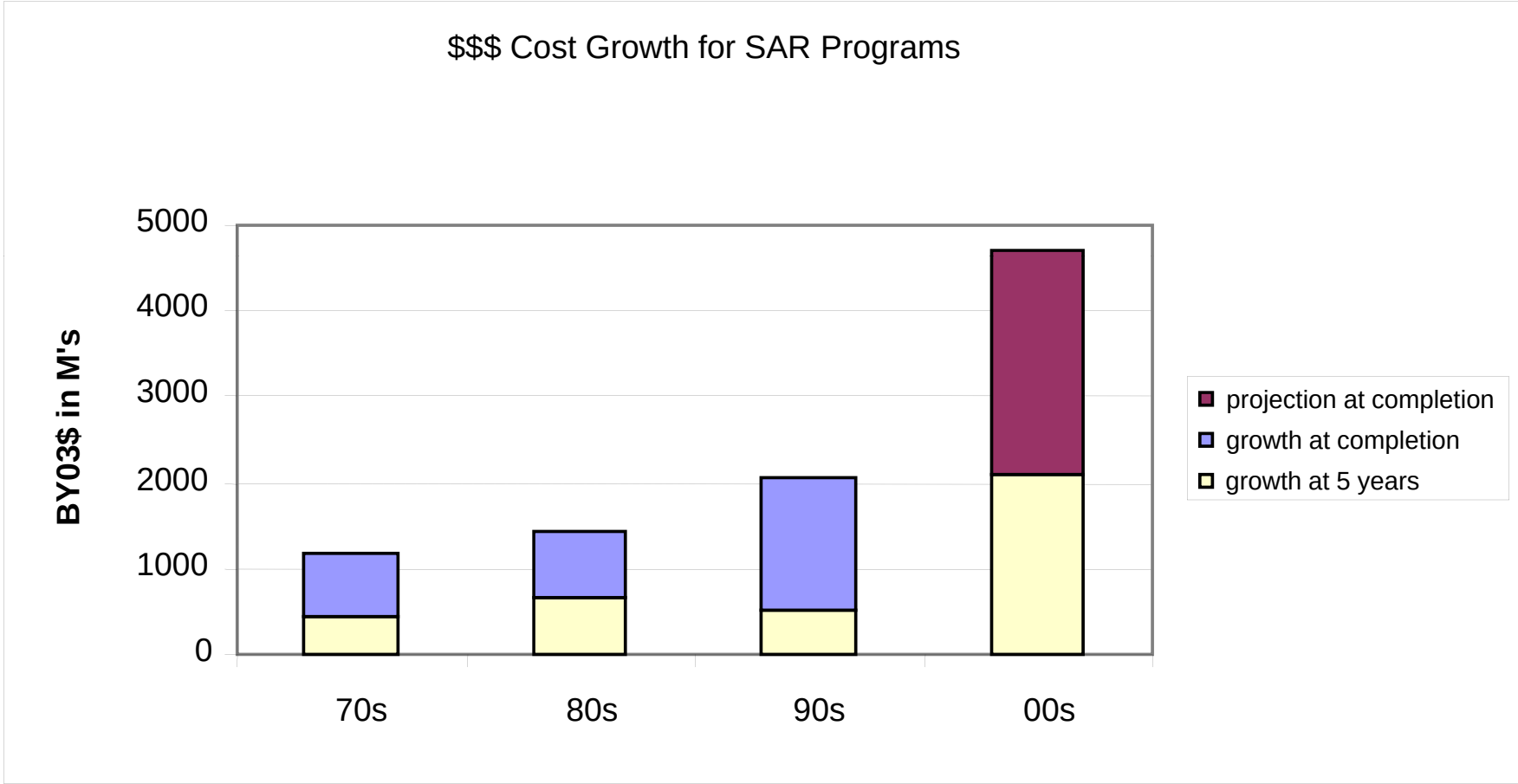
# A Different Look

## Dollarized Growth Trends by Decade



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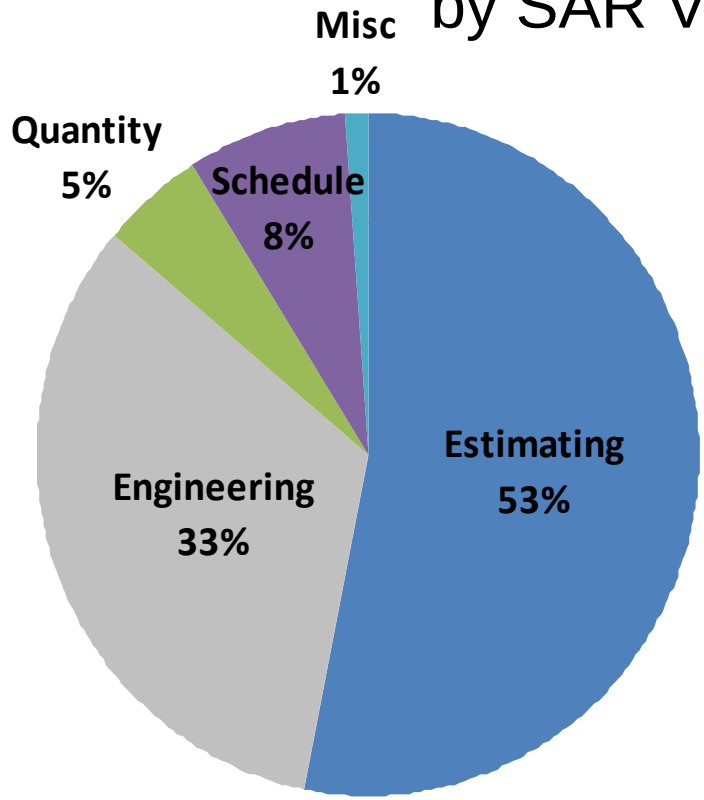
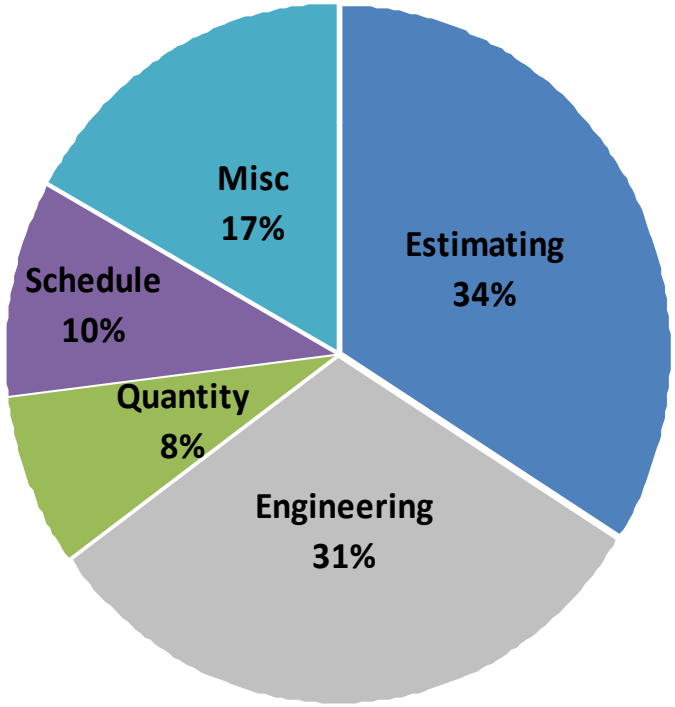
# Sources of Cost Growth

## Contribution to Development of Cost Growth by SAR Variance Category




"Straight SAR" Data




RAND Analysis

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# Observations

- Current trends Not Favorable
  - Projected growth at completion >2x prior generations
  - Dollarized cost growth trends cause for concern
  - Historically, most growth occurs prior to “Milestone B + 5 years” point, recent programs displaying growth well beyond
- Cost Growth Statistics Are Lagging Indicators
  - Start to measure at 5 years past Milestone B
  - Today’s stats reflect decisions of mid-90’s, early 00’s
- Recent Initiatives Help, But More Action Necessary

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# THE RESPONSE

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# Congressional Attention

- FY05 HASC Strategic Forces Subcommittee
- FY06 National Defense Authorization Act (NDAA)
- FY07 NDAA [HR 109-702]
  - Sec. 816 Major Automated Information System Programs
  - Sec. 820 Government Performance of Critical Acquisition Functions
  - Sec. 853 Program Manager Empowerment and Accountability
- FY08 NDAA, Sec. 852, DoD Acquisition Workforce Development Fund
- Weapons System Acquisition Reform Act (WSARA) of 2009
  - House Report 2101 - Weapons Acquisition System Reform Through Enhancing Technical Knowledge and Oversight (WASTE TKO)

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# WSARA of FY2009

- Creates Director of Cost Assessment & Program Evaluation
  - Direct report to SECDEF, moves OSD CAIG & PA&E under
  - Creates Director, DT&E under AT&L; creates Director, SE under AT&L
- Tightens up Provisions for Allowing Troubled Programs to Continue
- Specifies More Things JROC Must Do to Validate Programs
- Requires Dir, Def Research and Engineering to Annually Assess Tech Maturity and Integration Risk on MDAPs
- GAO to Evaluate Accuracy of O&M Cost Estimates And Actuals
- Requires DFAR to ID Organizational Conflicts of Interest
- Cash Awards for Acquisition Personnel

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# Current Initiatives
## In Measurement

## Strategic

- Standard Work Breakdown Structure (WBS) and Contract Data Deliverable
- Improving Basis of Evaluation (BoE) Proposals and Evaluation
- Technical/Schedule Baseline Realism
- Historical Engineering Change Proposal (ECP) Analysis – Understanding Cost Estimating Content
- Improving Risk Analysis – Input Distributions
- Cost Estimating Performance Metrics

## Tactical

- CSDRs and Commodity Specific Databases
  - JCARD
  - Software –sizing (SLOC vs.- functional parts, nodes and links), complexity attributes
  - ERPs
- Technical Baseline Data
  - Technology Readiness Levels, Integration Readiness Level
  - % New Design, payload/bus mass Ratio,
  - Traditional Technical Attributes
- Gvmt/industry Cost IPTs
- Inflation Studies
- Etc., etc. etc.

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# Take-Aways

- Measurement Critical to all Phases of Cost Analysis
  - Data collection, methods development, estimating, executing, evaluating
- Requires Solid Analysis
  - Consistent, standard approaches offer high value
  - Numerous initiatives underway
  - Great promise, but need your help!

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# Closing Thoughts

- Cost Estimator Has Fiduciary Responsibility
  - The honest broker
- Cost Estimating is Forecasting – Use Knowledge of Past to Predict Future
  - Focus on measurement infrastructure (i.e., historical data)
- Challenge Technical and Schedule Assumptions
  - They drive your product

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# Questions

## ONE TEAM, ONE FIGHT


**Working together to improve cost analysis**

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# Key Requirements

- Qualified Personnel
- Data (and Methods)
- Objectivity
- Realistic Technical/Schedule Baseline
- Supportive Culture

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# Key Requirements

## Data (and Methods)

- Require Standard Work Breakdown Structure and Program Cost/Technical Data Reports
  - Cross-program analysis, cost estimating relationships, etc.
- Joint (Government and Industry) Efforts to Normalize and Interpret Data
  - Common government/industry understanding of data, reconcile differences, where possible
  - Track to auditable total program cost – reduce double-counting, errors of omission, content issues, etc.
- Dedicated Budget for Infrastructure
  - Data collection and methods development

***Reliable, Accurate Databases; Consistent Information to Oversight!***

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# Key Requirements

## Realistic Technical/Schedule Baseline

- Technical and Schedule Assumptions Have Heavy Influence on Estimate
  - Frequently optimistic
- Establish "Permanent, Institutional" Independent Technical Assessment Capability
  - Responsibility to build and maintain "evaluation" infrastructure, expertise, experience
    - ✓ Data & methods, lessons learned, past performance metrics, qualified subject matter experts
  - Accountability and process improvement through performance metrics
    - ✓ Predicted vs. realized technical parameters/assessments (e.g. sensor design maturity)
- Partnership with Cost -- "Interoperability" with Cost Estimating Process
  - Improved understanding/communication across functions
    - ✓ Better knowledge of other processes/inputs
    - ✓ Input exchange

***Realistic Technical and Schedule Assumptions for Cost Estimates!***

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# Key Requirements

## Supportive Culture

- Need Leadership Pull, Not Cost Push
  - Demand/use realistic cost estimates, value independent view
  - Understand/support requirements for cost estimate – time, resources, input from other functions, historical data
- Establish Supporting Policy
  - Guidelines, standards, and requirements
  - Require realistic cradle-to-grave cost analysis
- Maintain Cost Estimating Performance Metrics
  - Fact based performance evaluation, identify improvement opportunities

***Leadership support directly correlated with cost capability– critical to acquisition credibility and efficiency***

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# Expectations of the Cost Estimate

- Assessment of Tech/Schedule Baseline -- incl. Risk
  - Realism a BIG deal -- cost drivers, growth, COTS/heritage, risk analysis
- Transparent/Traceable
  - Historical actuals, complexity factors/adjustments & risk analysis
  - Caution with piecemeal data & multiple data/methods sources
  - Work Breakdown Structure (WBS)
  - Consistency with customer data collection results
- No omissions & double-counting
- Cross-checks – High- and Low-level,
- Calibrate “black box” models
- Link Estimate to Schedule & Time-phased Budget
- Communication & Utility