“WHY AFFORDABILITY IS A SYSTEMS ENGINEERING METRIC”

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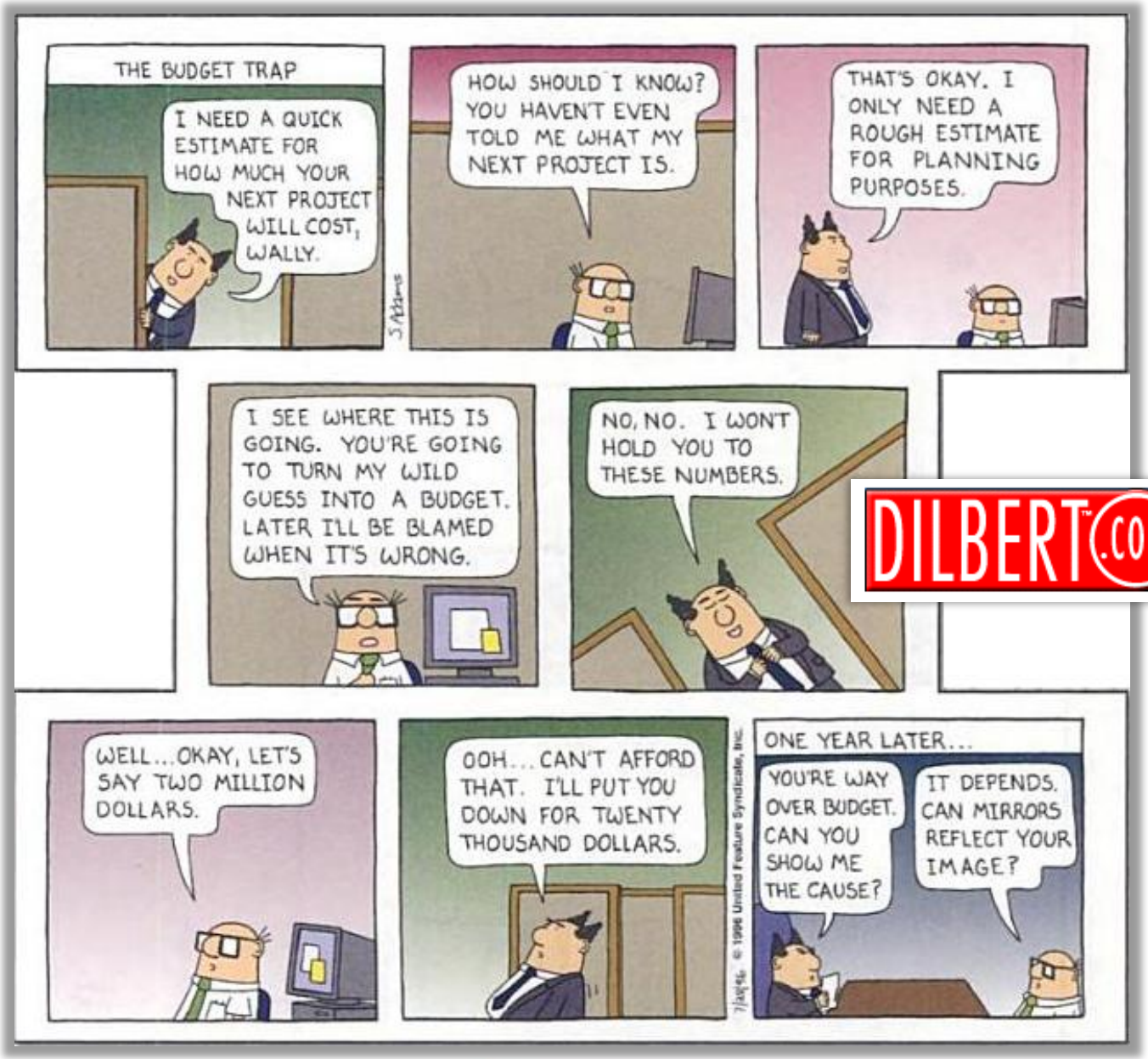
THE BUDGET TRAP
I NEED A QUICK ESTIMATE FOR HOW MUCH YOUR NEXT PROJECT WILL COST, WALLY.
HOW SHOULD I KNOW? YOU HAVEN'T EVEN TOLD ME WHAT MY NEXT PROJECT IS.
THAT'S OKAY. I ONLY NEED A ROUGH ESTIMATE FOR PLANNING PURPOSES.
I SEE WHERE THIS IS GOING. YOU'RE GOING TO TURN MY WILD GUESS INTO A BUDGET. LATER I'LL BE BLAMED WHEN IT'S WRONG.
NO, NO. I WON'T HOLD YOU TO THESE NUMBERS.
DILBERT.COM
WELL...OKAY, LET'S SAY TWO MILLION DOLLARS.
OOH... CAN'T AFFORD THAT. I'LL PUT YOU DOWN FOR TWENTY THOUSAND DOLLARS.
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ONE YEAR LATER...
YOU'RE WAY OVER BUDGET. CAN YOU SHOW ME THE CAUSE?
IT DEPENDS. CAN MIRRORS REFLECT YOUR IMAGE?

AFFORDABILITY…

The characteristic of a product or service that enables consumers to:

- Procure it **when they need it**
- Use it to meet their **performance requirements** at a level of quality that they demand
- Use it whenever they need it over the expected life **span of the product or service**
- Procure it for a **reasonable cost** that falls within their budget for all needed products or services

Department of Defense Definition

Affordability is the degree to which the life-cycle cost of an acquisition program is in consonance with the long-range investment and force structure plans of the Department of Defense or individual DoD Components. **Affordability procedures** establish the basis for fostering greater program stability through the assessment of program affordability and the determination of affordability constraints.

- Components shall plan programs consistent with the DoD Strategic Plan, and based on **realistic projections** of likely funding available in the Future Years
- **Affordability** shall be assessed at each milestone decision point beginning with program initiation – usually- MILESTONE 1.
- Cost Analysis Improvement Group (CAIG) reviews shall be used to ensure cost data of sufficient accuracy is available to support reasonable judgments on affordability for ACAT 1 programs.
- DoD Component Heads shall consult with the USD (A&T) or the ASD(C3I), as appropriate, on program objective memoranda (POM) and budget estimate submissions (BES) that contain a significant change in funding for, or reflect a significant funding change in, any program subject to review by the DAB or the DoD Chief Information Officer.

Why Affordability is an SE Metric

- Affordability is a **decision making tool** – supports selection of the most affordable technologies and systems.
- Affordability can be **improved, measured and predicted** – these techniques enable analysts to forecast expected affordability of alternative technologies and systems, and to measure improvement in affordability of a given system

Why Affordability is an SE Metric

- Provides a **structures analytical path** from determining requirements to fielding affordable systems.
- **Conducting research** into the concepts of affordability and methods to implement the approach.
- **Establishes a foundation** for creating Affordability Systems Engineering Science.

Why Affordability is an SE Metric

- Studying **Complexity Sciences** helps explain relationships between fitness and affordability.
- Investigation of **game theoretical modeling** and other advanced Systems Engineering concepts to focus on System thrusts that will leverage significant downstream system affordability.
- **Initiate research**

How Affordability is Utilized

1. Determine the **customer concerns** and understand those concerns
   - **Explicit** – States cost goals or operating budgets
   - **Implicit** – Customer desire to reduce program staffing
   - **Next Phase** – Contract contains a limited budget/funding
   - **Unit Production** – Average Unit Production Cost (AUPC) goals
   - **Total Ownership Costs** (TOC)-Reduced Total Ownership Costs (RTOC)- Life Cycle Costs (LCC) must be some determine percent (normally 30%) less than the replaced system

How Affordability is Utilized

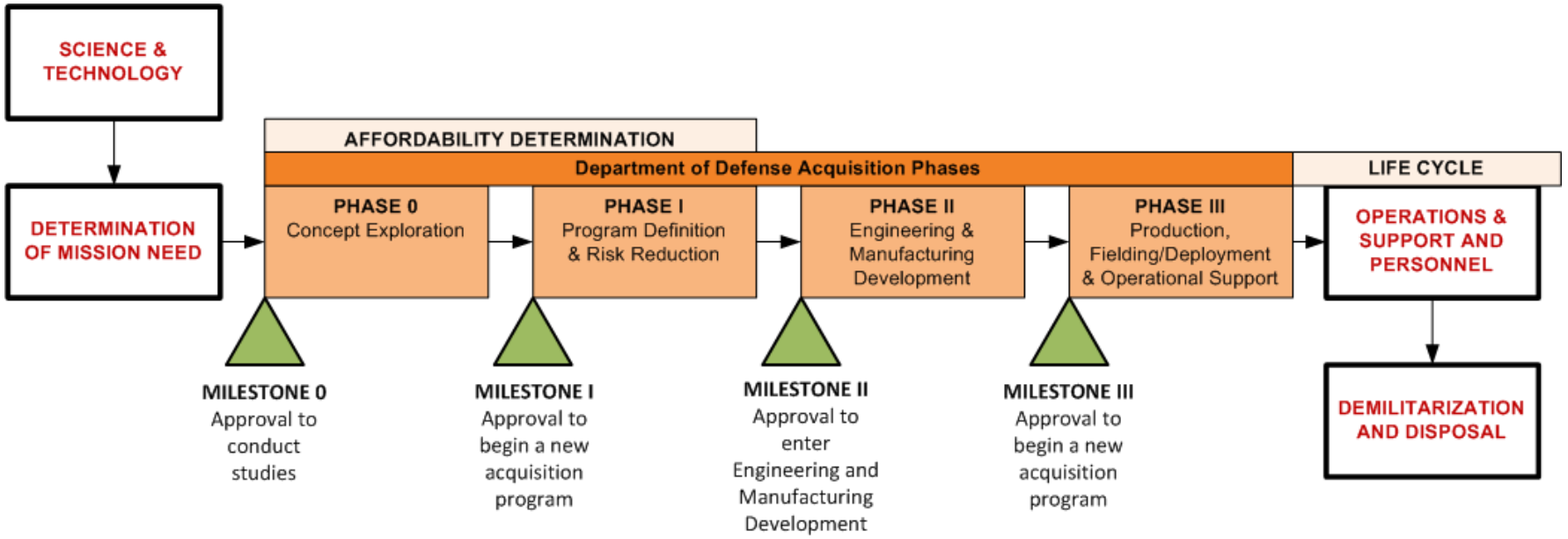
2. Determine **competition impact** on affordability
   - Marketing determines cost limit to WIN the contract
   - Existing inventory items with potential modification costs

3. Set **design goals** (Including system cost Goals and Targets)
   - Top level system or architecture
   - Subsystems All phases

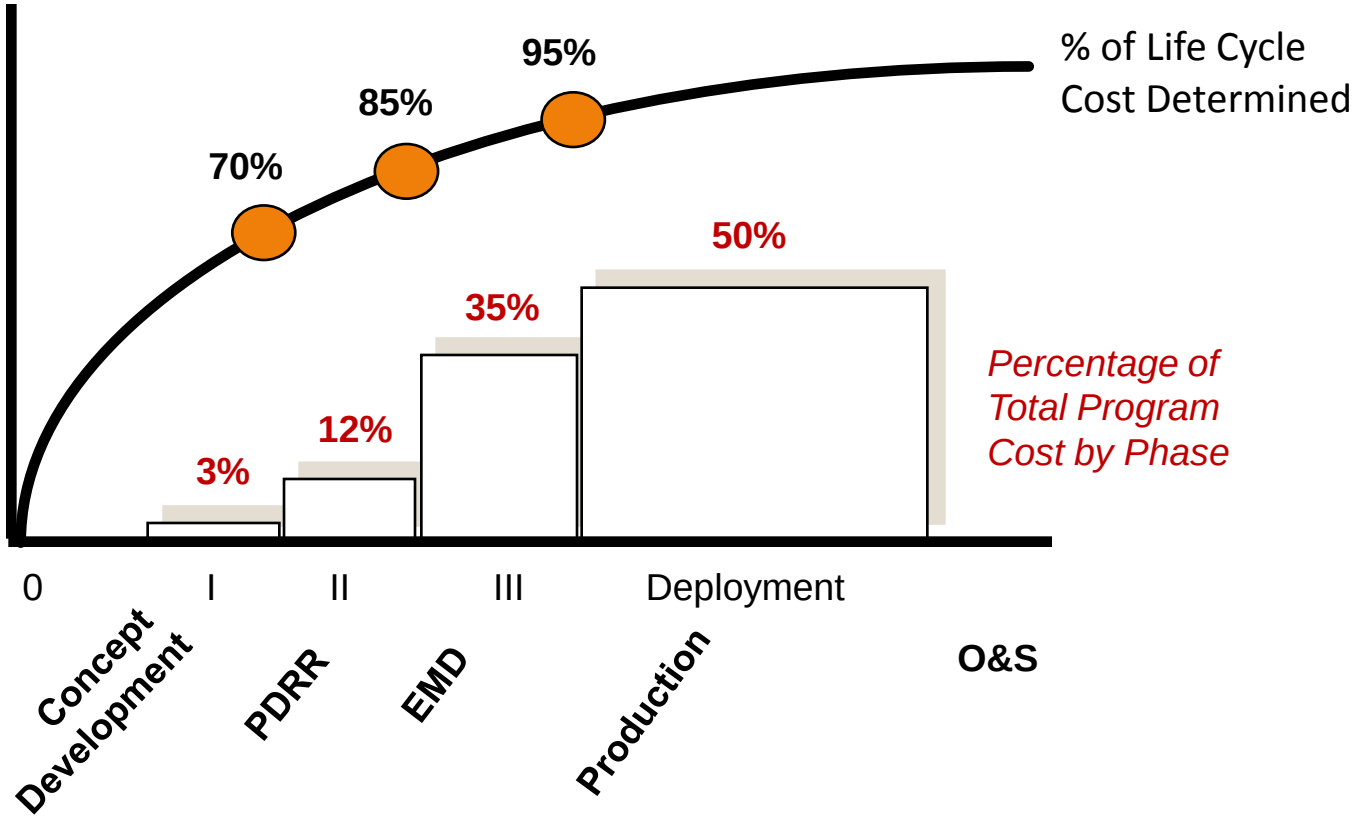
How Affordability is Utilized

4. Understand system **requirements vs.** system **affordability**
   - Perform the economic analysis
   - Establish a Cost As Independent Variable, Design To Life Cycle Cost or Design To Cost program
   - Systems Engineering Owns all requirements including the cost goals and targets.
5. Review the **present estimates against goals often** and react appropriately and expediently

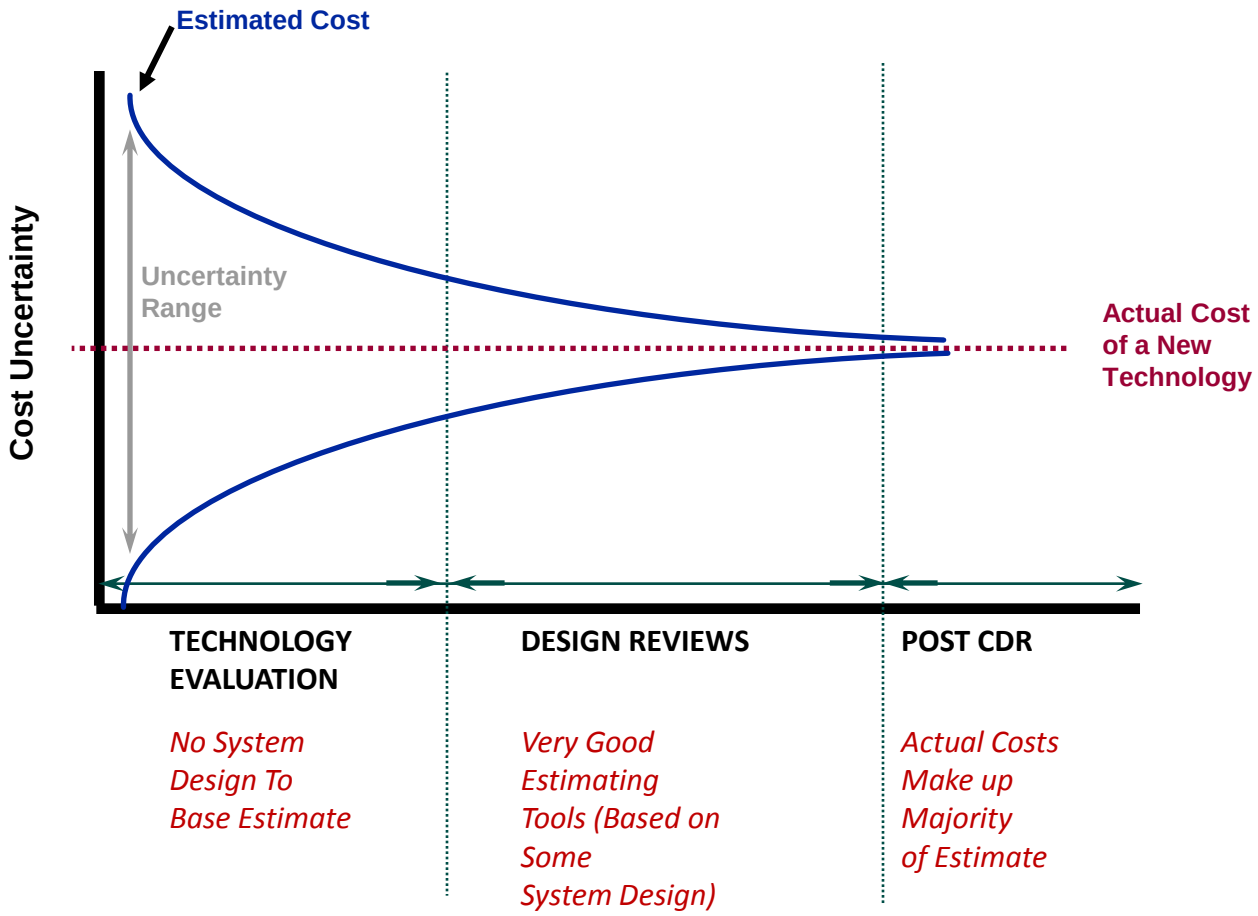
Acquisition Phases & Milestones



Cost Estimate Uncertainty

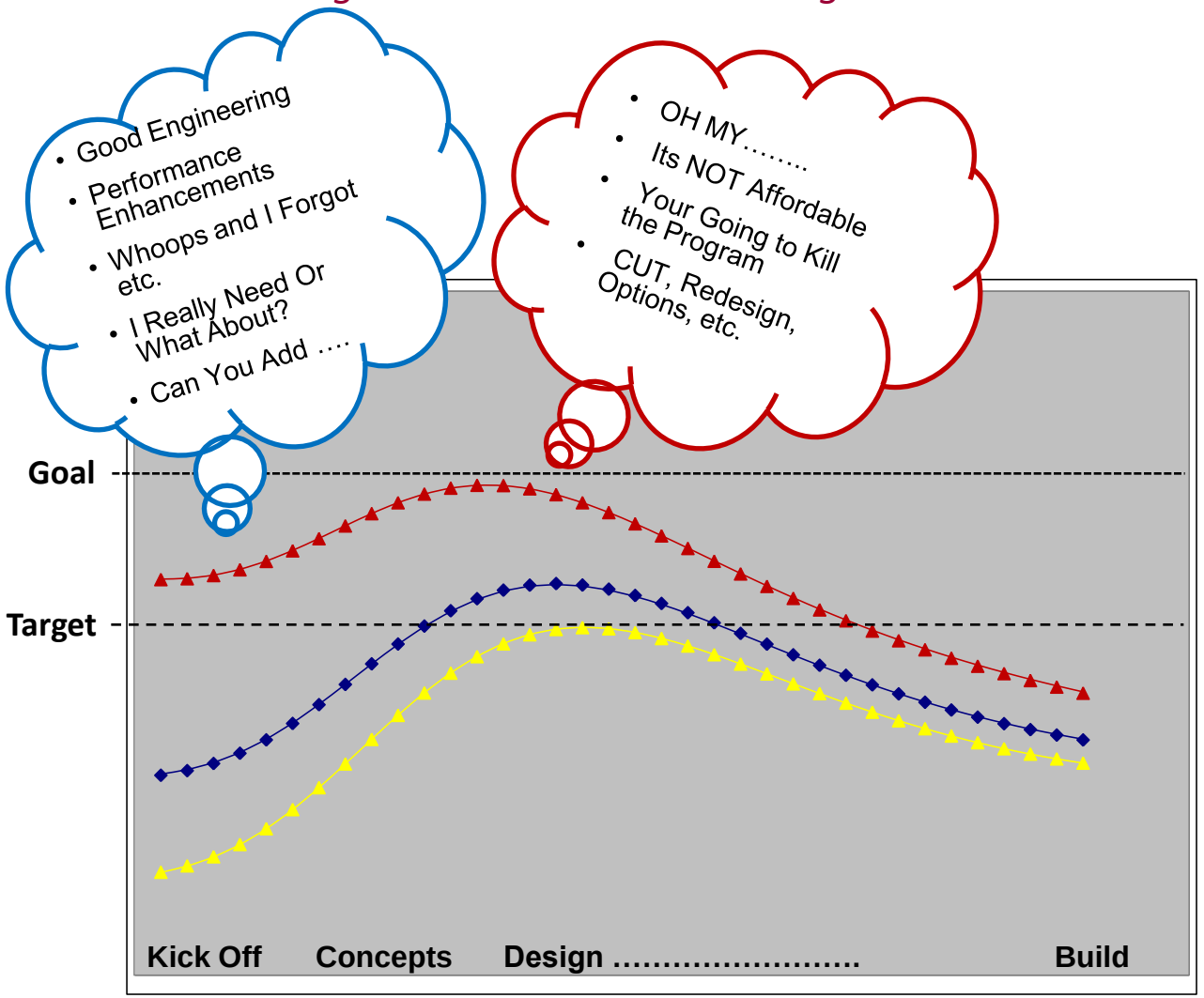


Cost Estimate Uncertainty



Estimate Uncertainty Through Development

Understand Programs and Estimates Change

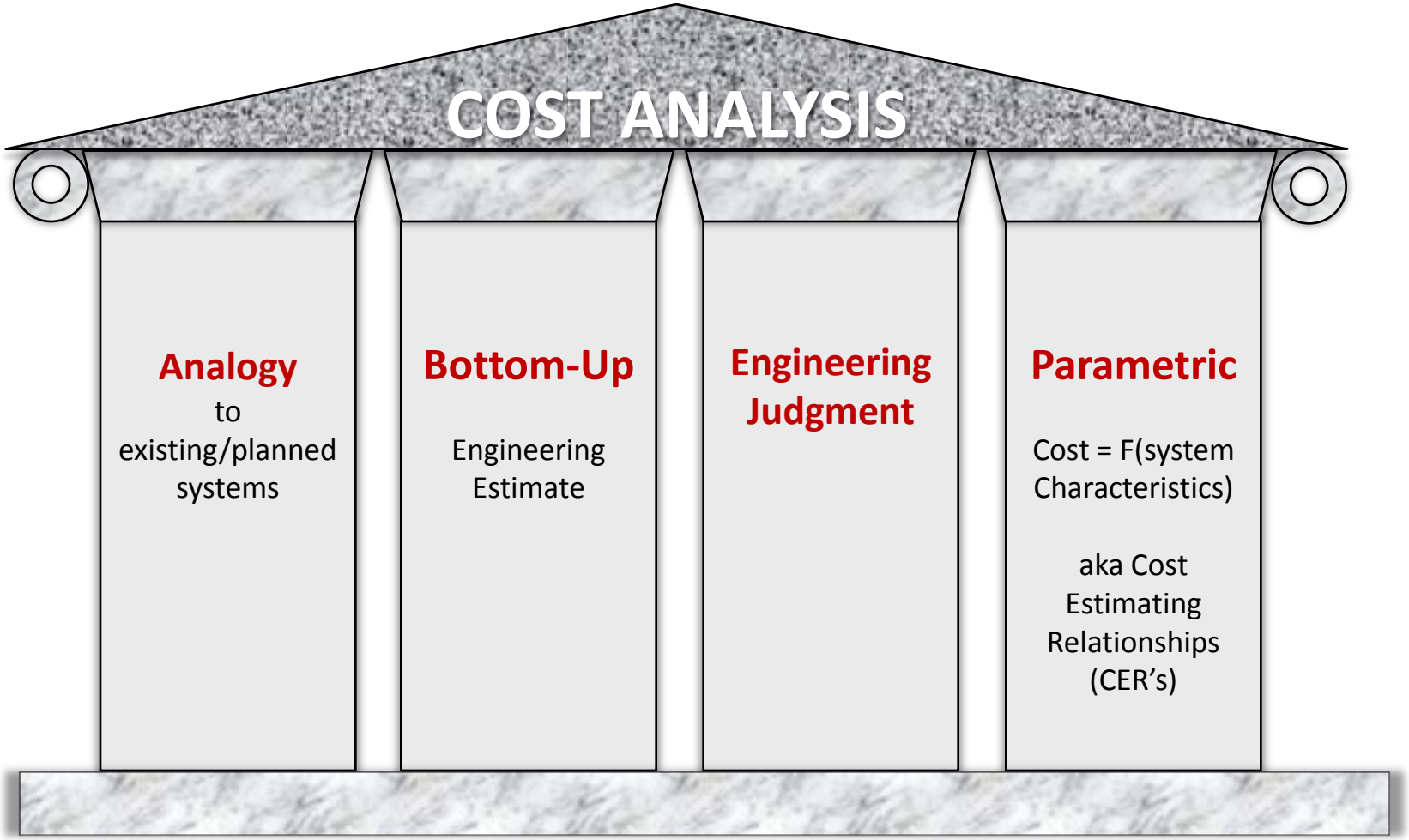


Upper Uncertainty Range of Estimate

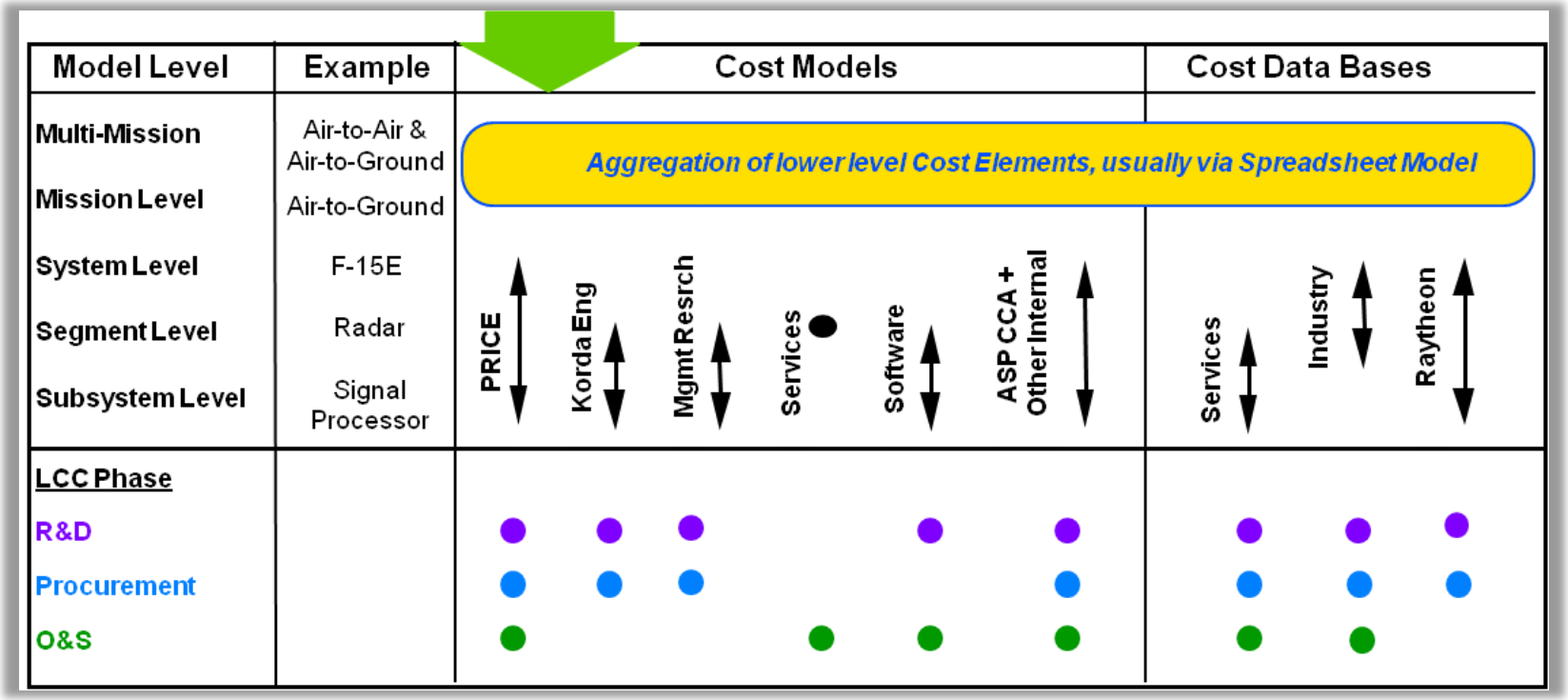
Estimates (LCC, TOC, RTOC, AUPC, Investment, Acquisition, etc.

Lower Uncertainty Range of Estimate

Four “Pillars” of Cost Analysis



Parametric Cost Models
Span System Fidelity & LCC Phases

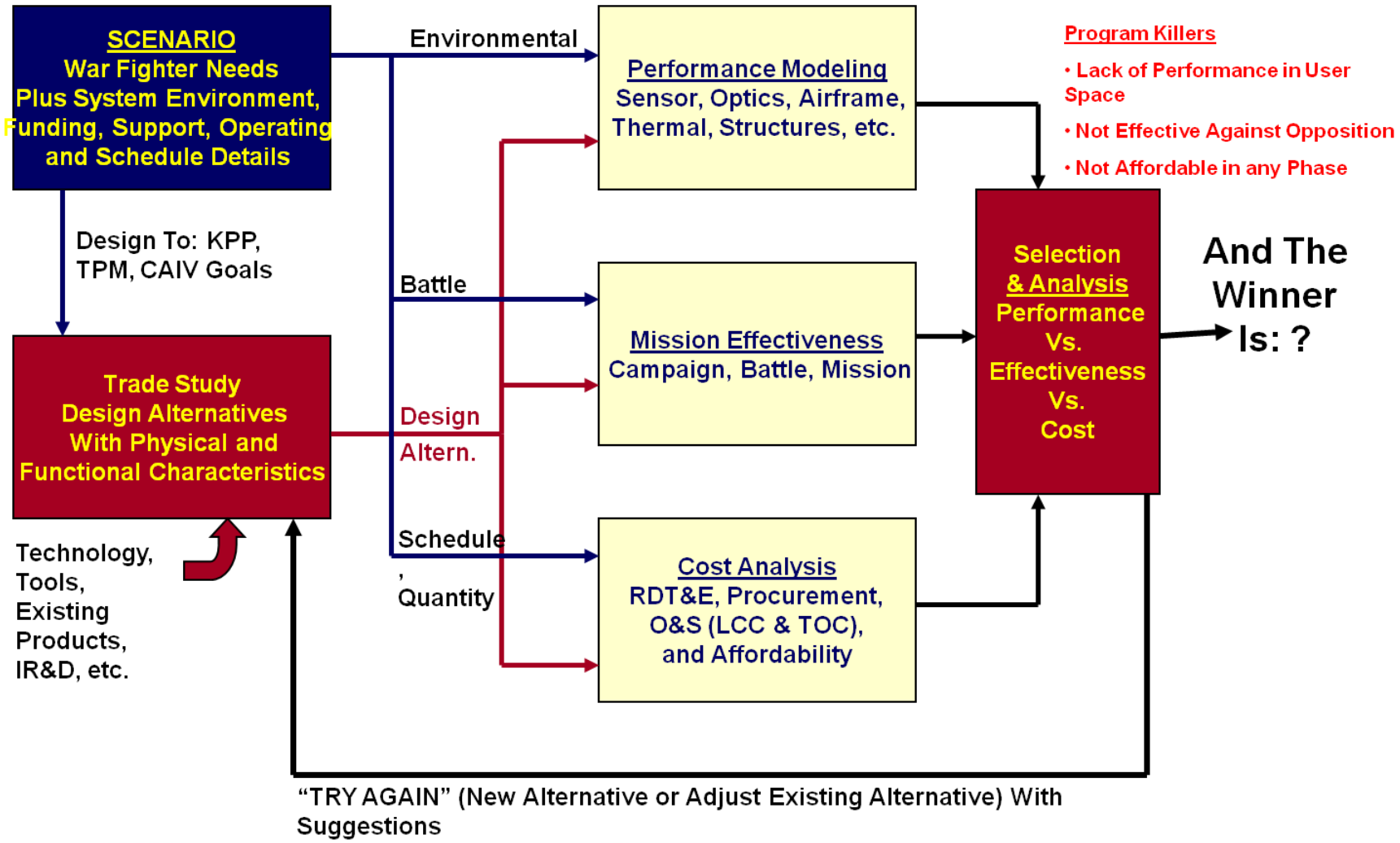


Parametric Model Types - Cost is a…..

- **Function of Physical Characteristic** - *Example $ = ƒ(Weight & Complexity)*
- **Function of # of Statements** - *Example $ = ƒ(Lines) * $/hr.*
- **Function of Similar To Item** - *Example $ = ƒ(Similar Item & Complexity Delta)*
- **Function of Performance** - *Example $ = ƒ(Thrust & Temperature)*

CAIV DECISION POINT

Selection of the "Best Value" Alternative



CAIV DECISION POINT

Software is included in the “Best Value” Alternative

Trade Study Design Alternatives With Physical and Functional Characteristics

Technology, Tools, Existing Products, IR&D, etc.

Missile Alternative Example

- Physical and Functional Characteristics
  - Size, Weight, Speed, Range, Payload, etc.
  - Functions Performed (Search, Ballistic Load, etc.)
    - Hardware Resident
      - Seeker Head
      - Propulsion, Warhead, etc.
    - Software Resident
      - Target ID, Tracker, etc.
    - HW/SW Combined
      - Position in Space (IMU and GPS)

Software

- Functions Performed
  - Lines of code (Size)
  - Interfaces
- Coding Group Capabilities
- Environment
- Schedule

Systems Engineering Affordability Keys

1. Identify System Affordability Constraints Early
   - Set TOC and Acquisition Cost Goals
   - Work with Customer and Establish Real Schedule
2. Design Systems Using CAIV and/or DTLCC
   - Evaluate KPP vs. Cost
   - Customer Involvement
   - Schedule vs. Quantity for Best Unit Cost
   - TOC or RTOC or LCC Goals
3. Review Often With Customer Involvement
   - Continually Work Problem

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Q&A

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