Working Group 2

Development Planning and the Early Life Cycle

WG Leadership:
Government Co-Chair – Col Steve Stoddard, PhD, USA CAA
Industry Co-Chair – Rick Null, Lockheed Martin
Assistant Chair – Becky Mackoy, PhD, USA TRADOC
Assistant Chair – Alix Minden, LCMI Engineering
Assistant Chair – Harry Conley, AFMC/A5C

WG Participants (20)

- Frank Decker TRADOC Analysis Center (TRAC)
- Bob Epps Lockheed Martin
- Brian Gladstone, IDA
- Roger Haiar Lockheed Martin Aeronautics
- George Harris, AMSO, Center for Army Analysis
- Donna Jones Defense Intelligence Agency
- John Keough The Boeing Company
- Jeff Loren DRC HPTG
- Michael Mignone DIA
- Mark Mulligan, OSD(CAPE)
- Annie Patenaude, Synthesis Group
- Dennis Pippy SAF/AQ - AFHSIO
- Gene Porter IDA
- Mike Remias Lockheed Martin Missiles and Fire Control
- Jim Rodrigue Raytheon
- JD Shumpert, Northrop Grumman
- Mario Solano, HQMC, I&L Logistics Ops
- Aileen Sedmak, OASD(SE)
- Dana Trzeciak, PAIO
- Mike Winzeler, Lockheed Martin

Reason for Workshop

- **MORS Special Meeting on Risk, Trade Space and Analytics in Acquisition (September 2011)**
  - Discovered that affordability analysis was ill-defined.
  - Recommended
    - Developing and formalizing affordability analysis processes, including recognizing the difference between cost and affordability analyses
    - Affordability analysis should include mission-based, portfolio-based, and capability-based analyses.

- **NDIA & INCOSE Affordability Working Groups**
  - Have developed definitions for affordability
  - But now have approached MORS for defining affordability analyses
  - Both WGs involved on the planning committee

- **MORS Sponsors**
  - Approved for MORS Year, June 2012 – June 2013

Plenary Session, Tuesday, 2 October 2012

- **Keynotes and Proponent / Host Welcomes**
  - Government / Proponent – Ms. Katrina McFarland, Assistant Secretary of Defense for Acquisition
  - Industry / Host: Dr. Ray O Johnson, Senior Vice President and Chief Technology Officer, Lockheed Martin Corporation
- **Plenary Panel**
  - OSD(ATL) Affordability Lead: Dr. Phil Anton, OSD(ATL)
  - CAIG Representative: Mr. Steve Miller, OSD(CAPE)
  - AoA Representative: Dr. Jerry Diaz, AF/A5RP, USAF AoA SME
  - J8 (JCIDs / CBAs): Brig Gen Scott Stapp, J8 Director of Requirements
  - NDIA SE Affordability WG Lead: Frank Serna, Draper Labs, NCID SE Co-Chair
  - INCOSE Affordability WG Lead: Joe Bobinis, Lockheed Martin Senior Fellow
- **ISMOR Affordability Overview (Lunchtime Presentation)**
  - Gene Visco, MORS FS, Representative to ISMOR

Working Group Sessions, 2-4 October 2012

- **WG 1: People, Authorities, Organizations, Methods and Tools**
- **WG 2: Development Planning and the Early Life Cycle**
- **WG 3: Post-Milestone A and the Remaining Life Cycle**
- **WG 4: Affordability and Logistics / Sustainment Considerations**
- **WG 5: Expanding the Affordability Definition and Trade Space: Providing a More Holistic Life Cycle Cost and Operational Outcomes View**
- **Synthesis Group**

WG 2

Purpose

The Development Planning and Early Life Cycle Working Group will explore methods to infuse affordability thinking and analysis into the Development Planning process.

Goals (Working Group 2 Desired Outcomes)

- Identify current analytic affordability practices in the DP phase.
- Examine current DP analytic affordability practices and identify problems and shortcomings by looking at the requirements and gaps.
- Recommend approaches to improve current DP analytic affordability practices.
- Identify new approaches to DP affordability analysis.

Affordability Analysis

- Affordability Analysis: What is it?
  - Affordability is ***inseparable*** from prioritization.
  - Would this cost or savings exist without this new acquisition?
  - Affordability analysis ***illuminates what is achievable*** within a portfolio.
  - Need to define "consonance" and how to assess it.
  - Affordability analysis considers what DoD can afford to forego (i.e., assessment of risk).
- How is it different from Cost / Cost-Benefit Analysis?
  - Cost is a component of affordability, but affordability also includes:
  - Affordability analysis does not have the clarity of definition, sufficiency criteria, regulatory policy, and guidance as cost/cost-benefit analysis.
  - A *portfolio* perspective
  - An examination of *trades* between cost, quantity, performance, schedule, and associated risk.
  - Affordability is a process and art, supporting a decision, and is not a number.

State of the Practice

- Bow Waves:
  - GAP: Beyond the FYDP, no one seems to be held accountable.
  - Recommendation: Affordability Analysis Guidance (part of AoA Guidance) that specifies that analysis include a portfolio view, the “out years” beyond the FYDP, and portfolio trades between cost, quantities, performance, schedule, and risk.
- Industry:
  - GAP: Industry’s function is to provide technology, looking for guidance for their efforts.
    - Periodic RFIs do not accomplish sufficient partnership – it’s one-way information.
  - Promising Examples: USAF CCTDs, CRADAs, Industry Days, Market Research
- Affordability Analysis:
  - GAP: Challenge to show the range of costs over time in a meaningful way.
  - Recommendation: Develop and communicate a policy that defines the components and criteria for affordability analysis.
  - Recommendation: Develop course(s) to conduct affordability analysis.

Examples of Analytical Rigor

- Defense Planning Projection:
  - Provides view of potential bow-waves.
  - Incorporates portfolio view.
  - But it is ***NOT*** tied to AoA or Services' affordability analyses.
- JLTV:
  - Affordability analysis drove ***post-AoA trades*** (specifically, traded transportability for protection). Without the trades to meet acquisition cost and physical barriers, the program would have been terminated within the service.
  - *This happened because the affordability analysis was complete **well before** the decision point.*
- Three Dimensional Expeditionary Long Range Radar (3DELRR):
  - Service provided the operational context during the RFP, and the ***contractor provided performance and cost trade space***.
  - This was a change of behavior by the government.
  - Avoids constraints of intellectual property (IP) and Organizational Conflict of Interest (OCI).

Affordability Analysis and the OA

- Must understand the criticality of OA in times when we can't afford to make bad decisions.
- Recommendation:

  Affordability Analysis Guidance (part of AoA Guidance) that specifies that analysis include a portfolio view, the "out years" beyond the FYDP, and trades between cost, quantities, performance, and schedule.

Considerations Across the Life Cycle

- For Affordability Analysis, must consider the ***full range of costs.***
- Gaps:
  - Criteria for total owner cost analysis:
    - Industry: For the proposal
    - Services: For program assessments
    - DoD: For Milestone decisions
  - Inclusion of O&S costs
  - Inclusion of ranges of O&S cost estimates

WG 2 Findings

QUESTION: What decisions are made at MS A that are impacted by affordability analysis?

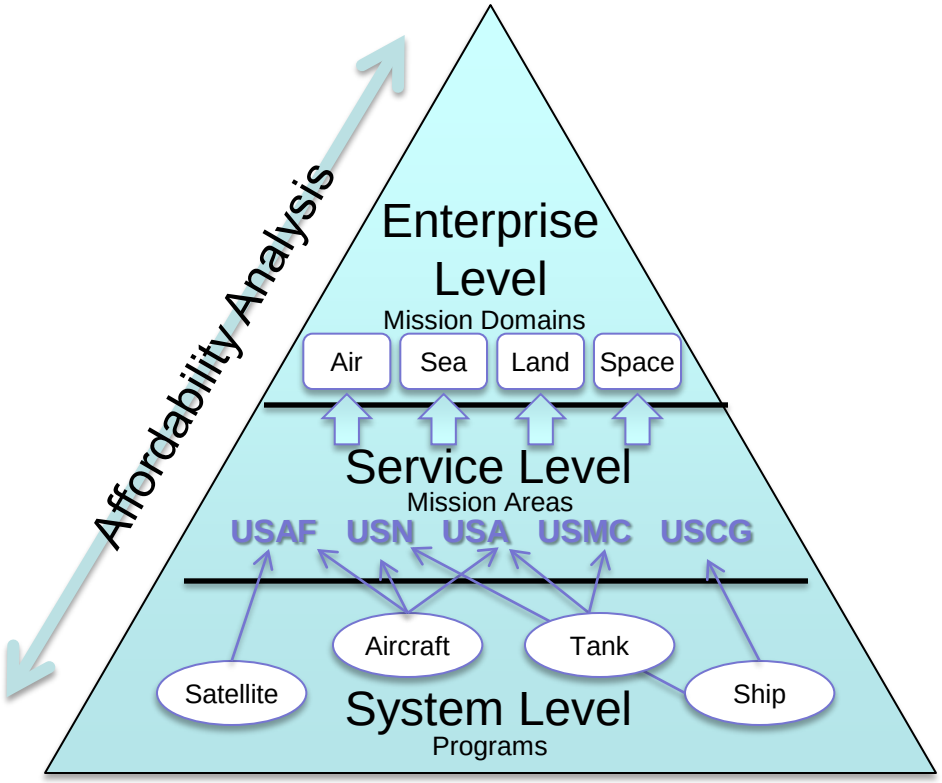
1. DoD: Milestone Decisions:
   - Put out RFP to invest toward MS B?
   - Push back for more development and analysis?
   - Cancel?
2. Services: Investment decisions within a portfolio.
   - Invest to full requirement of program?
   - Invest in alternatives within the portfolio?
   - Cancel?
3. Industry: Bid, or no bid.
   - Bid?
   - No bid?
4. All: Trades
   - Modify KPPs?
   - Decrease quantities?
   - Adjust schedule?

WG 2 Findings

QUESTION: What do decision makers require in affordability analysis to make affordability decisions? What does affordability analysis look like?

1. ***Total costs***: How a system fits under the target costs, with specific inclusion of O&S costs.
2. Incorporate ***associated dependant cost*** – complete cost understanding for meeting full mission requirements.
3. ***Portfolio***: Look at near, mid and far-term.
4. ***Trades***: Confirm the priority is worth changing the current portfolio. Provide performance cost/value trade space.
5. Need ample ***time*** to complete affordability trades prior to MS-A.
6. ***What does it look like***?
   - Should include full range of costs and sensitivity analysis.
   - Sand charts that capture the alternatives and uncertainty?
   - Must include the "box" to capture trades between cost, quantity, performance and capability, schedule and risk.
   - How does this address performance trades?
   - Start with Technical Acceptable, then search for Lowest Price (LPTA).

Portfolio View



WG 2 Findings

QUESTION: **What is the state of practice of affordability analyses?**

1. Pockets / centers of excellence exist but need to be unified / normalized / more commonly defined and practiced
2. Affordability analysis / cost estimates are done but nobody listens / believes them / uses them.
3. O&S cost / affordability is even less understood or able to be analyzed than acquisition cost / affordability.
4. Mission / capability weightings / priorities are not well defined / consistent or repeatable.

WG 2 Findings

How should the affordability analysis address uncertainty and different types of risk?

1. Document assumptions behind the estimates.
2. Sensitivity analysis on cost/schedule/performance occurs, but it is not part of the affordability analysis.
3. Apply Stochastic, Monte Carlo and probability analytic methods
4. Focus on the drivers to risk in cost/schedule/performance.
5. Services should identify trade space around the box to give industry the flexibility to innovate and return viable alternatives.
6. Better Buying Power memos: Conduct at MS A to support TD phase:
    a. Portfolio view.
    b. Production cost target basis.
    c. Sustainment cost target basis.
    d. Key trade-offs to contemplate.

WG 2 Findings

What are roles and responsibilities in Development Planning for Affordability Analysis (pre-milestone A)?

1. Interaction and dialog with industry is essential. New ideas, new technologies and new concepts / innovations are found within industry as well.
2. Legal implications often stifle exchange with and participation with industry.
3. Who validates and prioritizes capability gaps and ensures there is funding to address them (i.e. how do we focus the funding we have on the problems that matter?)
4. When Services identify gaps they should also identify funding / acquisition strategy. What will I fund and what will I forego?
5. Who is the responsible authority for affordability? Who decides a program is affordable?

For More Information

- Overall Workshop Outbriefs
  - NDIA SE Affordability Track: Thu 10/25, 8-8:35 AM
  - Workshop Proponent, ASD(A): Tue 11/13
  - MORS Sponsors: Week of 11/12-15
- Overall Workshop Final Report
  - Expected completion: early 2013
  - Posted on MORS web-site (www.mors.org)
- For More Information
  - Workshop Chair: Kirk Michealson, Lockheed Martin, kirk.a.michealson@lmco.com, 407-375-3440

Working Group 2 Supplemental Material

STRENGTHEN AFFORDABILITY ASSESSMENTS

Dr. Gene Porter, Institute for Defense Analysis

- To limit "over-programming" of MDAPs beyond the FYDP years and the resulting "bow wave" of unaffordable programs, the DAE should work with the Director CAPE to ensure that the DPP is updated at least annually.
- Then it should be used explicitly at each DAB to assess long-term affordability within the expected acquisition portfolio funding totals.
- The annual Program Objective Memorandum POM review should include an assessment of the longer-term affordability of the entire acquisition program, as well as a verification of the implementation of the DAB-approved funding plans for each MDAP.

Analysis of Alternatives

Mr. Mark Mulligan, OSD(CAPE)

Tasks:

- Top-level review of key statutes and policy
- Perspective on what an ideal AoA provides
- Review of recent practices

Purpose:

- Establish common basis of AoA statutes and policy
- Understand goodness of recent practices
- Seek recommendations, feedback, and learning in order to make improvements to the process, as appropriate

Definitions

Cost Analysis:

- The act of developing, analyzing, and documenting cost estimates through various analytical approaches and techniques. It is the process of analyzing and estimating incremental and total resources required to support past, present and potential future costs of relevant equipment, programs, processes etc. [workshop glossary]

Cost Benefit Analysis:

- Process of quantifying costs and benefits of a decision, program, or project (over a certain period), and those of its alternatives (within the same period), in order to have a single scale of comparison for unbiased evaluation. Considers all benefits to include non-financial or non-quantifiable benefits of a specific course of action (COA). This feature is important because although the financial data may favor one COA over another, there may be situations where the non-financial data/information is considered more important to the analyst or senior decision maker. [workshop glossary]

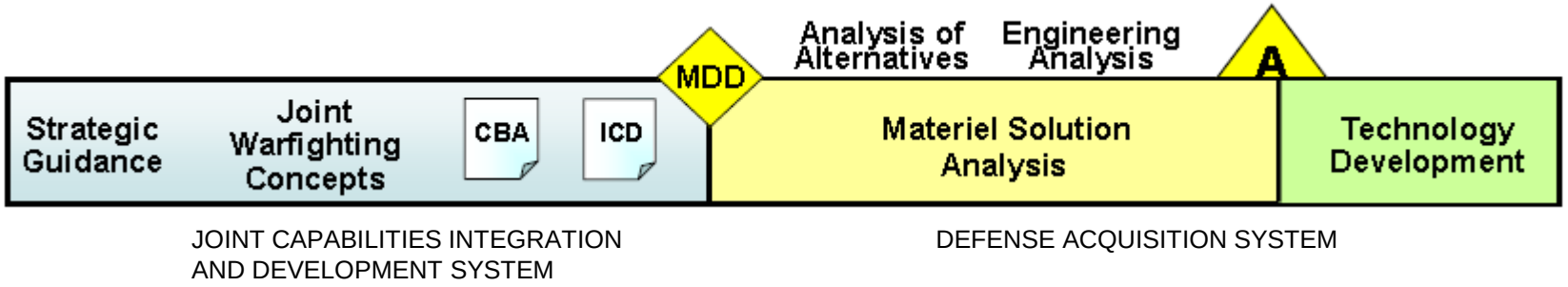
Capabilities Based assessment:

- Identifies the capabilities and operational performance criteria required to successfully execute missions; the shortfalls in existing weapon systems to deliver those capabilities and the associated operational risks; the possible non-materiel approaches for mitigating or eliminating the shortfall, and when appropriate recommends pursuing a materiel solution. [Joint Capabilities Integration and Development System CJCSI 3170.01G]

Affordability Analysis:

- A detailed examination that includes the determination that 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. [workshop glossary]

Development Planning



Development Planning

Development Planning: The upfront technical preparation to ensure successful selection and development of a materiel solution

[Office of the Director, Systems Engineering, Office of the Secretary of Defense]

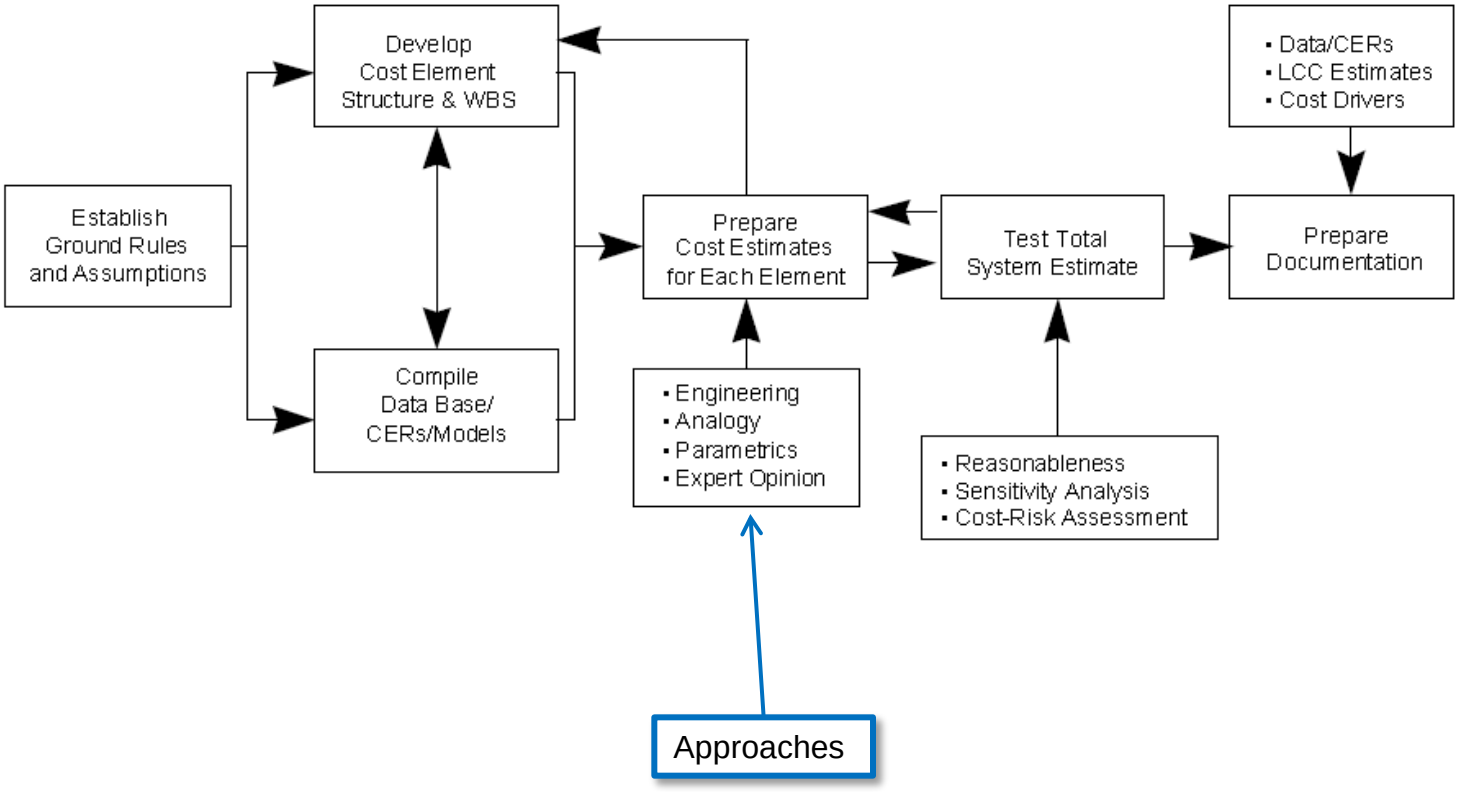
Cost Analysis

- Features
  - Applies scientific and statistical methods to evaluate the likely cost of a specific item in a defined scenario.
  - Includes considerations for uncertainty.
  - May employ Cost as an Independent Variable (CAIV)
  - Not concerned with identifying or defining capability gaps
  - Candidate solutions are usually provided / defined.

- Additional Definition(s)
  - Cost as an Independent Variable: CAIV emphasizes keeping system life cycle cost within an established range by trading the other system acquisition variables of performance or schedule.

[Defense Acquisition University, Feb 2011]

Cost Analysis Process



[Department of the Army Cost Analysis Manual, May 2001]

Cost Benefit Analysis

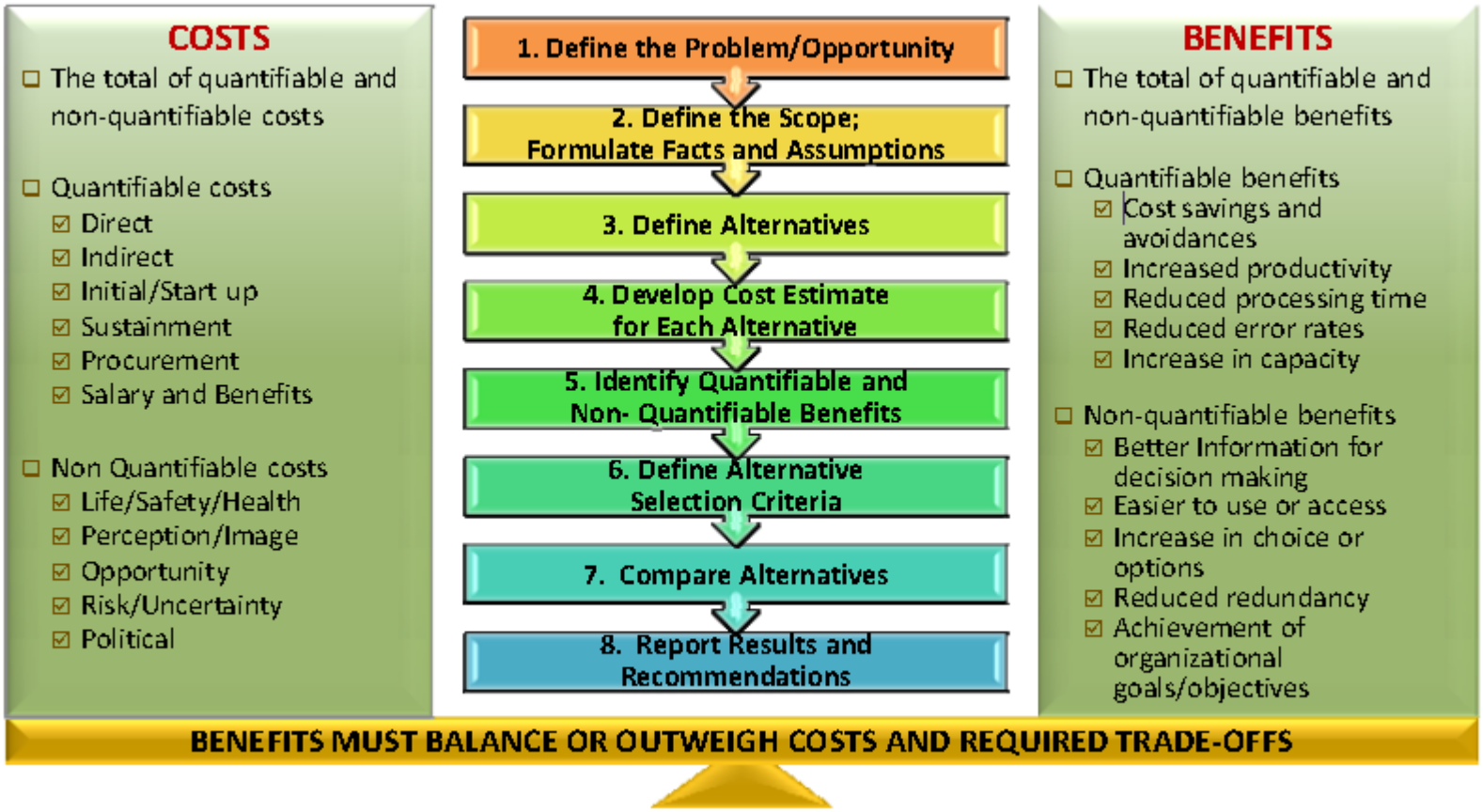
- Features
  - Compares costs and benefits of two or more alternatives (including the status quo) in order to select the preferred alternative.
  - Identify, quantify, and evaluate costs and benefits of alternative solutions.
  - Includes quantifiable and non-quantifiable costs and benefits.
  - Provides justification [value proposition] of proposed solution before significant investment is made.

- Additional Definition(s)
  - Value Proposition: A short statement that describes the tangible results/value a decision maker can expect from implementing the recommended course of action and its benefit.
  - Cost Estimate: The total cost of each alternative over its entire life cycle and is a summation of all .relevant cost elements
  - Benefits: Results expected in return for costs incurred for a given alternative

[US Army Cost Benefit Analysis guide, 8 April 2011]

CBA Process

Cost Benefit Analysis



[US Army Cost Benefit Analysis guide, 8 April 2011]

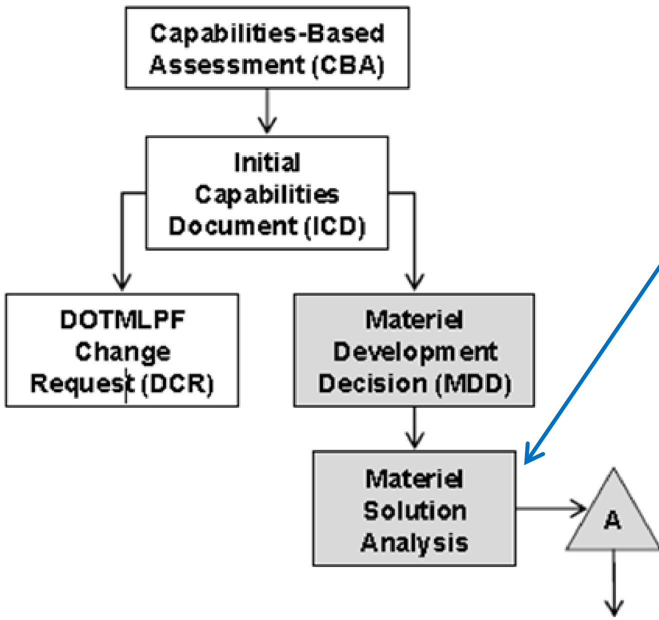
Capabilities Based Assessment

- Features
  - Describes needs in terms of capabilities not systems or force elements
  - Derives gaps / shortfalls for current and projected force
  - Associates risk with gaps
  - Recommends solutions (material and/or non-material)
  - Should take no more than 90 calendar days
  - Serves as key input to Initial Capabilities Document (ICD) necessary for Milestone A

- Additional Definition(s)
  - Capability: The ability to achieve a desired effect under specified standards and conditions through combinations of means and ways to perform a set of tasks. [CJCSI/M 3010 series]

CBA Process and Affordability

Capabilities Based Assessment



The JROC has deemphasized solutions analyses. Their current thrust is to use the CBA to both identify gaps and help advise which particular gaps require action…

<u>Affordability Consideration in the Capabilities Based Assessment</u>

The statement of needs cannot be a plea for a miracle, nor can it induce the DoD to produce something made of unobtainum or unaffordium. Your statement of needs has to be tempered by rough feasibility, cost, and schedule estimates, and you have to have some idea of what the DoD is willing to tolerate for additional investments in your areas.
[CBA Guide version 3]

Affordability Analysis

- Features
  - Cost effectiveness and performance of solutions.
  - Business case analysis.
  - Measured against set “affordability targets”.
  - A “trade-off analysis showing how cost varies as the major design parameters and time to complete [schedule] are varied.” [Ashton Carter, USD AT&L]

- Additional Definition(s)
  - Cost Effectiveness: Economical in terms of the goods or services received for the money spent. [thefreedictionary.com]
  - Business Case Analysis: Economic, risk, and technical arguments for selecting an alternative. [AFI 65-509 Sep 2008]

CBA Risk Approach

Capabilities Based Assessment

JCIDS Manual
19 Jan 2012

Risk / Criteria	Low	Moderate	Significant	High
Strategic Objectives	Near certain achievement	Very likely achievement	Likely achievement	Significant risk of failure
Operational Timelines	As planned	Minor extension	Significant delay	Delays with significant risk of failure
Resources	As planned	Requires resources from other plans or operations	Requires resources that create significant shortfalls	Requires resources that preclude other plans or operations
Unanticipated Requirements	Easily managed, minimal impact	Managed via minor adjustments to other plans	Managed via significant adjustments to other plans	Cannot manage
Force Provider Resourcing	Full capacity to source requirements	Sourcing requires limited duration capability gaps	Sourcing requires extended duration capability gaps	Requires full mobilization to cover capability gaps
Institutional Capacity	Full capacity to source requirements	Requires shifts within DOD components to meet requirements	Requires shifts among DOD components to meet requirements	Requirements exceed capacity of the Joint force

Risk Assessment Framework

Impact Assessment Matrix					
Likelihood					
5	M	M	H	H	H
4	L	M	M	H	H
3	L	L	M	M	H
2	L	L	L	M	M
1	L	L	L	L	M
Impact	1	2	3	4	5

L = Low, M= Moderate, and H = High

Cost Benefit Analysis Process

Cost Benefit Analysis Steps

1. Define the problem
2. Formulate Assumptions and Identify Constraints
3. Define and document alternatives
4. Develop cost estimates for each alternative
5. Identify Quantifiable and Non-Quantifiable Benefits
6. Define Alternative Selection Criteria
7. Compare Alternatives
8. Report Results and Recommendations

[US Army Cost Benefit Analysis guide, 8 April 2011]

WG 2 – Session 5

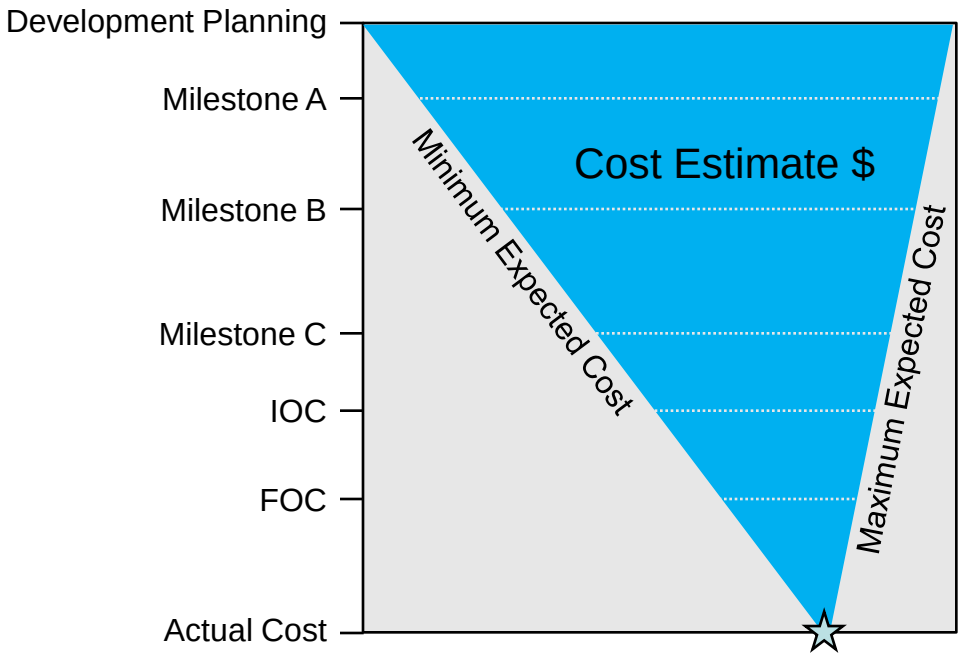
Purpose

Discuss how pre-Milestone A activities impact and influence affordability / Affordability Analysis.

Key Questions

1. Which components of life cycle costs tend to generate “un-affordability” pre-Milestone A?
2. What are the key decisions made during this timeframe that are critical to affordability (i.e., what factors prior to Milestone A are most important)?
3. How should the affordability analysis address uncertainty and different types of risk?

Cost Estimate Accuracy



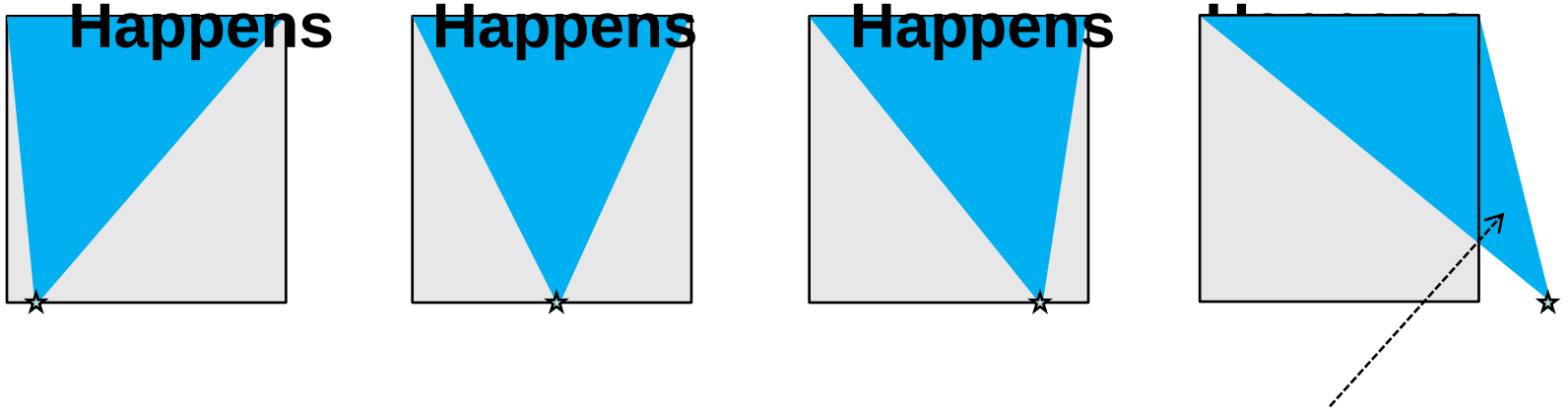
Cost Estimate Reality

Never Happens

Almost Never Happens

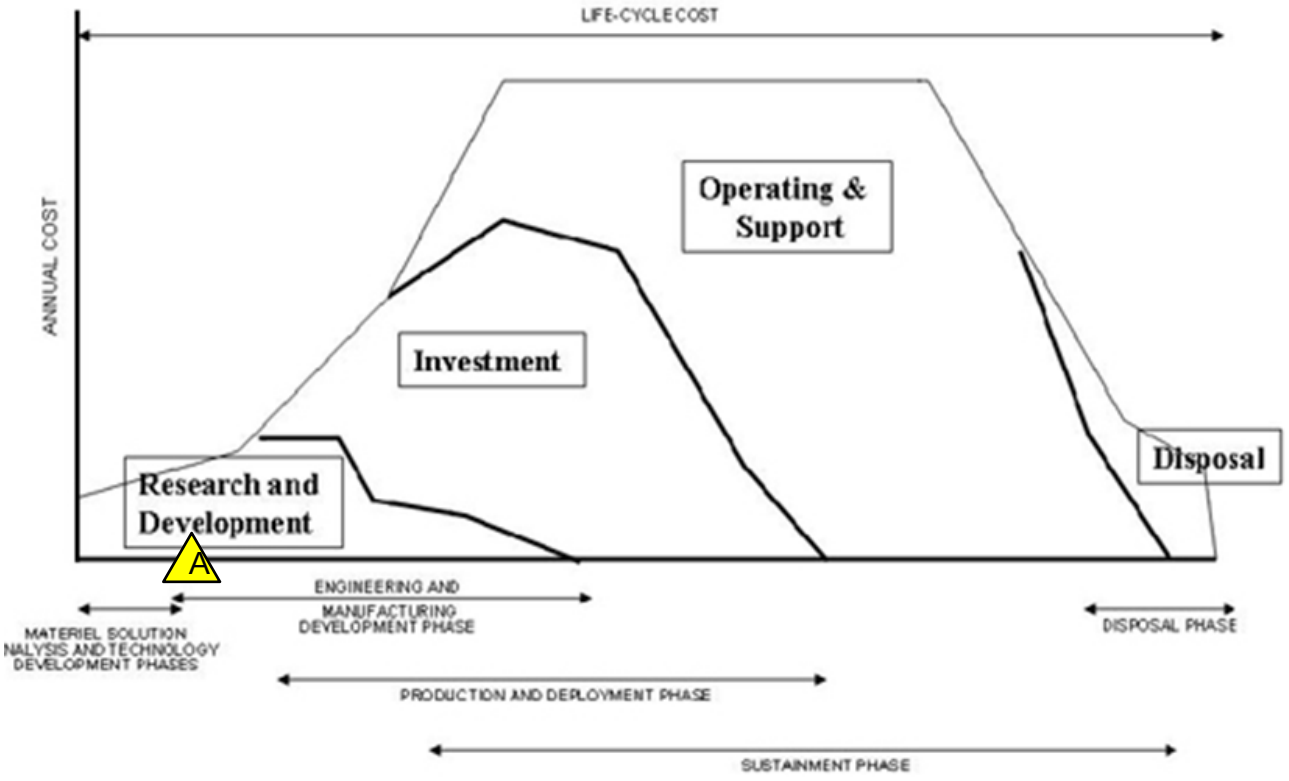
Sometimes Happens

Almost Always



Nunn-McCurdy Zone

Program Life Cycle Cost



Program Life Cycle (Illustrative)

[Defense Acquisition Guidebook, chapter 3]

Workshop Purpose

- **Provide a forum for discussing Defense Department (i.e., Army, Navy, Marine Corps, Air Force, and Joint) approaches to *affordability analyses throughout the life cycle*.**

- **Provide an opportunity for operators, engineers, decision makers, academicians, and military and civilian operations research analysts**
  - To examine topics, methodologies, analyses, and innovations pertinent to all aspects of analysis for affordability as a function of total ownership cost and system performance

- **Balance "voyage of discovery" without "distracting from the work already completed" – moving forward**

Industry Marketing Partners

- Advertise to their members and on their website
- Member participation on planning committee and during the workshop

NDIA National Defense Industrial Association — Promoting National Security Since 1919

Military Applications Society (MAS)

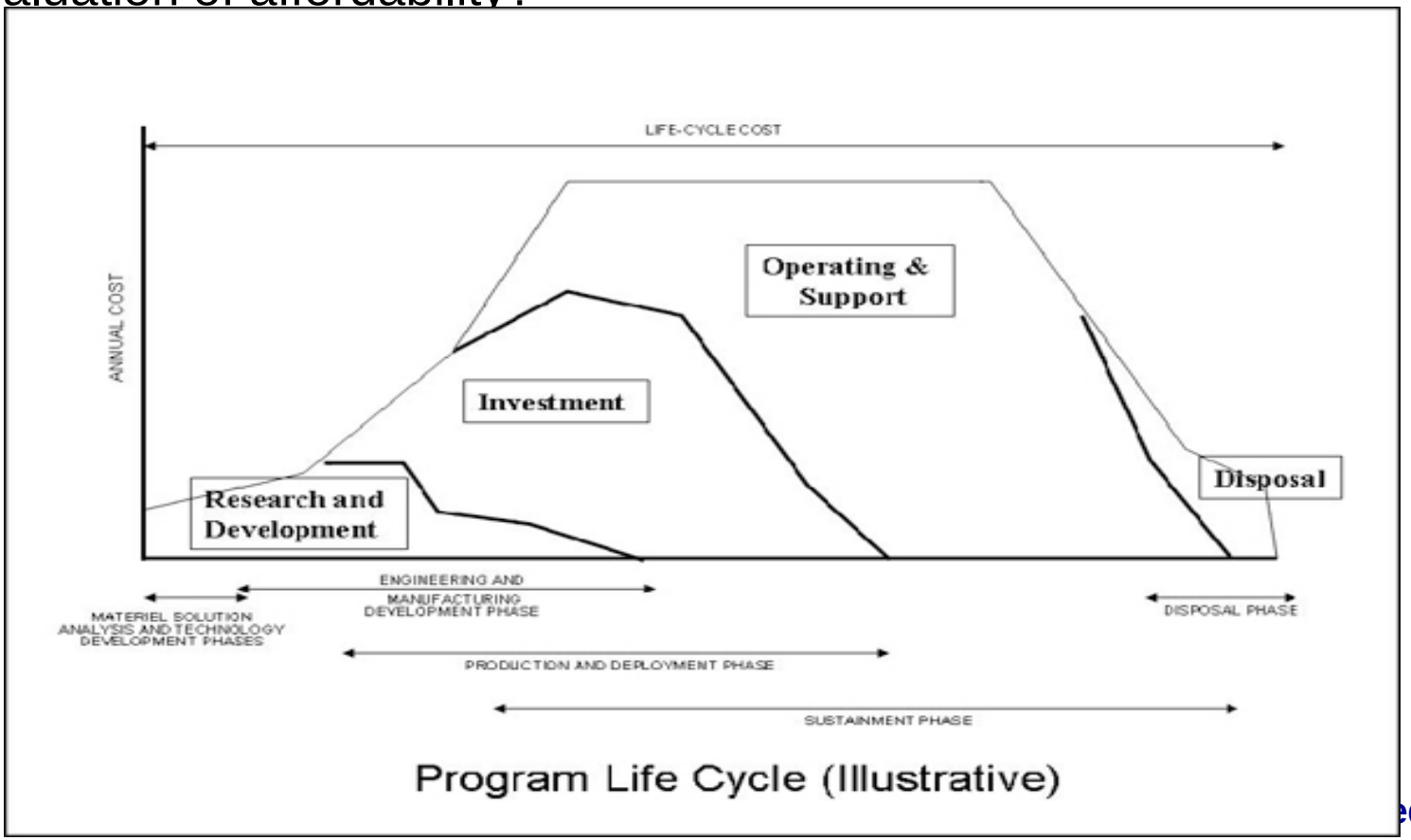
INCOSE International Council on Systems Engineering

SCEA The Society of Cost Estimating and Analysis

- **Supporting Government Group**
  - Acquisition Modeling & Simulation Working Group
  - Link to the MORS Workshop on their website

WG 2 Findings

QUESTION: What decomposition of life cycle costs can simplify evaluation of affordability?



Program Life Cycle (Illustrative)

WG 2 Findings

QUESTION: What are meaningful life cycle costs determined in the DP phase?

- Cost for problem analysis
- Cost for requirements development
- Cost for technology development
- Manufacturing Cost / Unit cost
- O&S, training, facilities, operations tempo, spares, modernization / upgrades / life extensions
- Decommissioning / disposal costs
- Try to identify discriminators that have large impacts on cost that overshadow the cost uncertainties that exist.
- Use a holistic, balanced approach applied equally and fairly to all concepts.

WG 2 Findings

QUESTION: How do we adequately consider TOC prior to MS A and consider both system of interest and enabling systems

Needed: Criteria for total owner cost analysis:

- Industry: For the proposal
- Services: For program assessments
- DoD: For Milestone decisions

Needed: Method for early inclusion of input from industry

WG 2 Findings

QUESTION: **What is needed from the operations analyst to conduct affordability analyses?**

1. Good understanding of what affordability analysis really is. What is / are the deliverables?
2. Analysts should have engineering, physics / OR backgrounds. Previous operational experience is invaluable.
3. Good leadership. Understanding what the needs and visions are.

WG 2 Findings

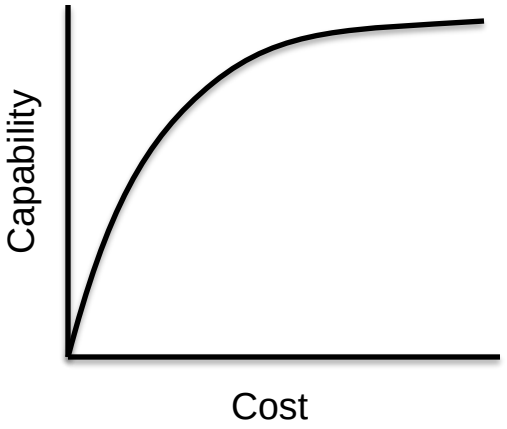
What is the difference between cost analysis, cost-benefit analyses, capabilities based assessment (CBA) and affordability analyses? How do these support affordability analysis?

- Cost is a component of affordability, but affordability also includes:
  - A *portfolio* perspective
  - An examination of trades between cost, quantity, performance, schedule and risk
  - Affordability analysis does not have the clarity of definition, sufficiency criteria, regulatory policy, and guidance and cost and cost-benefit analysis.
  - Affordability analysis offers targets that are achievable within a portfolio.
  - Affordability analysis considers an assessment of risk (what can I forego?).

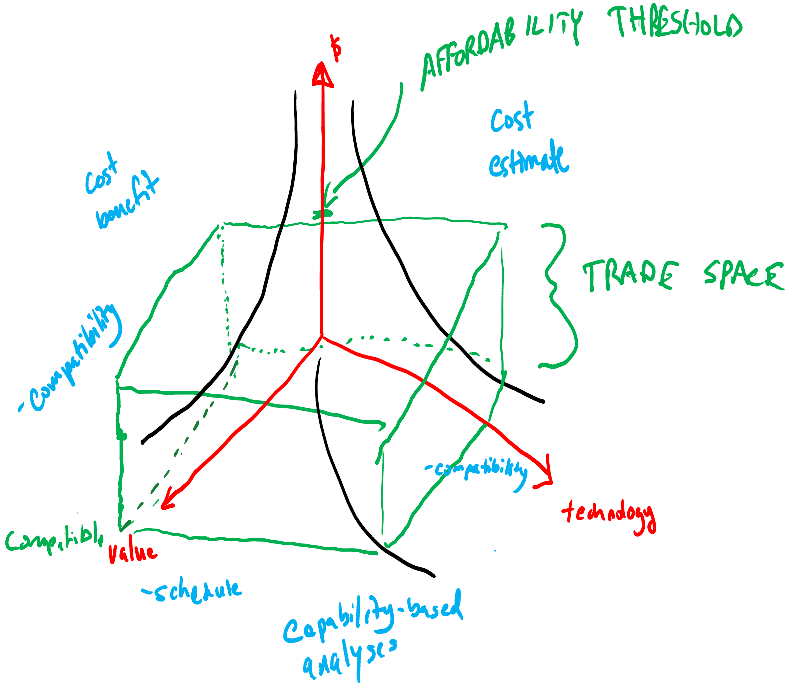
WG 2 Findings

Can a quantitative relationship between capability and cost be defined in order to help achieve affordability?

CAIV Curve



Cost, Value and Technology Affordability Function

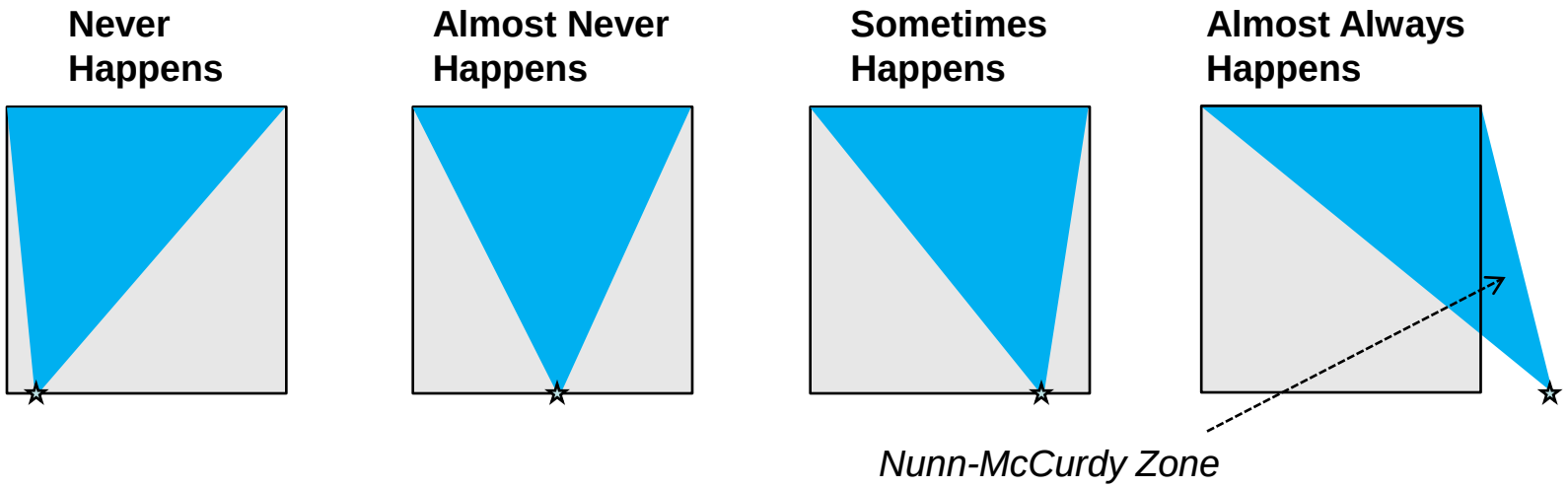


See Slide Notes

WG 2 Findings

Which components of life cycle costs tend to generate "un-affordability" pre-Milestone A?

1. **Mistakes** are made regarding all types of costs. The CAPE seems to do "better" than service cost estimates. The key is to follow acceptable practices and estimate cost ranges when appropriate, and revisit assumptions at each decision point.
2. **For example, decisions** lead to un-affordability when near term concerns dominate.



WG 2 Findings

What are the key decisions made during this timeframe that are critical to affordability (i.e., what factors prior to Milestone A are most important)?

Decisions are aided by well-defined, but not overly constrained, “boxes” of cost, schedule, and performance parameters.

Requirements

1. Selection of a preferred solution (it’s a truck!).
2. Drafting performance parameters (it’s a small, fast truck).
3. Configuration (it’s a truck that looks like this…).
4. Affordability (we’ll trade JSF to pay for this).

Schedule

1. When do you need it?
2. Are there bounds on that? What the space in which we can look?

WG 2 Findings

Can mission level requirements be developed pre-milestone A in order to better define mission capability for use in the system development and test and evaluation processes?

Ensure that guidance for affordability analysis includes:
- Time horizon.
- Additional systems (radars, trailers, etc.).
- Sub-systems (radios, etc.).
- Over-structure for potential system growth.

Gap: Little Test and Evaluation integration affordability guidance in DoD5000.

An analytic framework should be established at the Capability Based Assessment and carried through development for consistency, continuity of understanding, documentation. Why / how did this requirement come into existence?

Final Thoughts

- Where can we throw in a “can” of affordability analysis?
- How big is the “can”, and what’s in it?

- Affordability analysis has to be a deliberate process from the beginning of the acquisition…

- Operational analysis during this phase is critically important to understand how proposed materiel solution parameters impact mission success.`