

INCOSE Affordability Working Group - Design for Affordability

For the INCOSE Affordability Working Group

Joe Bobinis PMP -LM Sr. Fellow

Edwin Dean – Consultant

Terry Mitchell - LM Principal Systems Engineer

Paul Tuttle – LM Principal Systems Engineer

INCOSE Affordability Working Group (AFFWG) Vision

The Affordability Working Group's goal is to enhance the systems engineering affordability body of knowledge. The scope is to advance the state of the practice for systems engineering for affordability across the Life Cycle. This includes defining the relative value of the system across the total life cycle based on desired system capabilities.

The Problem - How do we get to Affordable Solutions?



Standard Issue Army Hummer –
M1123 without Armor
\$92,200 Unit Cost
18000 Miles Between Maintenance
Actions
No Warranty
No Diagnostics

Joe's Hummer - COTS
•\$30,000 Unit Cost (fully loaded)
•30000 Maintenance Free Period
•100,000 Mile Warranty
•Embedded Vehicle Diagnostics
•Remote Diagnostics and Reports



What is the difference between the two Hummers?

AFFWG Problem Space and Approach

AFFWG is looking for approaches for analysis of the variables that contribute to systems engineering trade space that effect “cost of function”. Function is an abstract concept that defines what must be done in the form [verb, noun]. AGGWWG is seeking to identify and provide guidance for the relevant trades across the life cycle, especially during the system definition time frame that impacts the system affordability. AFFWG will explore new operational or support concepts, reuse or refurbishment of existing systems., optimizing a system based on cost of capability, and modeling and simulation of architectures for variable cost-performance points.

Desired Outcomes and Products

AFFWG seeks to document in our future guidebook approaches for analysis of the variables that contribute to systems engineering trade space that effect cost of function, new operational or support concepts, reuse or refurbishment of existing systems, the optimization of a system based on cost of capability, modeling and simulation of architectures for variable cost-performance points, the identification and provision of guidance (service) for the relevant trades across the life cycle, especially during the system definition timeframe that impact the system affordability, the mapping of tailored activities with INCOSE Systems Engineering (SE) Handbook and applicable standards, supplements to the INCOSE SE Handbook, and technical communication to INCOSE membership through papers, insight, journals, and webinars.

Initial Direction and Areas Currently Being Explored

Working Definitions in the Context of Systems Engineering for Affordability.

System affordability is the cost of system mission effectiveness over its complete life cycle.

Affordability engineering is a process that enables companies to reduce costs and improve value throughout the whole life cycle of a product by the use of cost and schedule estimating, technical performance, and risk information, especially at the conceptual design stage.

Systems affordability is the ability to design a system with the outcome attributes of cost effective capability over the Systems complete life cycle.

Design effectiveness is captured in measures of capability (MoCs) – how efficient does the system do what it was designed for and at what cost?

O&S effectiveness is captured in operational availability (Ao) – is the system available for use or not and at what cost?

Mission effectiveness is a function of operational availability and measures of capability.

Specification of Affordability.

Affordability is specified at points in time by the required capability, associated performance and the budget constraint(s).

Budget

Identify budget elements (e.g., Development, Operations and Support) for this system to be included in the affordability specification.

Define time phased overall budget, or define time-phased budget for each of the elements.

Required Capabilities

Identify required capabilities and time phasing for inclusion of each of the capabilities.

Required Capabilities Performance.

Identify required measures of effectiveness (MOEs) for each of the capabilities.

Define time phasing for achieving each of the MOEs, identify measures of suitability (MOSs), and define time phasing for achieving each of the MOSs.

Trade Space Considerations - The Variables Required To Determine Cost vs. Capability

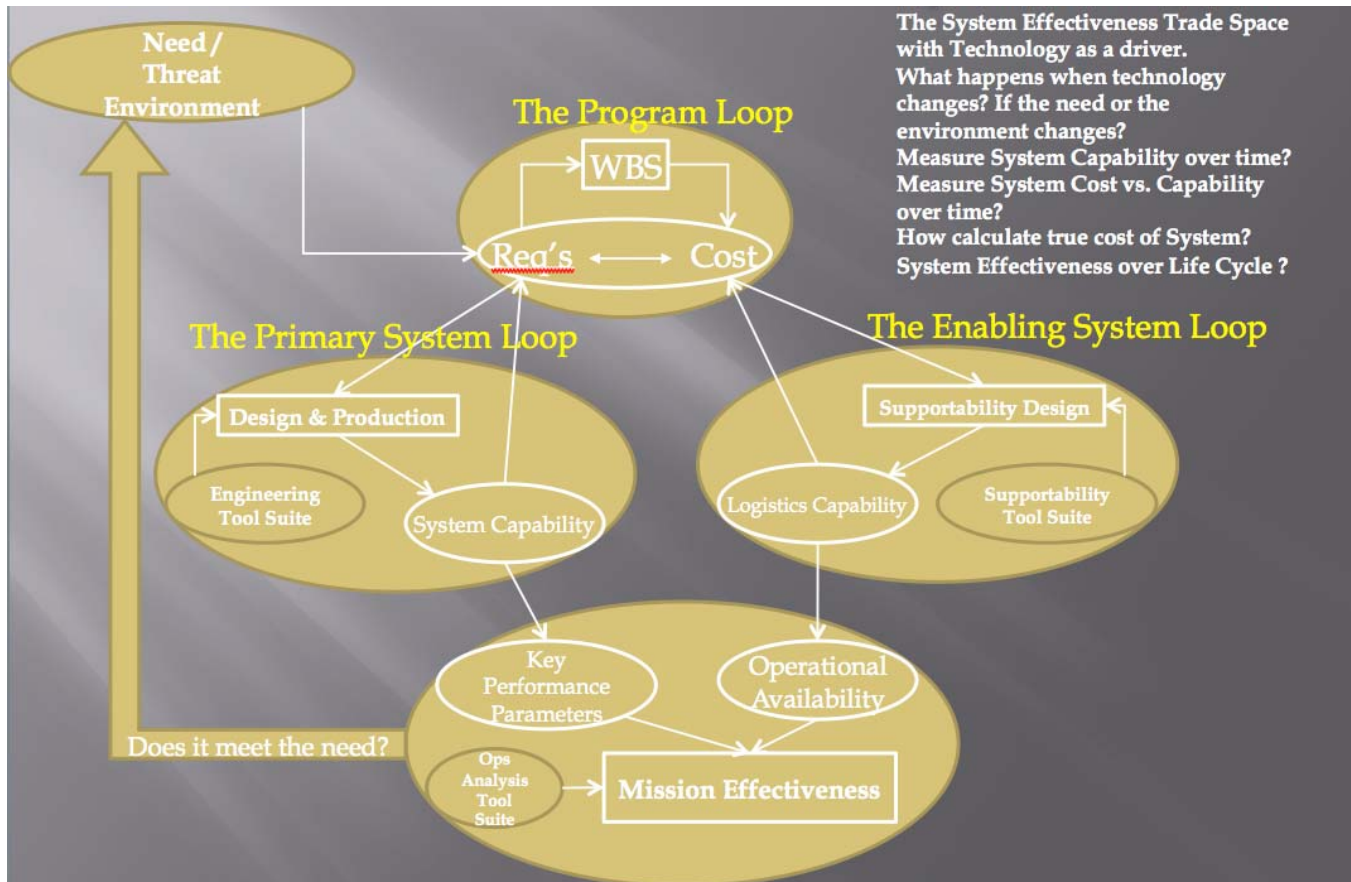
System effectiveness is the cost of system mission capability over its life cycle.

The upper left of the figure below addresses the primary system functionality. The upper right of the figure below addresses total ownership cost as the measurement. The lower left of the figure below addresses the enabling system functionality. The lower right of the figure below addresses the external and temporal boundary variables.



System Affordability / Mission Effectiveness Trade Space

The figure below is the current conception of the system affordability / mission effectiveness trade space.

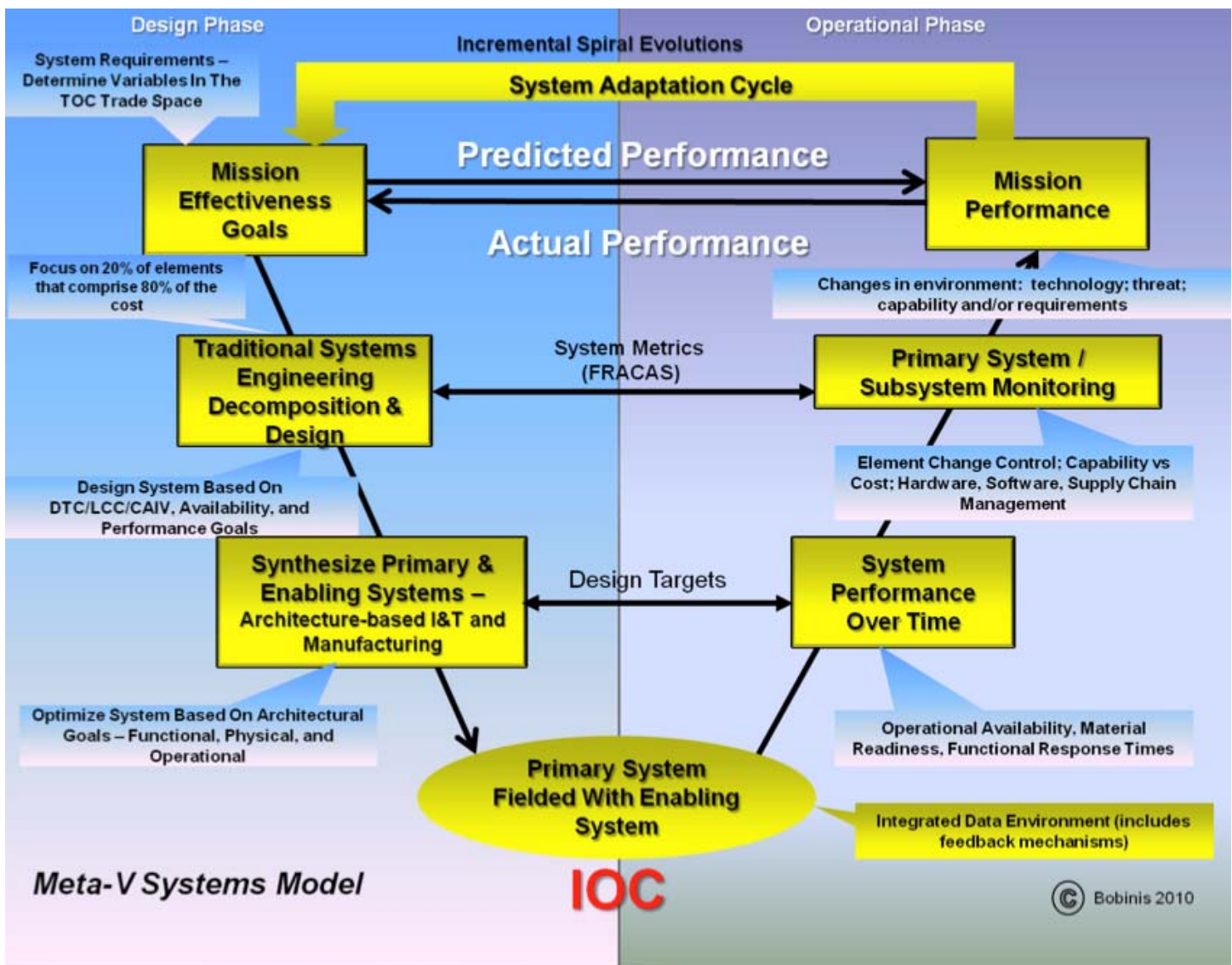


The trade space is driven by the threat or need. The program transforms the requirements into a work breakdown structure that can be used to estimate the system cost. The primary loop uses the requirements to design and produce the system with a certain capability that is fed back to the program to match against requirements and cost. The enabling system loop includes the design for supportability to provide a specific logistics capability. The system and logistics capability provide system performance parameters and operational capability to determine mission effectiveness. The mission effectiveness is used to determine if the system actually meets the threat or need.

Note that this is an iterative process with many internal loops, each of which requires effort until the mission effectiveness finally meets the threat or need.

System Affordability V

The figure below represents the engineering process in the form of the International Council on Systems Engineering (INCOSE) V structure. Note the incremental spiral evolutions where information flows from the operational phase to modify the design based upon actual performance.



INCOSE Affordability Working Group (AFFWG)

The AFFWG was formed at the 2010 INCOSE International Symposium and now has 36 members representing Department of Defense (DoD) contractors and customers, commercial industry, and international DoD.

It has monthly telephone meeting and recently met at the 2011 INCOSE International workshop. For INCOSE members, the INCOSE Connect address is

<https://connect.incose.org/tb/SEsupport/affordability/default.aspx>.

The AFFWG Co-Chairs are Joe Bobinis (joseph.bobinis@lmco.com) of Lockheed Martin and Taki Turner of Boeing.