



Achieving Higher Value in More Affordable Systems

Robert (Bob) Scheurer
Associate Technical Fellow
Boeing Defense, Space and Security | **Systems Engineering**

Topics for Discussion

1. Value and Affordability
2. Achieving Higher Value
3. Becoming More Affordable
4. Where Value Meets Affordable
5. Summary & Conclusions

Goal: Challenge Conventional Thinking About Value and Affordability to Achieve Better Outcomes

Value and Affordability: Defined

Value: *The most cost-effective way to reliably accomplish a function that will meet the user's needs, desires, and expectations.*⁴

Value = Function/Cost

where:

Function = the specific work that a design/item must perform.

Cost = the life-cycle cost of the product.

Affordability: *The ability to allocate resources out of a future total budget projection to individual activities*

Defense Acquisition Guide

Affordability = “Cost within budget”

Affordability Analysis @Boeing : *Cost is balanced along with performance and schedule to define and deliver best value solutions to the customer.*

*“It’s a great value,
but I just can’t afford
it.”*

*“I can afford it, but it’s
not the best value.”*

*“It’s a great value
and very affordable.”*

***Both Value and Affordability are Established from
the Context of the Customer/User***

The Value – Affordability Challenge

- Acquirer: **Defines quality** or effectiveness of a system
- Supplier: **Produces a design** that meets expectations or requirements
- Acquirers tend to define only the lower limit of those expectations
- Supplier often exceed those minimums, believing that better quality (i.e. effectiveness) always equals better value

But...

Better quality/effectiveness usually:

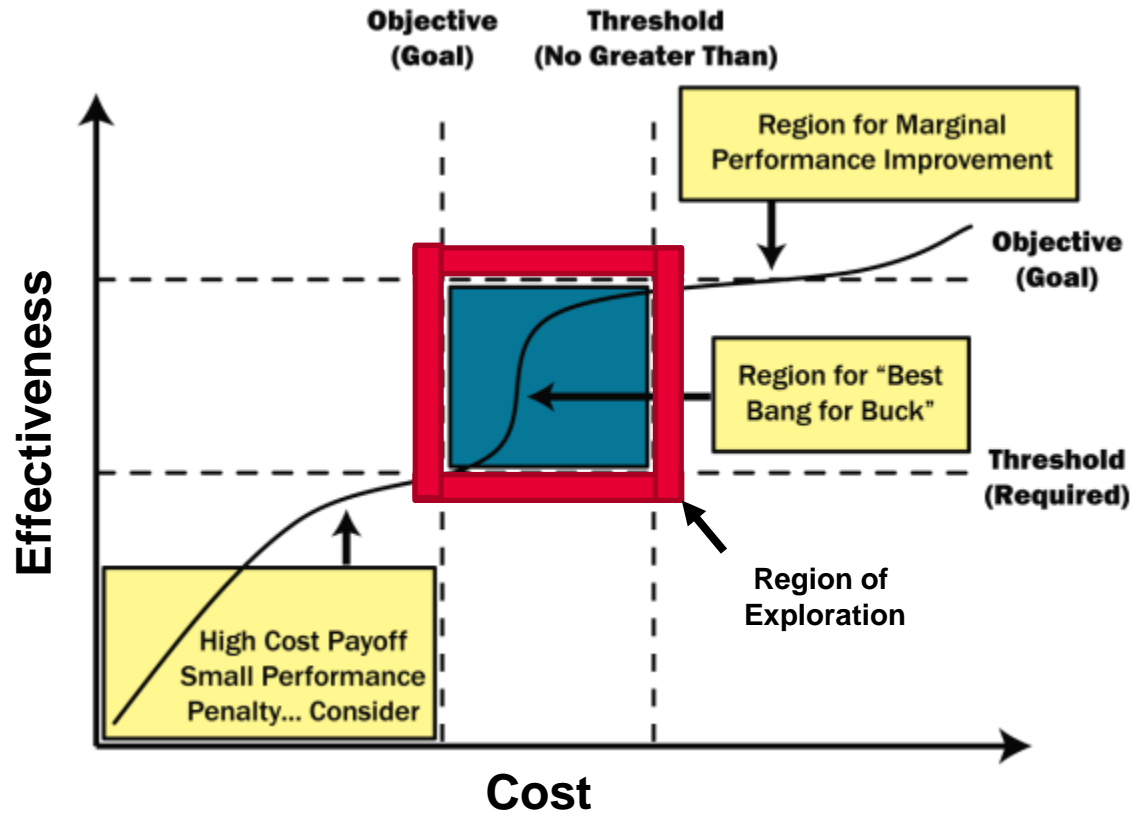
- 1) comes at an increased cost and
- 2) is not on a linear relationship with value.



A one-level increase in quality could come at a two- to three-level increase in cost.

Acquirer and Supplier Together Determine the Right Value for a System that Meets Affordability Requirements

Value Determination Zone



Identifying "Knees" in the Effectiveness vs. Cost Curve is Key to Locating Higher Value

Assessing Value

1. **Information Gathering**—project requirements and design, the status of the budget and schedule, and constraints.
2. **Functional Analysis**—examination of the project's functional requirements within budgetary limitations, understand why the system is being built, and what the final result should be.
3. **Creativity/Brainstorming Solution Candidates** —developing and listing ideas and options for value, keeping in mind the functional requirements of the project.
4. **Analysis of Alternatives**—expanding the creative ideas into workable solutions, evaluating their impacts and costs, and ranking them in terms of cost, feasibility, and value received.
5. **Recommendation**—presentation of the value-oriented proposals, expected savings, and value results



Challenging Functional Requirements⁴

- **Basic function**: Essential to the performance of a user function, fulfill a user requirement, or describes the primary utilitarian characteristic of a product.

“Can this function be eliminated and still satisfy the user?”

- **Required secondary function**: Any function that must be achieved to meet requirements or standards.

*Example: A basic function of a weapon system is to **deliver munitions**. A fire-suppression system may not be needed to fly the air vehicle, but may be needed to retain safety of flight or survivability.*

- **Secondary function**: A function that, if removed from the design, still permits both the *basic* and *required secondary* functions to be met – or met better.

Example: Eliminate the need for multiple optical detectors, heavy and complicated distribution systems, and redundant wiring harnesses by placing fire detection tubing in close proximity to known fire hazards.

Innovative Alternatives for Functionality Can Improve Value

Achieving Higher Value

Design and Development Techniques

- Agile Software Development (Deliver Functional Value Faster)
- Managing Complexity (Less is More)
- Decision Analysis/Trade Studies (Traceability to Performance Drivers)
- Improving Specialty Engineering Attributes (Reliability, Maintainability, Supportability, etc.)
- Increasing Functional Density (More is Better)
- Re-Use of Existing Technology (incl. Integration Risk)

Integration & Production Methods

- Economies of Scale
- First-Time Quality
- Improved Safety

Reducing Waste (13 Lean Product Development Principles⁷)

Value from Adapting Processes to Deliver More: Faster and Efficiently

Achieving Higher Value

Strategic Planning, Budgeting, and Management

- Planning for Value
- Pre-Planned Product Improvements
- Link Risk Management to Value - Scan the Horizon for Black Swans
- Supplier – Stakeholder Collaboration
- Value-Based Management / Value Chains

Improve Product Features

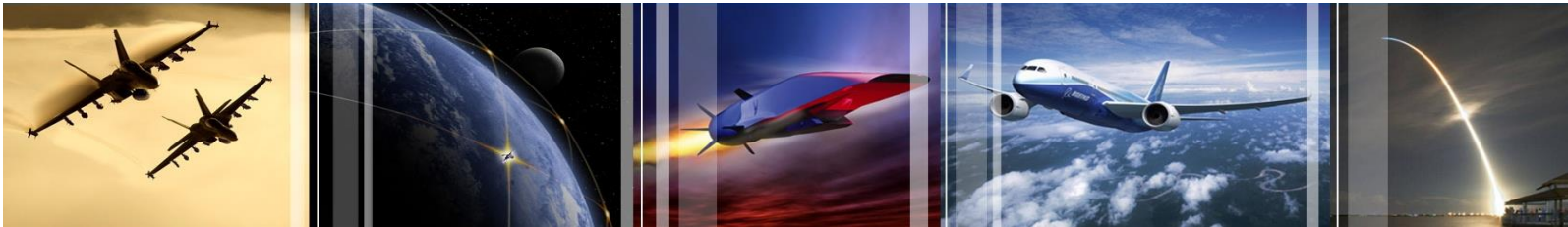
- Product Variants & Families
- Product Automation, User Workload Reduction



Value from Enterprise-Level Business Strategy

Characteristics of Being Affordable

- 1) It can be procured when customers need it.
- 2) It functions when users need it over the expected life span.
- 3) It meets users' performance requirements at a level of quality that they demand.
- 4) It is attainable for a reasonable cost that falls within the customer's cost budget.



“Being Affordable” Means More than Cost

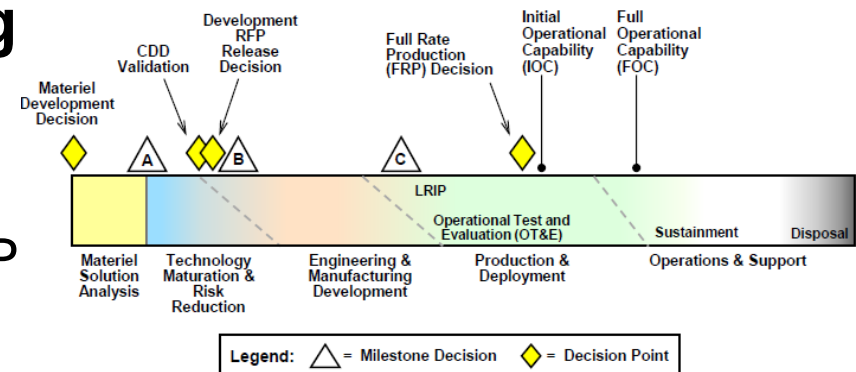
Achieving More Affordable Systems

■ Sound Systems Engineering Practices

- Identifying Right Requirements (e.g., Model-Based SE)
- Eliminating Requirements Volatility
- System Architecture as Basis for Derived Requirements
- Ensuring Requirements Quality at All System Levels

■ Integrated Technical Planning

- IMP/IMS
- SEP – SEMP Alignment
- Affordability Plan Aligned with SEMP
- Event-Driven Technical Reviews

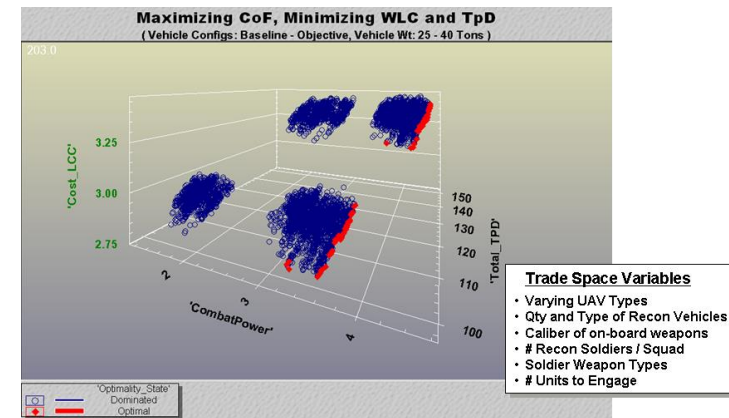


***More Affordable Systems Enabled by Integrated Plans
and Robust Requirements***

Achieving More Affordable Systems

■ Decisions Anchored in Affordability Analyses

- Cost-Effectiveness Analysis
- Cost of Requirements Analysis
- Life Cycle Cost (LCC) Analysis
- Cost Driver Analysis
- Cost Uncertainty and Cost Risk Analysis
- Analysis of Alternatives / Design Trades



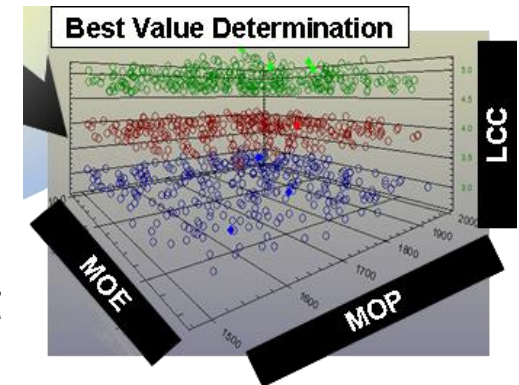
■ System Innovation Enablers

- Changing the Perspective: Systems Thinking
- Innovation Workshops
- Using the Crowd (Crowdsourcing)

More Affordable Systems Identified via Systems Techniques and Analytically-Based Decisions

Where Value Meets Affordability^{8,9}

1. KPP's/MoE's Determined
2. Affordability Goals and Other Figures of Merit Identified
3. Requirements, Features, and Performance of System Under Design Captured
4. Baseline Design Alternatives Identified
 - a) Technical Analysis
 - b) Cost-Schedule Analysis
 - c) Benefits Assessment Based on Figures of Merit
 - d) Risk Determinations
5. Assessment of Alternatives Performed w/Sensitivity Analysis
6. Results & Recommendation Documented



Affordability Goals Establish Value-Based Trade Space

Boeing Programs Delivering Value and Affordability



Joint Direct Attack Munition (JDAM)



- Converts existing unguided free-fall bombs into accurately guided "smart" weapons
- JDAM kit: A tail section that contains
 - Global Positioning System aided Inertial Navigation System (GPS/INS)
 - Body strakes for additional stability and lift
- U.S. Air Force, U.S. Navy and more than 26 international customers employ JDAM
- Product improvements add capability to existing JDAM guidance kits
 - Laser JDAM laser guidance module
 - JDAM Extended Range low-cost wing module
 - Incorporation of JDAM guidance on other payloads

***Currently the Cost-Effective JDAM is
in Production and Operational in Four Variants***

Boeing Programs Delivering Value and Affordability

EA-18G



- Variant of the combat-proven F/A-18F Super Hornet Block II
- Conducts airborne electronic attack missions
- Vast array of sensors and weapons provides a lethal and survivable weapon system
- Inherits F/A-18F Super Hornet air-to-air and air-to-ground capabilities
- AEA Suite provides formidable and flexible capability with significant growth capability

The first production aircraft was delivered to the U.S. Navy on Sept. 24, 2007, almost a month ahead of schedule

Summary & Conclusions

- **Specific Methods are Available to Identify and Drive Value in Systems**
- **Functional Alternatives or Capabilities Per Unit Cost Provide Informed Choices and Can Lead to Better Outcomes**
- **Optimum Results are Realized when the Acquirers and Suppliers Work Closely Together**
- **Systems Engineering Principles and Targeted Business Strategies are Key to Achieving Higher Value in More Affordable Systems**



References

1. “Three Ways to Create Value that Lasts” - <http://www.fastcompany.com/3015225/leadership-now/3-ways-to-create-value-that-lasts>
2. “Getting Innovation Right” - <http://www.amazon.com/dp/1118378334>
3. “How to Create a Useful Value Proposition” - <http://conversionxl.com/value-proposition-examples-how-to-create/>
4. “The Good and the Bad of Value Engineering” - <http://www.healthcaredesignmagazine.com/article/good-and-bad-value-engineering>
5. “Value Engineering History” - http://www.acq.osd.mil/se/initiatives/init_ve.html
6. “Increasing Business Value by Adopting Agile Methods” - <http://www.stickyminds.com/article/increasing-business-value-adopting-agile-methods>
7. “The 13 Principles of Lean Product Development” – <http://www.industryweek.com/companies-amp-executives/13-principles-lean-product-development>
8. Redman, Quentin “The Role of Value Engineering in Affordability Analysis”, <http://www.pricesystems.com/Portals/1/presentations/PRICE-ICEAA-2013-Value-Engineering-Affordability-Analysis.pdf>
9. Redman, Quentin “Why Affordability is a Systems Engineering Metric”, https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB4QFjAAahUKEwiCsOD_yYjIAhWGNygKHStcBxY&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS1877050912000762&usq=AFQjCNHzYJgWXjHPKKfbsfujstIVH3kEq

Abstract

A drive to more affordable solutions doesn't mean that something always has to be given up. In fact, industry and history prove regularly that it's possible to deliver even more value at the same or lower cost over time. To do that successfully, though, systems engineering principles and sound planning have to be carefully applied. This will ensure that the design or service solution is developed within the affordability constraints of the acquirer and matched against the realization abilities of the supplier(s).

In this presentation, we look at value vs. affordability along with what drives each of them. We further investigate what successful programs are doing today to break the old paradigm that states that achieving greater capabilities or functionality comes at a usually higher cost. We finally look at how achieving higher value in more affordable systems is the cornerstone of the value proposition of systems engineering. By extending the systems engineering principles into the tough problems at the system and even enterprise levels, we can achieve the innovations and breakthroughs that are coveted but often elusive.