

Element #1: Fundamentals of Design Interface

Jon Jay Buder, DML
Jacobs Technology, Inc.
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Agenda

- Objective
- Background
- Definition - Design Interface
- Maintenance
- Activities and Analysis:
 - RAM
 - COEA
 - Maintenance Analysis
 - Continuous Modernization Planning
 - HSI
 - Interoperability Analysis
 - Supportability Analysis
 - Support Systems Alternatives
- Systems Engineering Perspective
- Life Cycle Perspective
- Summary

Objective

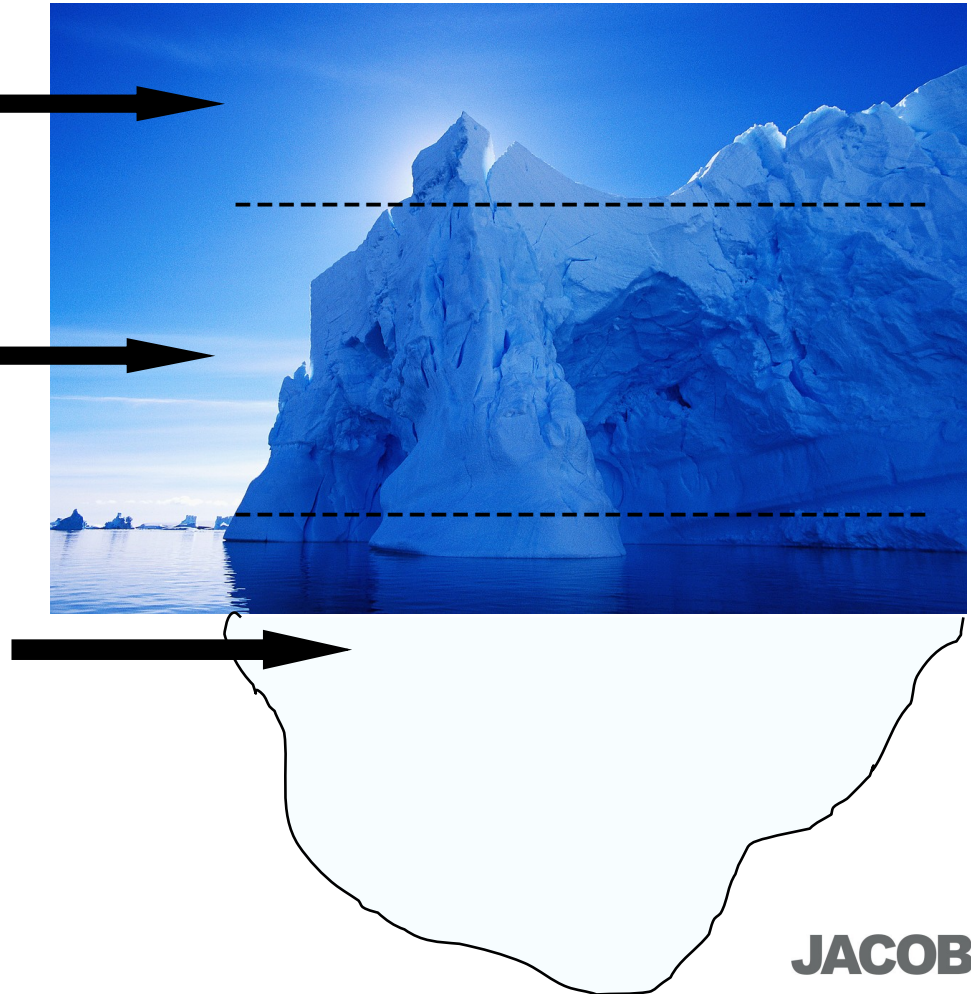
- To provide an overview of Design Interface activities
- To provide some strategies for developing design criteria

Background – Elements of Logistics

- Design Interface
- Maintenance Planning
- Supply Support
- Manpower & Personnel
- Training & Training Support
- Computer Resources Support
- Facilities
- Packaging, Handling, Storage & Transportation
- Support Equipment
- Technical Data

Logistics Footprint

- What You See
 - 5 - 10% (R&D)
- What You See
 - Up to 30% (PMC)
- What You Don't See
 - 60 - 70% (O&MMC)



Logistics Impacts to Lifecycle Cost

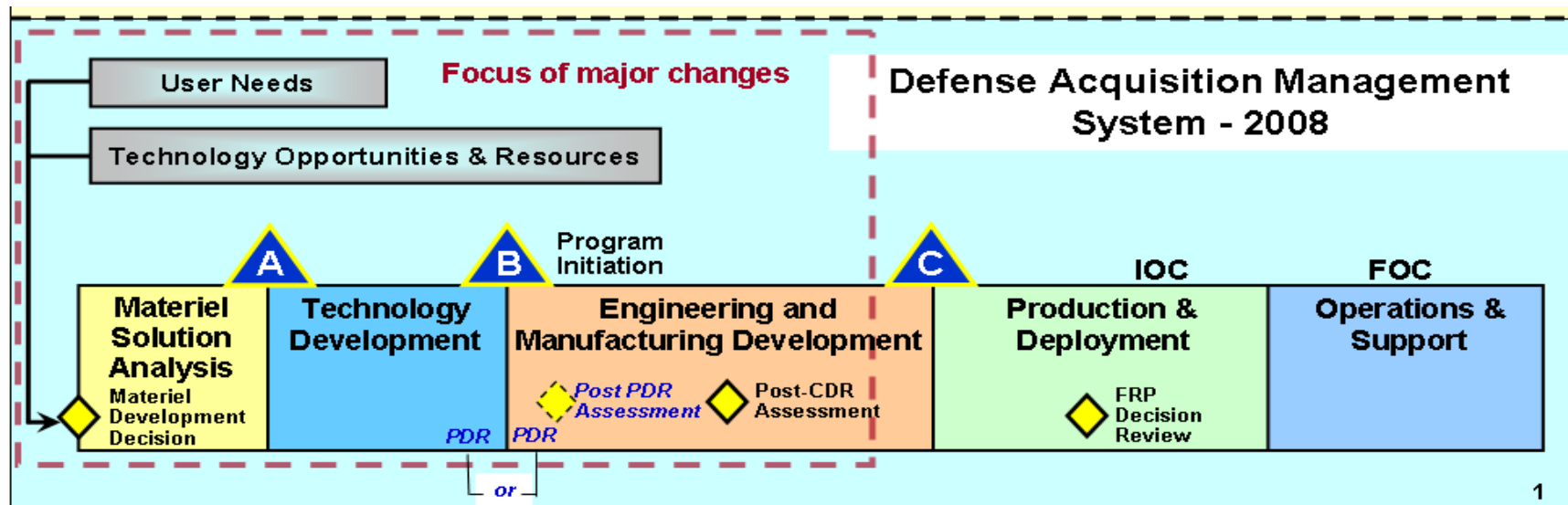
- Potential impact to Life Cycle Cost of Sustainment Decisions

Decisions made here:

65%

20 - 25%

10 - 15%



Definition

- **Design Interface** is a complex process that addresses:
 - **How components or sub-systems** within the system are designed and interfaced to achieve the best “System and Supportability” mix
 - **How the overall supportability design** of the system interfaces with other systems and
 - **How** supportability design parameters address operational effectiveness and suitability

Another Definition

- Design Interface is:
 - the foundation for the support strategy
 - the relationship of logistics-related design parameters (e.g., reliability, maintainability, availability and human factors) to readiness and support resource requirements.

It Includes:

- Reliability, Availability and Maintainability (RAM) Analysis
- Analysis of Alternative Strategies (Cost and Operational Effectiveness Analysis)
- Continuous Modernization Planning
- Human Systems Integration
- Interoperability Analysis
- Design and Supportability Analysis
- Operations and Maintenance Analysis
- Support System Alternatives
- Tradeoff Analysis (Continuous) – System, Support System, Training, Repair Level Analysis, Transportability

Design Interface Activities

RAM - what is it?

- **R** The probability that a system or item will perform its intended mission, for a specified length of time without failure, assuming it is used under conditions it was designed for ¹
- **A** The probability that a system or item is in an operable and committable state when called upon at an unknown (random) time ¹
- **M** The probability that a failed system or item can be repaired in a specified amount of time using a defined set of resources ¹

RAM Tests and Metrics

- Reliability: MTBF, Failure Rate (λ_1), FRACAS
- Availability: (ALDT)
 - Inherent Availability
 - Achieved Availability
 - Operational Availability

Maintainability:

- Mean Time To Repair
- Mean Corrective Maintenance Time
- Mean Preventive Maintenance Time

Analysis of Alternatives (formerly Cost and Operational Effectiveness Analysis (COEA))

- Estimating Methodologies
 - **Expert Opinion.** When data are insufficient for higher accuracy methodologies. Appropriate SMEs on either the system or the cost element (as it relates to the system) and discuss analytical techniques used to resolve differences among the experts' opinions
 - **Analogous.** Identify similar End Items that may be used for applying analogous costs. Data from analogous systems may be used from previously fielded systems - Life Cycle Cost Estimates (LCCEs) or Cost and Operational Effectiveness Analysis (COEAs)
 - **Parametric.** Use of Cost Estimating Relationships (CERs) have been identified for a cost element. Parametric approaches are typically a linear formula with empirically derived factors and constants.
 - **Engineering (Bottom-Up).** Estimate of costs by breaking the whole cost element into smaller components (or modules). Then after estimating the cost of the components, they may be summed to provide a total cost.

Maintenance Analysis

- FMEA (Failure Modes and Effect Analysis)/FMECA (Failure Modes, Effect and Criticality Analysis)
 - Conducts failure analyses
 - Each failure mode occurrence results in corrective maintenance task would be implemented.
 - Develop Preventative Maintenance tasks through a Reliability-Centered Maintenance approach
 - FMECA ensures there are no unknown failure modes in the architecture that would degrade the final availability or ability to complete mission. Most beneficial in sensitive areas - such as single point failures, etc.
 - Supports Safety Engineering, Testability Engineering, Maintainability Engineering, Logistics Engineering, Availability Engineering and Design Engineering
- LORA (Level of Repair Analysis)
 - Evaluate maintenance actions to determine the most cost effective level of repair or discard of repairable items

Maintenance Analysis (Cont)

- The FMECA supports the design engineering effort to ensure that program design requirements are addressed such as no single points of failure etc., redundancy, etc
- The FMEA/ FMECA can be implemented as a functional and or physical analysis
- Criticality Analysis ranks each failure mode as identified in the FMEA, according to each failure mode's severity class and probability of occurrence
- RCMA (Reliability Centered Maintenance Analysis)
 - Conducted on each failure mode, as identified in the FMEA, to develop a preventative maintenance program

Continuous Modernization Planning

- The foundation for Continuous Modernization is laid early in the acquisition process
 - During the technology development and system design and development phases
 - Maximum use of open systems
 - Standard architectures and protocols
 - Commercial items and processes
 - Modular design
- Facilitates the rapid inclusion of new technology as it becomes available.

Human Systems Integration

- Human Systems Integration:
 - Manpower (numbers)
 - Personnel (what types)
 - Training (skills needed)
 - Human Factors (designed to allow XX% to operate and maintain)
 - Safety and Occupational Health (injuries/repetition)
 - Personnel Survivability
 - Habitability

Interoperability Analysis

- Interoperability is the ability of one system or technology to interact with another technology in order to implement some useful functionality
 - Open architecture and standards help make complex technology-related systems more interoperable
 - Modularity using same protocols
 - Testing confirms interoperability

Supportability Analysis

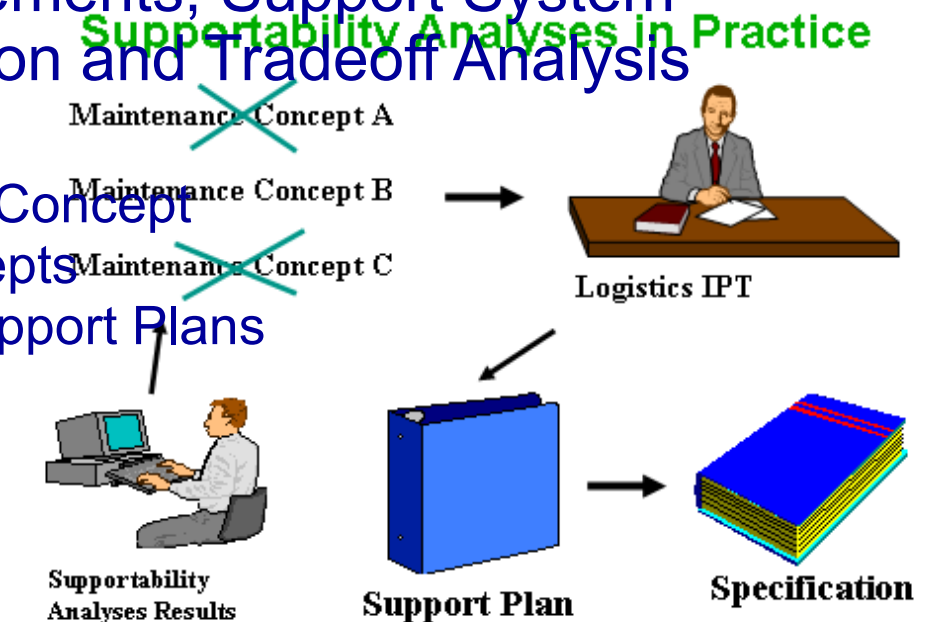
- Policy (DOD 5000.2-R)
 - Support requirements are **not** to be stated as distinct logistic elements, but instead as **performance requirements**
- Analysis that evaluates any support element performance threshold
 - Tailored application of engineering efforts during acquisition, to identify/solve logistics issues through an iterative SE process of definition, synthesis, tradeoff, T&E. (MIL HDBK 502)
 - Logistics Management Information (LMI) (MIL-PRF-49506): Documentation associated with supportability analyses
- Form the basis for decisions on how to most cost-effectively support a system over its life cycle

Support System Alternatives

- Analyze potential support system alternatives for the new system or equipment and determine the preferred support system alternative - most cost-effective solution that meets system/mission requirements.
- LSA Equivalent Tasks 301 – 303 (Use LMI) identify functional support requirements, Support System Alternatives and Evaluation and Tradeoff Analysis

– Develop:

- System Level Support Concept
- Evolve Potential Concepts
- Develop Alternative Support Plans
- Evolve Plans
- Identify Risks



Tradeoff Analysis

- Tradeoff Analysis (Continuous) – System, Support System, Training, Repair Level Analysis, PHS&T
 - May be required to determine most cost-effective alternative(s)
 - Verify or validate the need for special packaging, handling or storage, and eliminate it where possible.

Summary

- Designing to the Support Strategy Concept (including PBL);
- Designing to Planned Maintenance, Supply Support, MPT and other Logistics element capabilities;
- Developing **design criteria** early in the Concept Phase and Effecting them as design criteria in the SD&D Phase:
- SAVES Money, Increases Measures of Effectiveness!!!!

Questions



Contact Information

Jon J. Buder, DML
Jacobs Technology
3850 Fetter Park Dr., #101
Dumfries, VA 22025
(703) 221-7339 (O)
(703) 232-5214 (C)

