Aerospace Industries Association Product Support Group

Assessment and Recommendations to ADUSD-MR&MP

regarding a

Materiel Readiness Modeling and Simulation Capability

(Materiel Readiness Decision Support System)

1 August 2007

Executive Summary

OSD has a need for much more emphasis on the support (vice acquisition only) costs of a weapons system since roughly 65-80 percent of the total life cycle cost of weapons systems is during the sustainment phase and therefore its understanding vital for the long-term viability of force readiness.

On 30 August 2006, ADUSD-MR&MP, met with the AIA's Product Support Committee Executive Board and indicated a need for a Materiel Readiness Modeling and Simulation Capability relevant throughout the entire materiel life cycle, from pre-milestone thru disposal and desired industry insight and input. ADUSD - MR&MPs specific need was for development of a DoD-wide predictive modeling/analysis capability to determine cause and effect relationships for materiel readiness-based outcomes, such as:

- Reliability improvement initiatives
- Cycle Time Process improvements for Supply/Maintenance/ Transportation/Distribution
- Alternative resource strategies (short-term/long-term)
- Determining life-cycle costs from an integrated budget perspective when materiel readiness issues are addressed

An OSD/AIA Working Group was established and met periodically from October 2006 through April 2007 and worked to establish an Input Process Output (IPO) approach. Considerable time was spent on identifying and defining the multitude of Input factors, the Output factors (relating to the four Cornerstones of Materiel Readiness, and investments to change), and the processes internal to the Process (Modeling and Simulation) portion of the flow.

As the AIA Working Group ventured further into the identification and definition of Inputs, Process Models, and Outputs several things became increasingly apparent:

- Common definitions of Inputs were not achievable within Working Group time constraints

- Common definitions of Outputs were also not yet achievable, even though we were only dealing with the four Cornerstones of Materiel Readiness, and investments to improve Materiel Readiness
- The Process Model portion identification and definition process proved even more elusive because of the significant number of proprietary tools and processes used by industry during the System Development and Demonstration (SDD) and Sustainment phases of materiel acquisition and sustainment.

Notwithstanding these key observations and challenges, the AIA Working Group did make significant progress in understanding the breadth and depth of the approaches needed to determine which standard outcomes modeling tools should project, with a focus on determining investment for performance based outcomes.

Of importance, is the AIA Working Group's assessment that development of a DoD-wide predictive modeling/analyses capability to determine cause and effect relationships to materiel readiness-based outcomes is viable, and, in fact, is already being applied in some or all aspects in both the SDD and sustainment phases.

Of equal importance is our assessment that the existing predictive Materiel Readiness processes (and tools) can be used by both industry and the DoD to achieve essentially the same Materiel Readiness objectives.

What is generally lacking, however, is wide-spread knowledge of the availability of the existing Materiel Readiness prediction processes and tools. From the industry materiel design and development perspective, there are also restrictive proprietary and licensing issues.

A two phase implementation is recommended:

Phase One

1. AIA publish White Paper (this paper) on the Assessment and Recommendations to ADUSD-MR&MP regarding a Materiel Readiness Modeling and Simulation Capability (Materiel Readiness Decision Support System)".
2. ADUSD-MR&MP outline and publish their general vision, objectives, and basic processes to industry and DoD shortly. This will capture the immediate benefits that can be derived by moving this process forward without waiting for our recommended Phase Two results.
    - The issuance and explanation of the Materiel Readiness predictive vision and objectives that are applicable during the entire materiel life cycle
    - A statement of logic and additional benefits to be derived via even a simplified approach to predicting and improving Materiel Readiness
    - Allowance for different [Service and industry] definitions of how to calculate and predict changes to the four Cornerstones of Materiel

Readiness (Availability, Reliability, Mean Down Time, and Ownership Cost) with the objective that improvements in any or all will increase Materiel Readiness qualified by assessment of investment costs to achieve the Materiel Readiness improvement

- Encouragement to use a variety of techniques to validate or support any investment decisions, such as sensitivity analysis, scenario analysis, benefit-to-cost perspectives, parallel business case analysis, and other financial metrics (return on Investment, Payback, Net present value)
- The bottom-line objective of Phase One is for progress to be made quickly, along with resultant benefits, given the overall ADUSD-MR&MP vision and objectives to increase Materiel Readiness via focus on the improving the one or more of the four Cornerstones of Materiel Readiness using a financially sound approach for the investments
- The Phase One approach relies heavily on Service and industry ability to be creative in implementing the basic Materiel Readiness predictive modeling and decision process, but the AIA Working Group is confident that it can be done, especially if reporting requirements are imposed by OSD to document progress and benefits

Phase Two

OSD and AIA produce an implementation guide or standard, available for all of the aviation industry supporting DoD materiel acquisition and sustainment efforts. This product would be used as reference for all contracts involving research and development, manufacture, delivery, and long-term, life cycle support of all materiel, from component through weapon systems

- Phase Two would require a follow-on joint OSD-AIA Working Group to develop a plan and schedule for how agreement can be reached within the Services and industry on definitions, the math of calculations, the impacts on existing / legacy data bases and systems, and a more precise taxonomy of the readiness process model functions and attributes
- The value of this product will be a standard for input/output of data and data systems (tools, models, etc.) crossing the seam from industry to DoD
- The DoD will have the ability to request the “best of the best” industry has available in all future contracts
- The DoD will also have the ability to require use by materiel and fleet managers throughout all the Services
- The DoD will have the understanding of the standard deliverable and Life-Cycle Methodology and include this in the current end-to-end enterprise efforts for sustaining materiel readiness
- The DoD will have the understanding of the standard required by industry for information needed but not currently available to industry. This will allow for

improved materiel support and readiness analysis by circling back across the seam – from DoD to Industry

Disclosure / Disclaimer Statement

The Aerospace Industries Association represents the nation's leading manufacturers and suppliers of civil, military, and business aircraft, helicopters, unmanned aerial vehicles, space systems, aircraft engines, missiles, materiel, and related components, equipment, services, and information technology. This paper was developed by members of the Technical Operations Council, Product Support Committee, and will subsequently be coordinated through the formal Aerospace Industry Association approval process.

Background and Purpose

On 30 August 2006, ADUSD-MR&MP, met with the AIA's Product Support Committee Executive Board to discuss several OSD initiatives for which he desired industry insight and input. One of the initiatives relates to OSD's need for a Modeling and Simulation Capability relevant throughout the entire materiel life cycle, from pre-milestone thru disposal. The Modeling and Simulation Capability also needed to determine and project DoD Materiel Readiness from black box to a complete weapon systems platform. ADUSD - MR&MPs specific need was for development of a DoD-wide predictive modeling/analysis capability to determine cause and effect relationships for materiel readiness-based outcomes, such as:

- Reliability improvement initiatives
- Cycle Time Process improvements for Supply/Maintenance/ Transportation/Distribution
- Alternative resource strategies (short-term/long-term)
- Determining life-cycle costs from an integrated budget perspective when materiel readiness issues are addressed

As further background, ADUSD - MR&MP indicated that currently there is a variety of modeling tools and processes that exist to forecast outcomes for life cycle management situations. These models are very useful for analyzing investments, processes and technical risk. However, it’s difficult to compare the various modeling outcomes because specific techniques and solution sets offered by each model are different and typically not easily comparable.

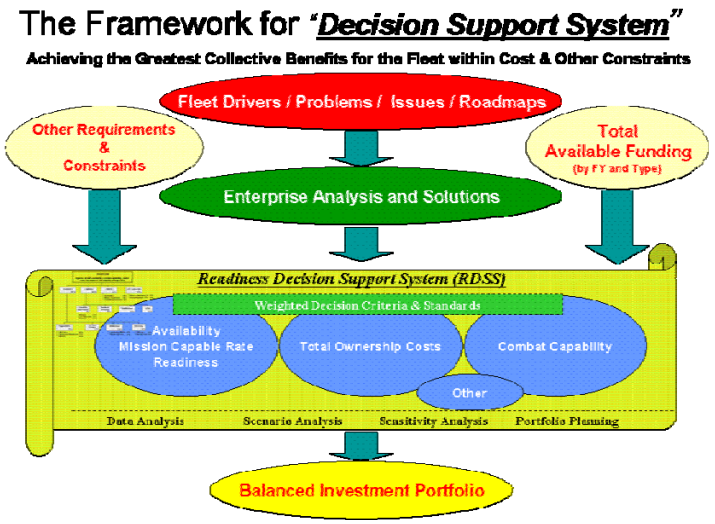
OSD's desire was to determine which standard outcomes modeling tools should project, with a focus on determining investment for performance based outcomes. It was in this context that an OSD/AIA joint effort was initiated on 9 October 2006.

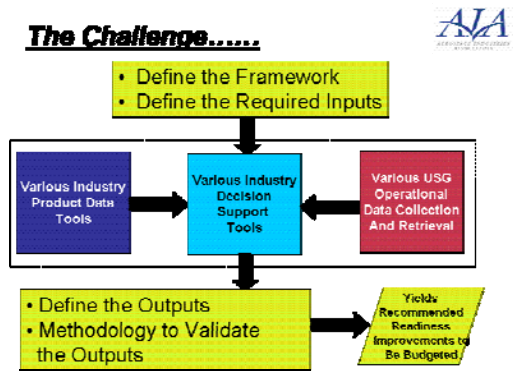
Additionally, on 21 November 2006 USD (AT&L) issued a Memorandum for USD (AT&L) Direct Reports, Subject: Integrating Life Cycle Management into Acquisition. This document stated that "...integration of life cycle management (LCM) into the DoD acquisition processes is crucial to provide effective support for the war fighter. Reliability and equipment readiness are vital to mission success. Of particular note is OSD's expressed need for much more emphasis on the support (vice acquisition only) costs of a

weapons system due to "...65-80 percent of the life cycle costs in the sustainability phase... (and is therefore) ... vital for the long-term viability of force readiness."

ADUSD - MR&MP was assigned a task force lead from DUSD (L&MR) per Goal 4 and 6 of the 21 November 2006 USD (AT&L) memo, with a March 2007 report-back date. This white paper was generated as an input for ADUSD-MR&MP consideration in meeting that requirement, and subsequently updated for currency.

On 5 December 2006, the AIA Product Support Committee provided a viewpoint on a Materiel Readiness Decision Support System (MRDSS) approach that focused on "what is missing" from the traditional approaches to materiel and weapon systems development and sustainment: *"A MaterielReadiness Decision Support System Utilizing an Integrated Data Management Process"*. With this perspective came a framework for such a decision support system (see first slide below), plus the associated challenge of defining the framework with appropriate inputs and outputs (see second slide below).





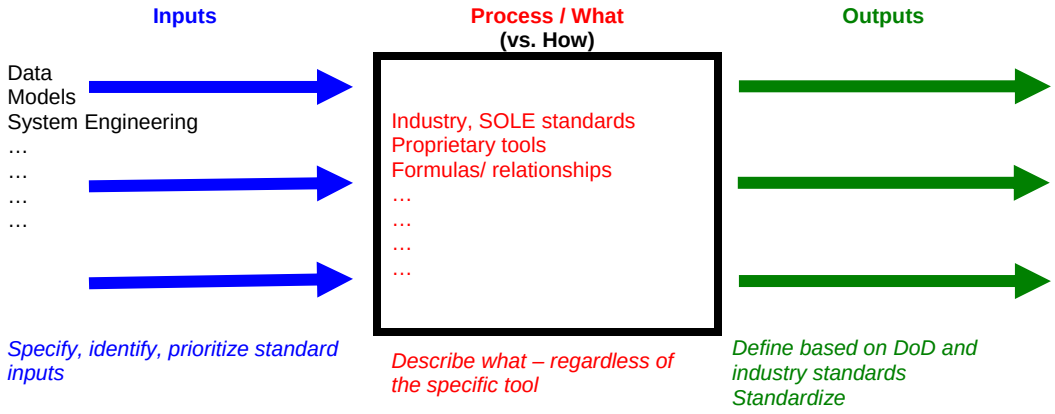
The AIA Working Group Process

Based upon the OSD vision, requirements, and challenges, our AIA Working Group endeavored to focus on the OSD top-level perspectives of "Materiel Readiness" as captured by the following four OSD Cornerstones of Readiness for Materiel, with "materiel" further defined as the spectrum from individual Component to Shop Replaceable/Line Replaceable Unit to Subsystem to Weapon System:

- Availability
- Reliability
- Mean Down Time
- Ownership Cost

Our attention was further focused on the investment(s) that could be made to increase Materiel Readiness via changes/improvements to one or more of the four Cornerstones of Materiel Readiness.

We worked to establish an Input Process Output (IPO) approach similar to the "Challenge…" diagram above. Considerable time was spent on identifying and defining the multitude of Input factors, the Output factors (relating to the four Cornerstones of Materiel Readiness, and investments to change), and the processes internal to the Process (Modeling and Simulation) portion of the flow.



As the AIA Working Group ventured further into the identification and definition of Inputs, Process Models, and Outputs several things became increasingly apparent:

- Common definitions of Inputs were not achievable within Working Group time constraints
- Common definitions of Outputs were also not yet achievable, even though we were only dealing with the four Cornerstones of Materiel Readiness, and investments to improve Materiel Readiness
- The Process Model portion identification and definition process proved even more elusive because of the significant number of proprietary tools and processes used by industry during the System Development and Demonstration (SDD) and Sustainment phases of materiel acquisition and sustainment.

Notwithstanding these key observations and challenges, the AIA Working Group did make significant progress in understanding the breadth and depth of the approaches needed to determine which standard outcomes modeling tools should project, with a focus on determining investment for performance based outcomes.

Of importance, is the AIA Working Group's assessment that development of a DoD-wide predictive modeling/analyses capability to determine cause and effect relationships to materiel readiness-based outcomes is viable, and, in fact, is already being applied in some or all aspects in both the SDD and sustainment phases.

Of equal importance is our assessment that the existing predictive Materiel Readiness processes (and tools) can be used by both industry and the DoD to achieve essentially the same Materiel Readiness objectives.

What is generally lacking, however, is wide-spread knowledge of the availability of the existing Materiel Readiness prediction processes and tools. From the industry materiel design and development perspective, there are also restrictive proprietary and licensing issues.

Nevertheless, as verified by the AIA, industry has numerous internal processes and tools to calculate and predict the four Cornerstones of Materiel Readiness (Availability, Reliability, Mean Down Time, and Ownership Cost) during the SDD phase. Industry applies these processes and tools during SDD in order to assure compliance with contract specifications and requirements. Once the materiel / systems are turned over to the receiving DoD organizations, different variables enter the picture as the many years of sustainment ensue.

Conclusions and Recommendations

Based upon the past several months of AIA Working Group study and assessment of MR&MPs vision and objectives, we believed the best way to achieve the goal was with a two-step implementation approach. A two phase implementation would get the ADUSD-MR&MP vision, objectives, and basic process to the field (industry and DoD) quickly, so immediate benefits can be derived. This would avoid lengthy delays that would likely happen due to disagreements on definitions and different Service or industry practices and data structures.

The second phase of implementation should be focused on a precise set of processes, data, and definitions given that there is enough time to wade through the "negotiation" process and make adjustments to the many different variations of existing Service data bases and structures.

On 13 April 2007, the two phase approach was presented to ADUSD-MR&MP. The assessment was that Step 1 would achieve a 95% solution, and that was far more important than trying to detail and fine-tune everything that would be involved during Step 2.

On 28 June 2007, the two phase approach was presented to the new PADUSD -MR&MP, Mr. Alan Estevez. He concurred with the Phase One recommendations for the AIA to create an industry standard that covered the essence of the Materiel Readiness predictive modeling/analyses capability to determine cause and effect relationships to materiel readiness-based outcomes during both the SDD and sustainment phases. He also agreed that "Materiel Readiness" is captured by the following four OSD Cornerstones of Readiness for Materiel, with "materiel" further defined as the spectrum from individual Component to Shop Replaceable/Line Replaceable Unit to Subsystem to Weapon System:

- Availability
- Reliability

- Mean Down Time
- Ownership Cost

Mr. Estevez confirmed that the focus should be on the investment(s) that could be made to increase Materiel Readiness via changes/improvements to one or more of the four Cornerstones of Materiel Readiness. He additionally confirmed that benefit-to-cost, sensitivity, and scenario analyses should become part of the readiness investment decision process, with the ultimate goal of achieving the greatest collective benefits within resource constraints. The Materiel Readiness investment analyses could also be used to justify increased resources.

Phase One Recommendations:

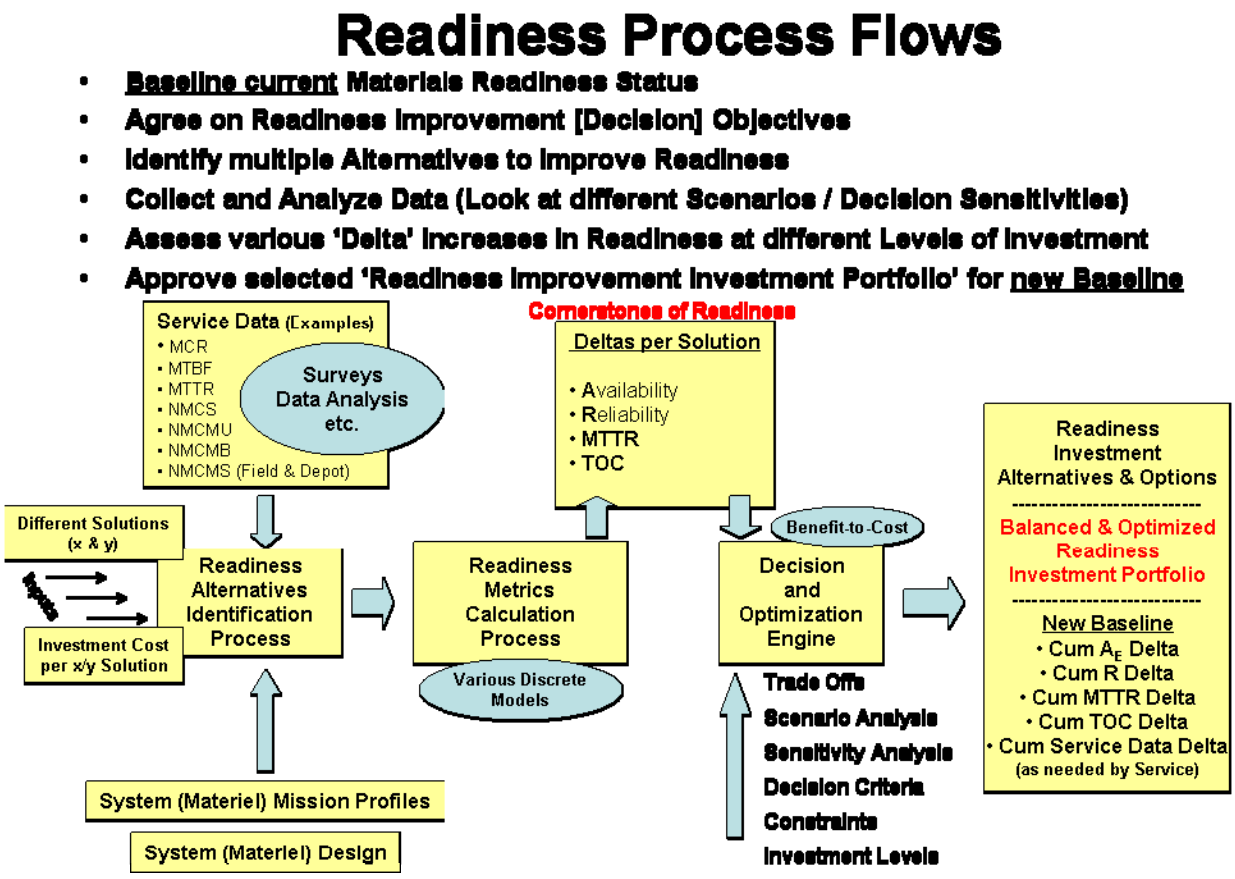
1. AIA publish White Paper on the "Assessment and Recommendations to ADUSD-MR&MP regarding a Materiel Readiness Modeling and Simulation Capability (Materiel Readiness Decision Support System)".

2. ADUSD-MR&MP outline and publish their general vision, objectives, and basic processes to industry and DoD shortly. This will capture the immediate benefits that can be derived by moving this process forward without waiting for our recommended Phase 2 results outlined below.

   - The issuance and explanation of the Materiel Readiness predictive vision and objectives that are applicable during the entire materiel life cycle
   - A statement of logic and additional benefits to be derived via even a simplified approach to predicting and improving Materiel Readiness
   - Allowance for different [Service and industry] definitions of how to calculate and predict changes to the four Cornerstones of Materiel Readiness (Availability, Reliability, Mean Down Time, and Ownership Cost) with the objective that improvements in any or all will increase Materiel Readiness qualified by assessment of investment costs to achieve the Materiel Readiness improvement
   - Encouragement to use a variety of techniques to validate or support any investment decisions, such as sensitivity analysis, scenario analysis, benefit-to-cost perspectives, parallel business case analysis, and other financial metrics (return on Investment, Payback, Net present value)
   - The bottom-line objective of Phase One is for progress to be made quickly, along with resultant benefits, given the overall ADUSD-MR&MP vision and objectives to increase Materiel Readiness via focus on the improving the one or more of the four Cornerstones of Materiel Readiness using a financially sound approach for the investments
   - The Phase One approach relies heavily on Service and industry ability to be creative in implementing the basic Materiel Readiness predictive modeling and decision process, but the AIA Working Group is confident

that it can be done, especially if reporting requirements are imposed by OSD to document progress and benefits

Here is an example and graphic portraying the essential "process" ingredients of the Phase One implementation, the essence of which is a simplified approach to predicting and improving Materiel Readiness in either the SDD or sustainment phases.



Mr. Estevez concurred that the next step was for the AIA to draft an industry standard, while concurrently the OSD was pursuing policies relating to a similar Materiel Readiness Investment Decision Process.

The Phase Two Recommendations:

- OSD and AIA produce an implementation guide or standard, available for all of the aviation industry supporting DoD materiel acquisition and sustainment efforts. This product would be used as reference for all contracts involving research and development, manufacture, delivery, and long-term, life cycle support of all materiel, from component through weapon systems
- Phase Two would require a follow-on joint OSD-AIA Working Group to develop a plan and schedule for how agreement can be reached within the Services and industry on definitions, the math of calculations, the impacts on existing / legacy

data bases and systems, and a more precise taxonomy of the readiness process model functions and attributes

- The value of this product will be a standard for input/output of data and data systems (tools, models, etc.) crossing the seam from industry to DoD
- The DoD will have the ability to request the "best of the best" industry has available in all future contracts
- The DoD will also have the ability to require use by materiel and fleet managers throughout all the Services
- The DoD will have the understanding of the standard deliverable and Life-Cycle Methodology and include this in the current end-to-end enterprise efforts for sustaining materiel readiness
- The DoD will have the understanding of the standard required by industry for information needed but not currently available to industry. This will allow for improved materiel support and readiness analysis by circling back across the seam – from DoD to Industry

Summary

The AIA partners with the DoD on issues that impact the war fighter. The intent of this whitepaper is to document the AIA analysis and the final ADUSD-MR&MP recommendations that will serve to increase the materiel readiness of the war fighter via focus on improving one or more of the four Cornerstones of Materiel Readiness using consistent and financially sound approaches for readiness investments.

On 13 April 2007, ADUSD-MR&MP asked the AIA to create an industry standard that covered the essence of the Materiel Readiness predictive modeling/analyses capability that would determine cause and effect relationships to materiel readiness-based outcomes during both the SDD and sustainment phases. Concurrently, it's our understanding that the OSD is pursuing policies relating to a similar Materiel Readiness Investment Decision Process.

The AIA appreciates the opportunity to be in the forefront of the development of enablers that will take us into the future regarding *"A Materiel Readiness Decision Support System"*.

Inclusions:

Addendum 1: Materiel Readiness Decision Model Overview

Addendum 1

Materiel Readiness Decision Model Overview

Model / Process Attributes

The characteristics below show an ideal full range of functions and attributes that can be tailored as required for each specific application / implementation, be it for stand alone materiel decisions or as part of investment decisions for a system of materiel.

These characteristics represent the processes that would constitute a robust Materiel Readiness Process Model designed to assess or project the overall effects on Levels of Materiel Readiness when inputs into the Materiel Readiness Process Model – including Investment Costs – are varied. The characteristics listed below are not prioritized.

Any Materiel Readiness Process Model will also handle the interdependence and variability of the four output constituents of Materiel Readiness (Availability, Reliability, Mean Downtime, and Total Ownership Cost). Input data requirements and specifications will be a function of the final Materiel Readiness Process Model design.

- Must be a Repeatable Process
  - Initial applications / implementations
  - Subsequent updates
- Must have Flexibility and Adaptability, such as:
  - Ability to handle multiple Service Materiel Readiness Metrics (different definitions)
  - Ability to be applied at any point in the Materiel Life Cycle (Design, Development, Mods & Upgrades, and Sustainment)
  - Ability to handle new or legacy Materiel / systems
  - Ability to handle different types of weapon systems / subsystems
  - Ability to handle any type of Materiel
- Ability to handle a variety of variables and constraints
- Ability to handle a variety of resource attributes, such as:
  - Manpower by Type
  - O&S Costs
  - Equipment Availability
  - Total Cost
- Ability to handle data descriptors (via relational data base), such as:
  - Branch of Service
  - Life Cycle
  - Organizational
  - Geographical
  - Points of Contact
  - Etc.
- Ability to handle different colors of money by fiscal year
- Ability to handle subjective as well as objective data
  - Examples of quantitative input and output data:
    - Delta MCR
    - Delta MTTR
    - Delta TOC
    - Flying Hours/Operating Hours
    - Maintenance Manhours

        - Total Ownership Costs
        - Reliability
        - Return on Investment
        - Etc.
    - Examples of qualitative input data:
        - Legislative/DoD/Service priorities
        - Policies
        - Levels of Maintenance
        - Maintainer experience levels
        - Operational parameters
        - Maintenance practices (CANNs, etc.)
        - Risk
- Integrated with a relational data base
    - Easily import and export data
- Easily calculate the impacts / changes in Outputs
- Ability to handle multiple decision criteria and models
- Ability to handle decision criteria weightings and standards
- Ability to handle scenario analysis
- Ability to handle sensitivity analysis
- Ability to handle outputs in addition to the four Materiel Readiness Outputs
- Ability to handle different combinations of Materiel Readiness Outputs and Other Outputs at the same time
- Ability to resolve multiple problems and problem sets simultaneously
- Capability to execute linear optimization solutions to project and achieve the greatest collective Benefits at various levels of cost or other types of constraints (Needs to get the greatest 'Bang for the Buck')
- Ability to handle a variety of Boolean combinations (groups, linkages, etc.)
- Ability to include key Stakeholders in the process
- Ability to include existing Service Plans, Roadmaps, etc.
- Ability to handle investment analysis capabilities
    - Return on Investment
    - Payback period
    - IRR/NPV
    - Portfolio analysis and planning
- Ability to handle Materiel Readiness-to-Cost Relationships (and other Benefit-to-Cost relationships)