Supportability Optimization Model to Improve Performance and Reduce Total Ownership Cost

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Background & Purpose

- As the services support and sustain today's weapons systems they face the following challenges throughout a system's life cycle :
  - Improve Operational Availability
  - Improve Mission Reliability
  - Ensure Safety
  - Reduce Total Ownership Costs

Simultaneously

- Requires a solution that balances operational needs with cost considerations necessary to ensure "**Affordable Sustainment**" at program milestones.

Today's Objective – Model Description

- This presentation will:
  - Introduce model approach, concepts, and theory
  - Identify necessary inputs and assumptions
  - Describe algorithms and formulas behind the calculations
  - Demonstrate the outcomes and their uses
  - Discuss current status and future efforts

- Model developed in concert with NAVAIR Systems Command and JSF Joint Program Office

- SOM is part of an overall Asset Management Suite called MPS&E

Definitions

- Supportability generally defined as a function of Availability, Reliability, and Total Ownership Costs

S = f{Availability, Reliability, Costs}

- ASI tasked by NAVAIR & JSF JPO to transform abstract concept to a concrete and quantifiable metric that can be defined, measured, and optimized

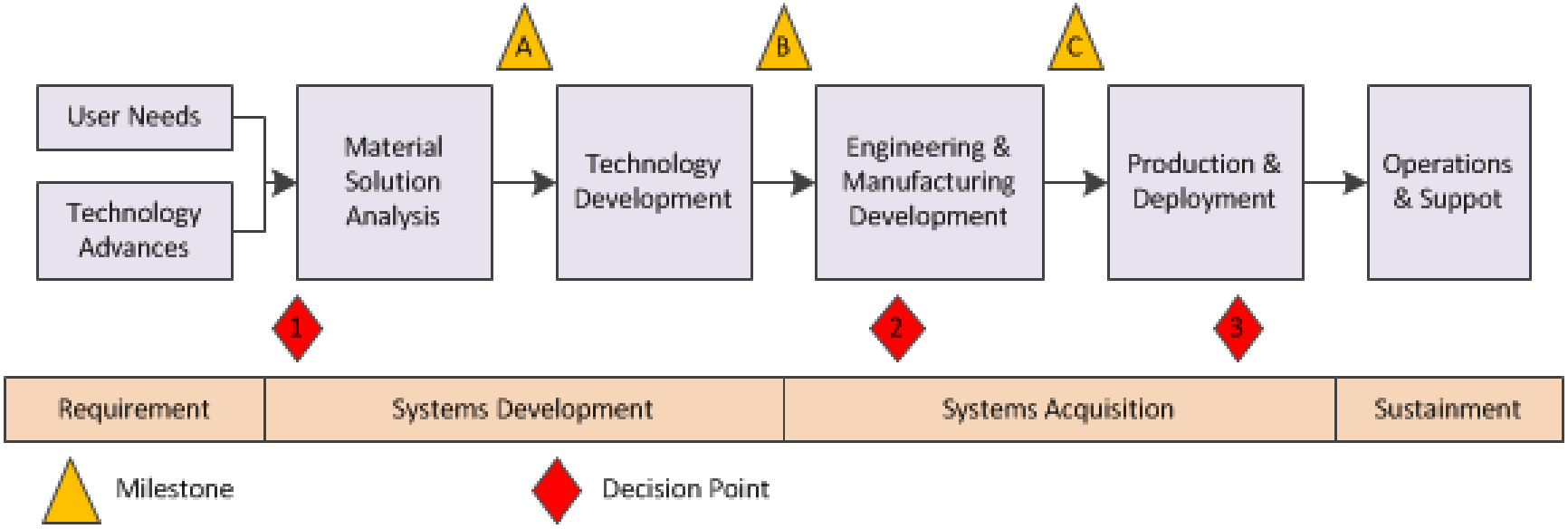
- Supportability metric is a multi-segmented modeling approach; combines Availability, Reliability, and Cost into single Objective Function

- Definitions of Availability, Reliability, and Costs taken from DOD RAM-C manual to ensure consistency and compliance

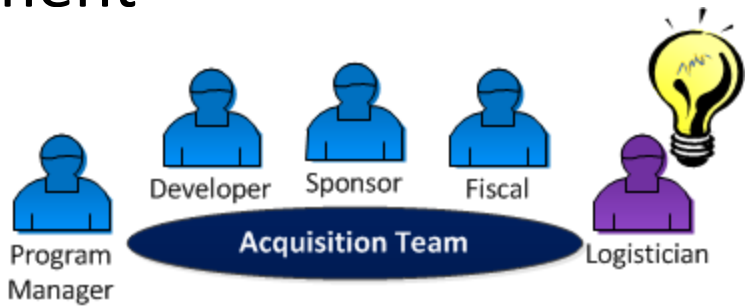
SOM Objectives

- Provide program **assessment** throughout each phase of product life cycles
- Establish Supportability **thresholds**
- Determine how well operational needs are being balanced with **cost containment measures**
- Perform **sensitivity** and business case analyses
- Evaluate whether contractual **requirements** are being met
- Identify **critical metrics** and key areas for improvement
- Compare legacy versus candidate systems using **L & S analysis**
- **Optimize** Life Cycle Sustainment/Performance

DoD Acquisition Milestones



- Requirement through Sustainment
- Three milestones
- Three decision points



Analysis Approach

- Computing the Supportability Index Involves utilizing Multi-Attribute Utility Theory (MAUT) and Value Function Theory
  - Provides utility function that quantifies anticipated improvement to a dimensionless number
  - Resultant index, once calculated, used for comparative purposes
  - Derived objective function can be optimized

- Swing Weight Method assigns weights to attributes
  - Weights are relative from Best and Worst conceivable values
  - Sensitivity analyses easily performed to validate weight assignments
  - Logical, structured process
  - All key stakeholders involved

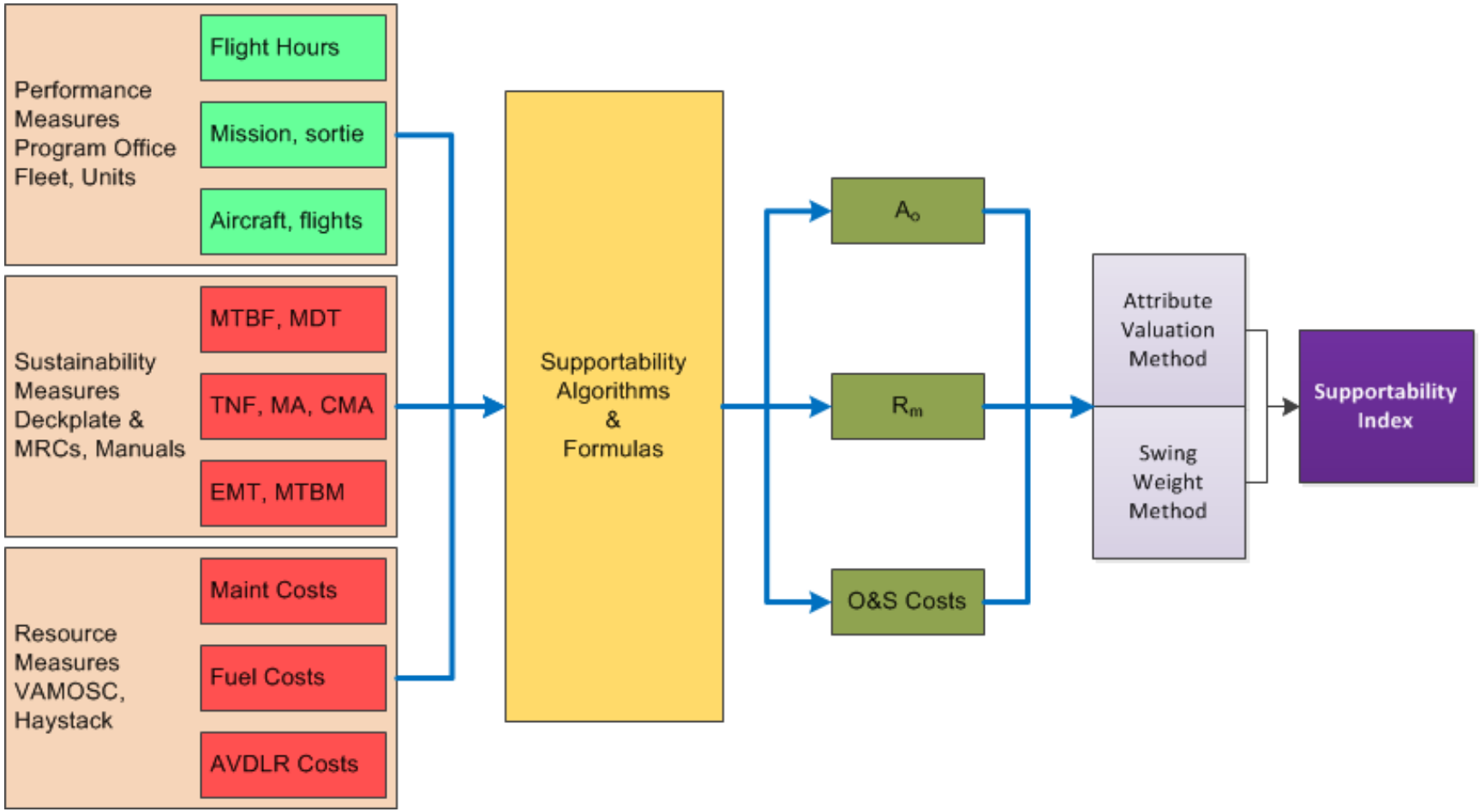
Calculation Results

- Upon completion of weight assignment process, Objective Measures are scaled to calculate Supportability:

$$S = k_1 A_o + k_2 R_m + k_3 C_{Total}$$

- Resultant metric is an index which ranges from 0 to 1
  - 0 is worst case scenario (lowest possible A_o and R_m, highest possible Cost)
  - 1 is ideal scenario (highest possible A_o and R_m, lowest possible Cost)
- Supportability calculated for end items, as well as at the system level, subsystem level, etc.
- "S" score used for evaluation and comparative purposes across various maintenance concepts, milestones, ECPs, like & similar analyses

Supportability Index Calculation – Block Diagram

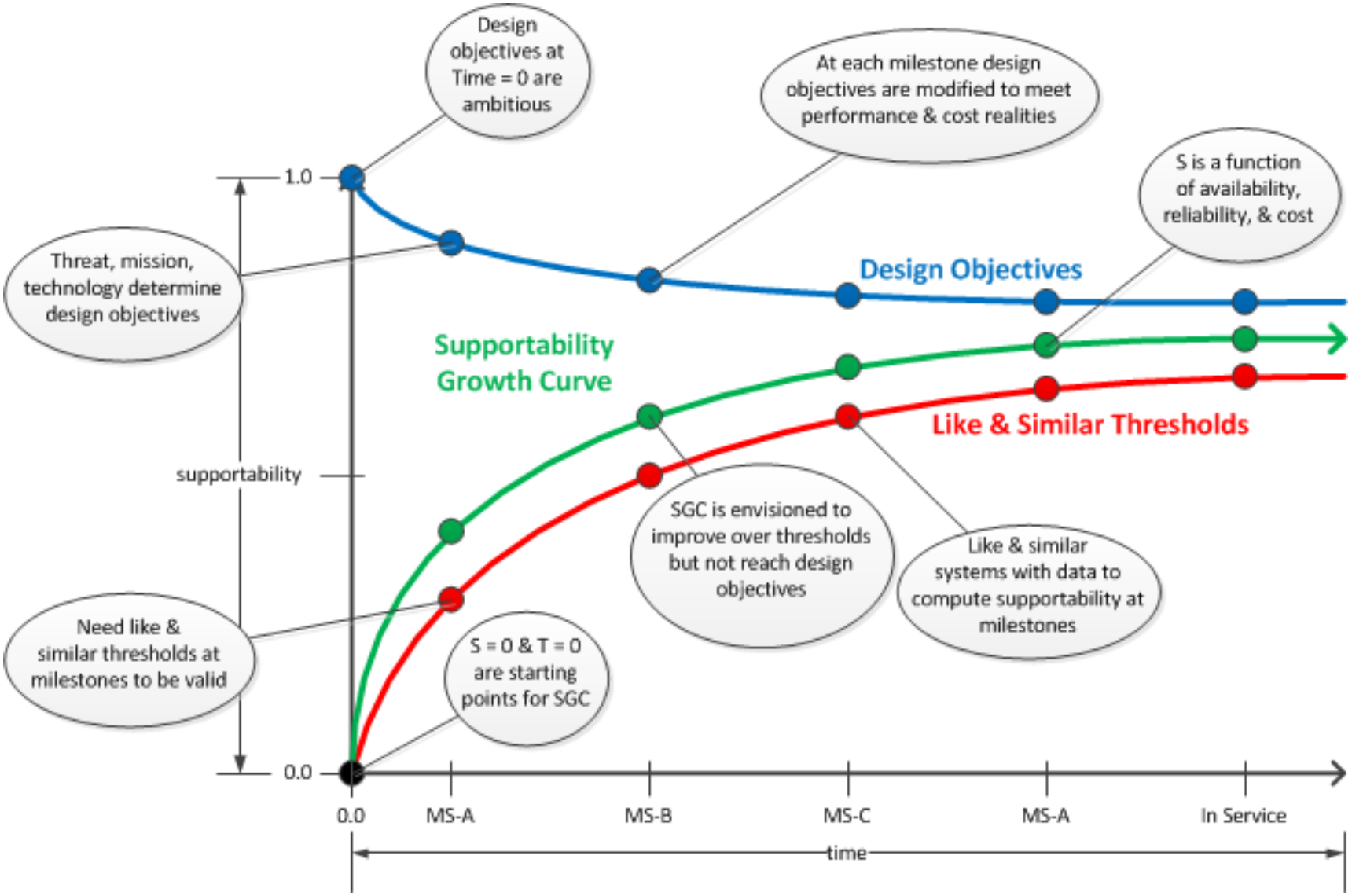


Supportability Index Goals

- "S" Score not only used to evaluate mature systems

- Key "S" Index Goal: Compare legacy system to new candidate system
  - When there is limited or non-existent data/information with which to predict performance
  - "S" Index falls between legacy system performance and design objectives (see next slide)

Supportability Growth Curve

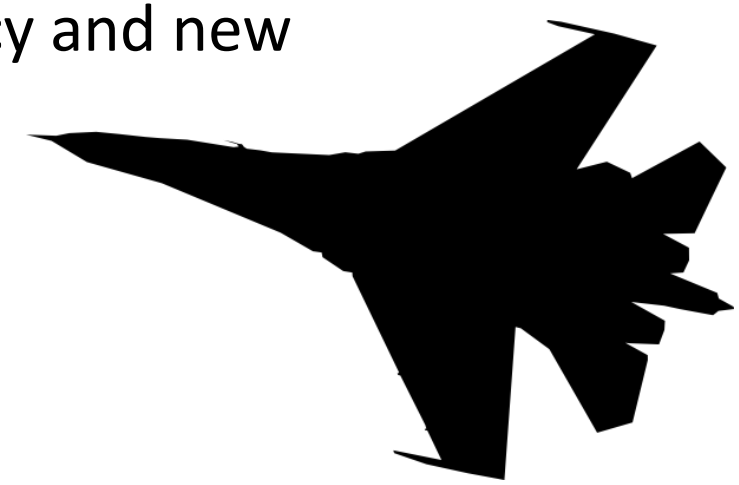


Real World Example

Recent effort completed for the JSF

Objectives:

- Perform Like & Similar Analysis on new system on F-35 Joint Strike Fighter
- Predict key Performance and Cost metrics for new system
- Calculate Supportability for legacy and new systems
- Conduct sensitivity analysis
- Utilize results to make decisions



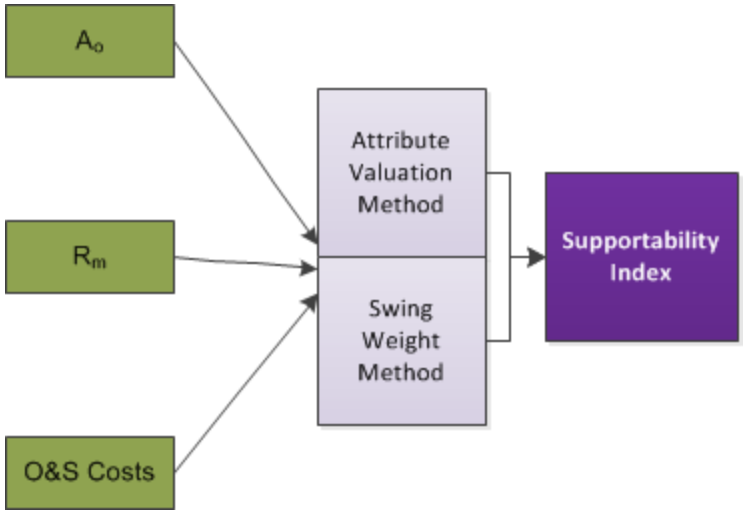
Like & Similar Comparison Results

Comparison	Check	%
Look & feel from photo comparison	✓	90%
Design & technology from drawing comparison	✓	85%
Capabilities from feature comparison	✓	90%
Similarity from sub-assembly comparison	✓	90%
Parts comparison	✓	80%
Summary (average of comparisons)	✓	87%

Supportability Analysis: F/A-18 Model

$S_{index} = \int(A_o, R_m, O\&S\ Costs)$

#	Variable	Calculation
1	A_o	XX %
2	R_m	XX FHs
3	O&S Costs	$ XX M



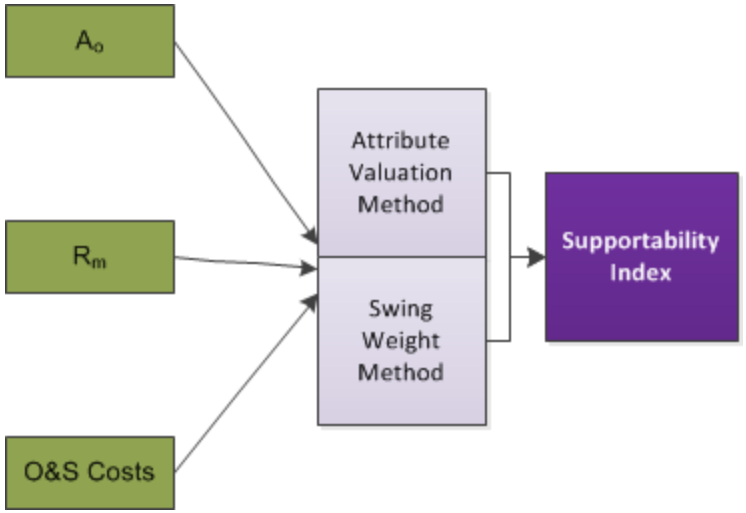
Legacy system

Supportability Analysis: F-35 Model

$S_{index} = \int(A_o, R_m, O\&S\ Costs)$

#	Variable	Calculation
1	A_o	XX %
2	R_m	XX FHs
3	O&S Costs	$ XX M

Candidate system



Summary Comparison

F/A-18 Model		F-35 Model	
Variable	Calculation	Variable	Calculation
Availability	XXX	Availability	XXX
Reliability (MTBF)	XXX FHs	Reliability (MTBF)	XXX FHs
O&S Costs	$ XXX M	O&S Costs	$ XXX M
Cost/Flight Hour	$ XXX	Cost/Flight Hour	$ XXX
Cost/Aircraft	$ XXX	Cost/Aircraft	$ XXX
Supportability	0.589	Supportability	0.368

JSF Model projected X% improvement in Availability, at an increase of $X Million (yearly estimate) in Sustainment Costs

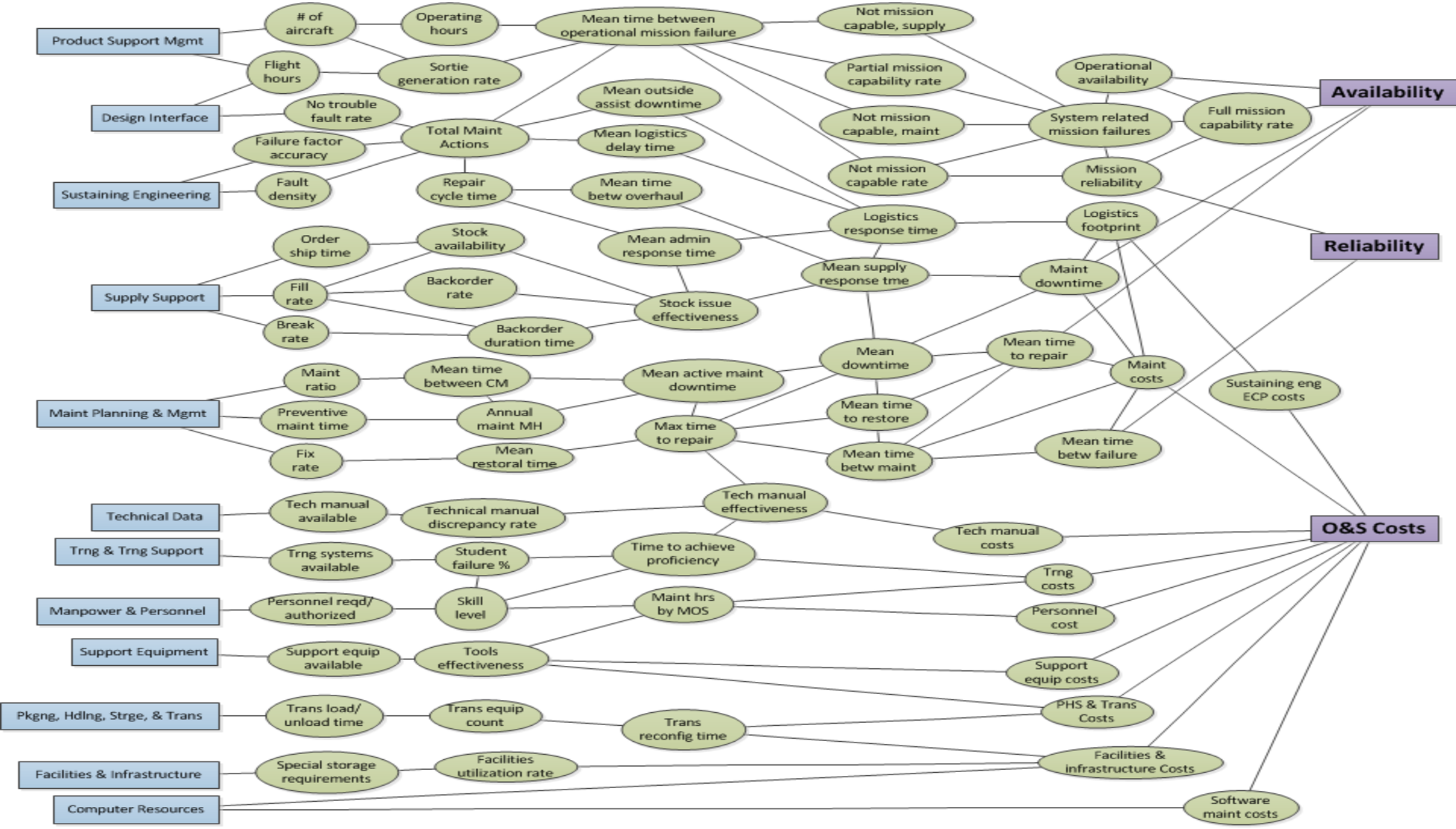
JPO used the results of this analysis (and other follow-up efforts) to make key decisions regarding Maintenance Planning and Sustainment of the system

SOM Status and Future Direction

- Numerous efforts completed to date and also in work:
  - Various NAVAIR platforms
  - Various JSF systems
  - Performed on end items, systems, components
  - Combined with other efforts (LORA, RCM, etc.)

- Future steps include
  - Use of Factor Analysis techniques to measure contribution of PSEs
  - Use of Operations Research techniques to optimize Supportability

Mapping of PSEs to Metrics - Example



Summary & Conclusions

- SOM provides numerous benefits but also poses several unique challenges
- Model employs logical, quantitative approach to simplify a complex problem
- Data analysis techniques utilized to improve the model and efficiently target improvement initiatives
- Serves as a DST to allow Program Offices to:
  - Assess performance at each milestone
  - Identify areas for improvement
  - Compare alternatives
  - Set goals and thresholds for acquisition and sustainment contracts

Points of Contact

Andromeda Systems Inc.

- Ron Wagner (Captain USN, Retired)
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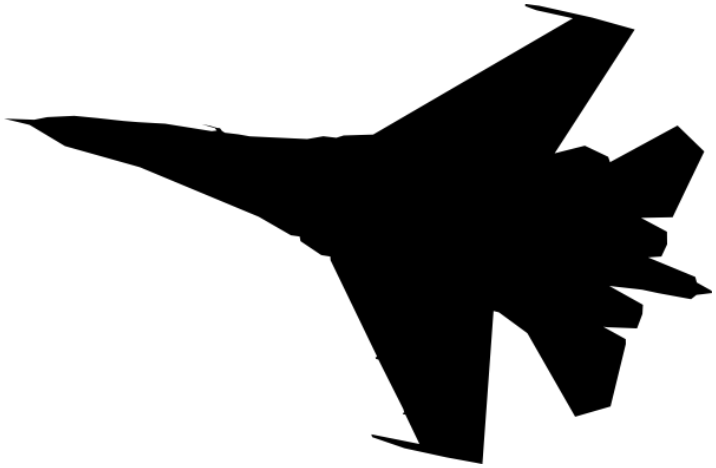
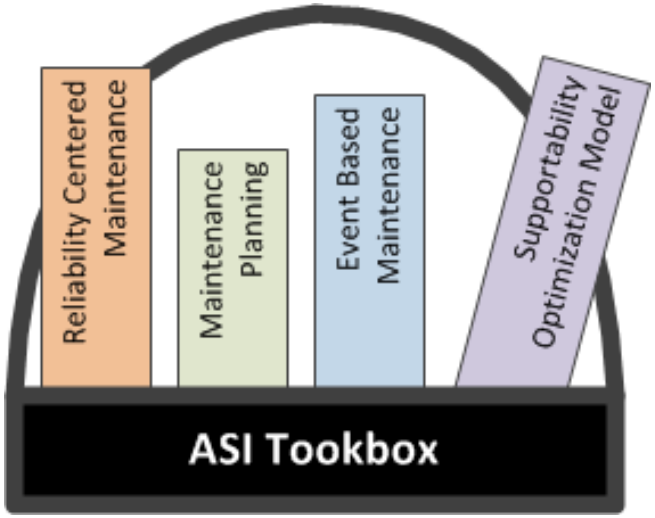


Comments
& Questions

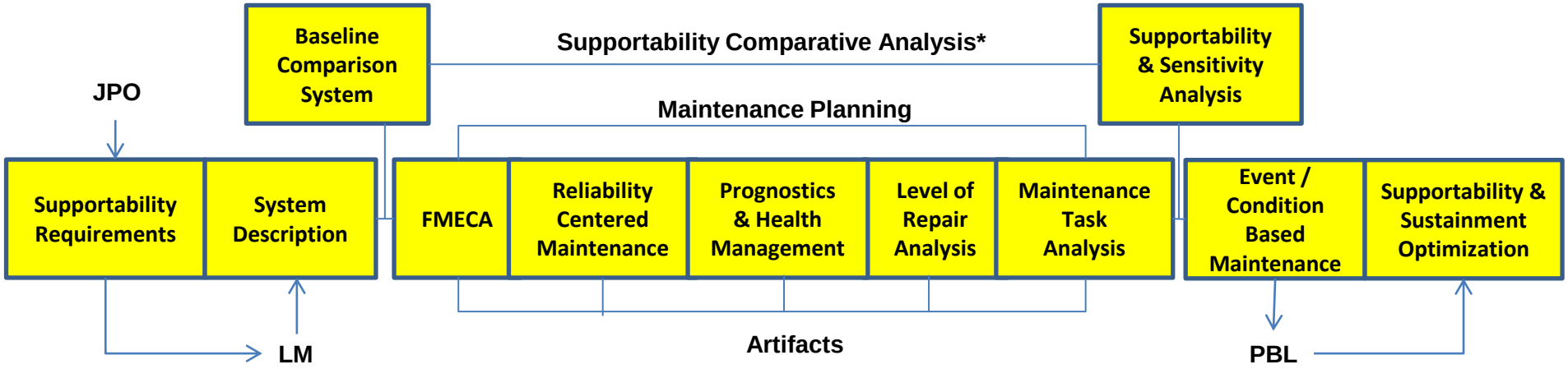
Backup Slides

Challenge & Solution

- Simply stated, we have an objective function that combines elements of availability, reliability, & costs
  - Function that requires optimization
  - Dimensionless metric – for comparison
- In other words, if there is only one dollar left in the budget, where should it be applied to maximize:
  - Improved performance
  - Reduced total life cycle cost
- Solution: Andromeda Systems Inc. (ASI) has developed a Supportability Optimization Model (SOM) calculating a supportability index/metric



Supportability Analysis & Optimization Process*



*Ref: JCS 2YZS00002 Rev M 8 October 2009: Section 3 System Definition Para 3.0.

- Review of process to illustrate context of Supportability Index Use

References

#	Reference
1	DECKPLATE – NAVAIR Logistics & Technology Information System
2	NAVAIR Maintenance Trade Cost Guidebook
3	Naval Visibility and Management of Operating and Support Costs (VAMOSC) 10.0 Weapon System Report User Manual
4	Reliability, Availability, Maintainability, & Cost (RAM-C)
5	OSD Guide to Sustainment
6	NAVAIR 11-75A-514; 1 Jul 2010; O & I Level Maintenance w/Parts Breakdown
7	NAVAIR 00-25-403: Guidelines for the Naval Aviation RCM process
8	SAE JA1012: Society of Automotive Engineers Guide to RCM Standard
9	RAC-HDBK-1120: FMECA - Failure Mode, Effects and Criticality Analysis
10	MIL-STD-1629A: Procedures for Performing a Failure Mode, Effects, and Criticality Analysis
11	MIL-HDBK-217: Reliability Prediction of Electronic Equipment