System Development Performance Measurement Working Group Results Summary

sponsored by the

NDIA Systems Engineering Division
Systems Engineering Effectiveness Committee
(In conjunction with Practical Software and Systems Measurement)

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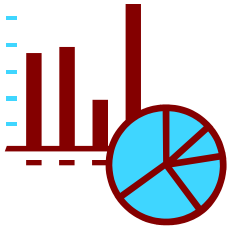
A Top Systems Engineering Issue

Technical decision makers do not have the right information & insight at the right time to support informed & proactive decision making or may not act on all the technical information available to ensure effective & efficient program planning, management & execution.

In September 2010, the NDIA Systems Effectiveness Committee chartered a working group to identify a small set of key leading indicators that would help address this issue. This presentation provides an overview of the working group process and its results.

Working Group Goal

Identify potential high value



- measures,
- indicators, and
- methods

for managing programs, particularly in support

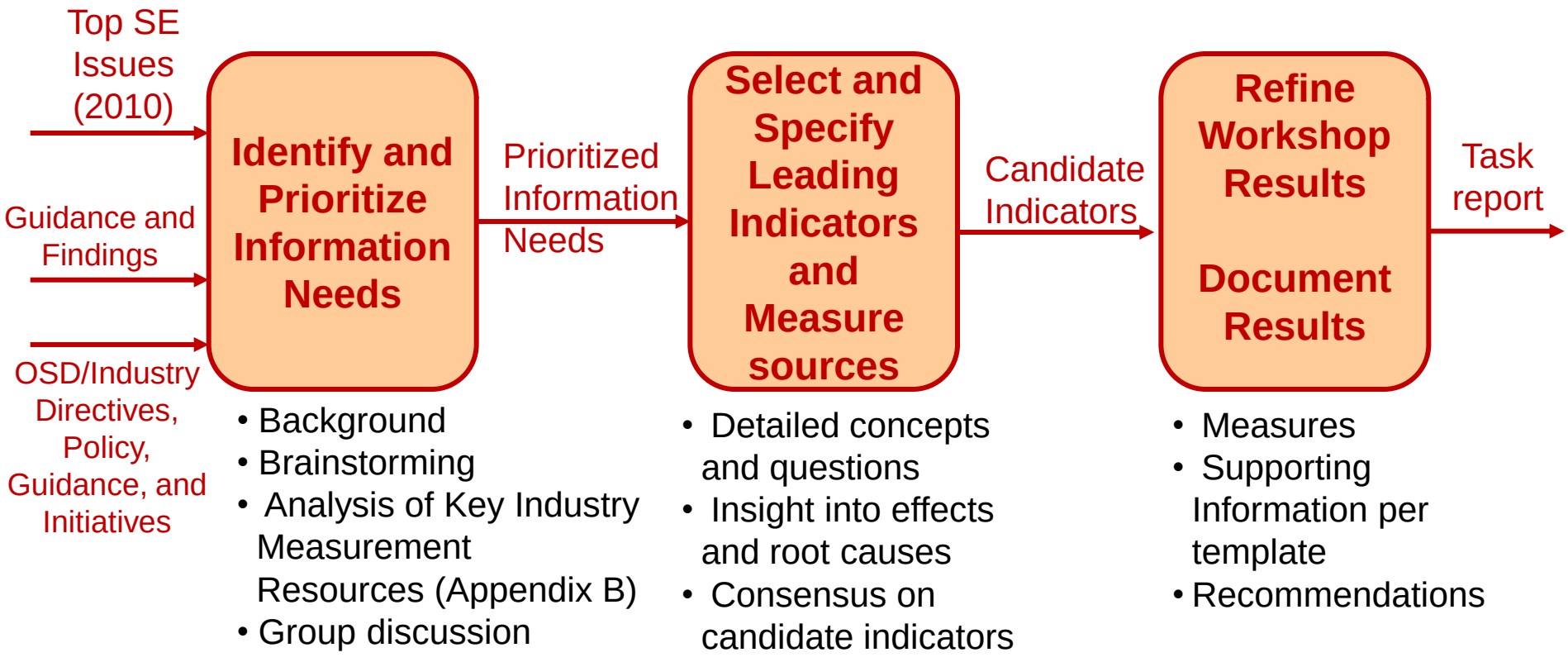
- making better technical decisions and
- providing better insight into technical risk

at key program milestones during

- Technology Development and
- Engineering and Manufacturing Development

for both the acquirer and supplier

Working Group Process



Important Information Needs

Highest Priority Information Needs (Addressed by current results)	**Other Information Needs** (To be considered in the future)
• Requirements • Interfaces • Architecture • Staffing and Skills • Technical Performance • Technology Maturity • Affordability • Risk Management • Manufacturability	• Testability • Requirements Verification and Validation • Defects and Errors • System Assurance • Process Compliance • Work Product Progress • Facilities and Equipment • Change Backlog • Review Action Item Closure

As Determined by the Workshop

Indicator Selection Criteria

- Strongly addresses the information need
- Feasible to produce
- Raw data exists and easily processed
- Already frequently utilized (in common use)
- Provides leading or predictive insight
- Applicable to Technology Development (TD) and Engineering Manufacturing & Development (EMD) phases

Recommended Leading Indicators

Information Need	Specific Leading Indicator
Requirements	Requirements Stability
Requirements	Stakeholder Needs Met
Interfaces	Interface Trends
Staffing and Skills	Staffing and Skills Trends
Risk Management	Risk Burndown
Technical Performance	TPM Trend (specific TPM)
Technical Performance	TPM Summary (all TPMs)
Technical Maturity	Technology Readiness Level
Manufacturability	Manufacturing Readiness Level

No recommendations at this time for Affordability and Architecture

Example: Interface Stability

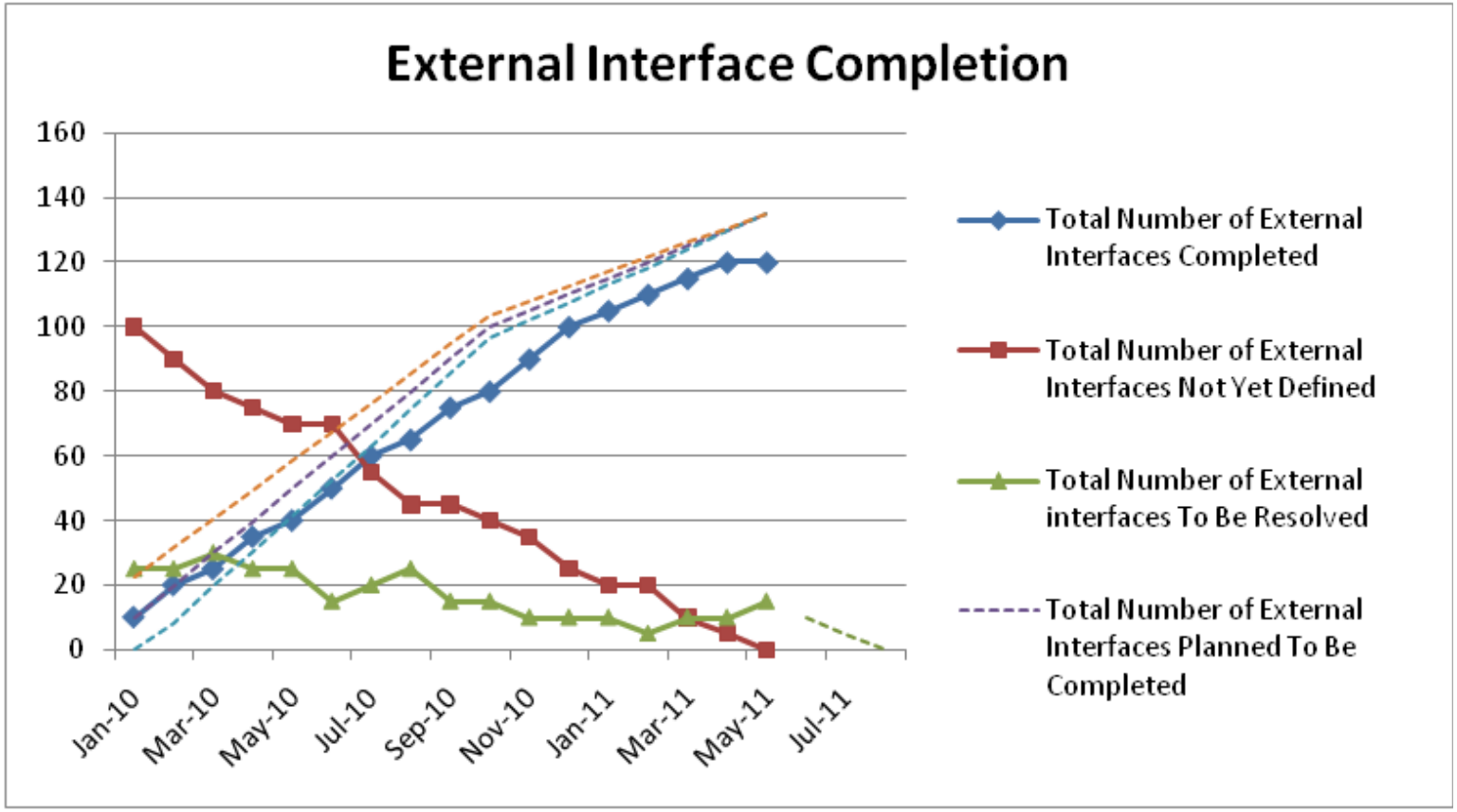
Indicator Name	Interface Trends
Information Need(s)	**Interfaces** Evaluate the growth, change, and correctness of external interfaces.
Question(s) Addressed	Is the definition of external interfaces correct and complete?
Measurable Concept	SE activities associated with correctness and completeness (i.e., approved) and validation of the definition and design of system external non-hardware interfaces.
Leading Insight Provided	Evaluates the stability and adequacy of the interfaces between the system under development to other systems to which it provide or receives information to understand the risks to other activities towards providing required capability, on-time and within budget.
Base Measures	Total Number of External Interfaces at the end of the reporting period (e.g., monthly) Total Number of External Interfaces Completed(determined by the application of explicit criteria) at the end of the reporting period Total Number of External Interfaces Not Yet Defined at the end of the reporting period Total Number of External interfaces To Be Resolved (interface defined but not completed; that is, have outstanding issues) at the end of the reporting period Total Number of External Interfaces planned to be completed by the end of the reporting period Total Number of External Interfaces planned to be resolved by the end of the reporting period
Derived Measures	Total Number of External Interfaces = Total Number of External Interfaces Completed + Total Number of External Interfaces Not Yet Defined + Total Number of External Interfaces To Be Resolved

Example: Interface Stability

Decision Criteria Interpretation and Usage	The plans should be based on results expected to be achieved at major milestones. For example, all external interfaces are defined at PDR and all issues are resolved by CDR. For unresolved interfaces use a tolerance band around the plan as Plan Value +/- <some percent> of Plan Value, e.g., Plan Value +/- 10%. The percent used should be based on historical experience on successful programs. For interface definitions use a tolerance band around the plan as Plan Value +/- <some percent> of (Total Interfaces Not Yet Defined) For both unresolved interfaces and interface definitions, investigate if a tolerance is exceeded for the latest reporting period or if the trend over the last several reporting periods is consistently trending toward a tolerance limit. If values are below the lower tolerance limit or trending towards the lower tolerance limit, then identify the dependent program activities impacted, define and evaluate the risks, and take actions to control the exposure. If values are above the upper tolerance limit or trending towards the upper tolerance limit, then the correctness and completeness of the definitions should be reviewed to ensure the quality requirements have been met.
Additional Considerations	A similar approach can be used for internal non-hardware interfaces., for example combat systems “Complete”, as used here, means the interface has been defined and determined to be complete through analysis or modeling and simulation, but has not been tested Showing major milestones on the chart is helpful for interpretation.

Example: Interface Stability

Example



"Time Now" is May-11, which is when all interfaces were planned to be completed. However, fifteen remain, with the chart indicating these will be completed within three months. Corrective action was attempted mid-stream but was not sufficient to recover schedule. Since completions were trending toward and crossing the lower threshold much earlier, the basic lesson learned is to take action aggressively when anomalous behavior is first detected.

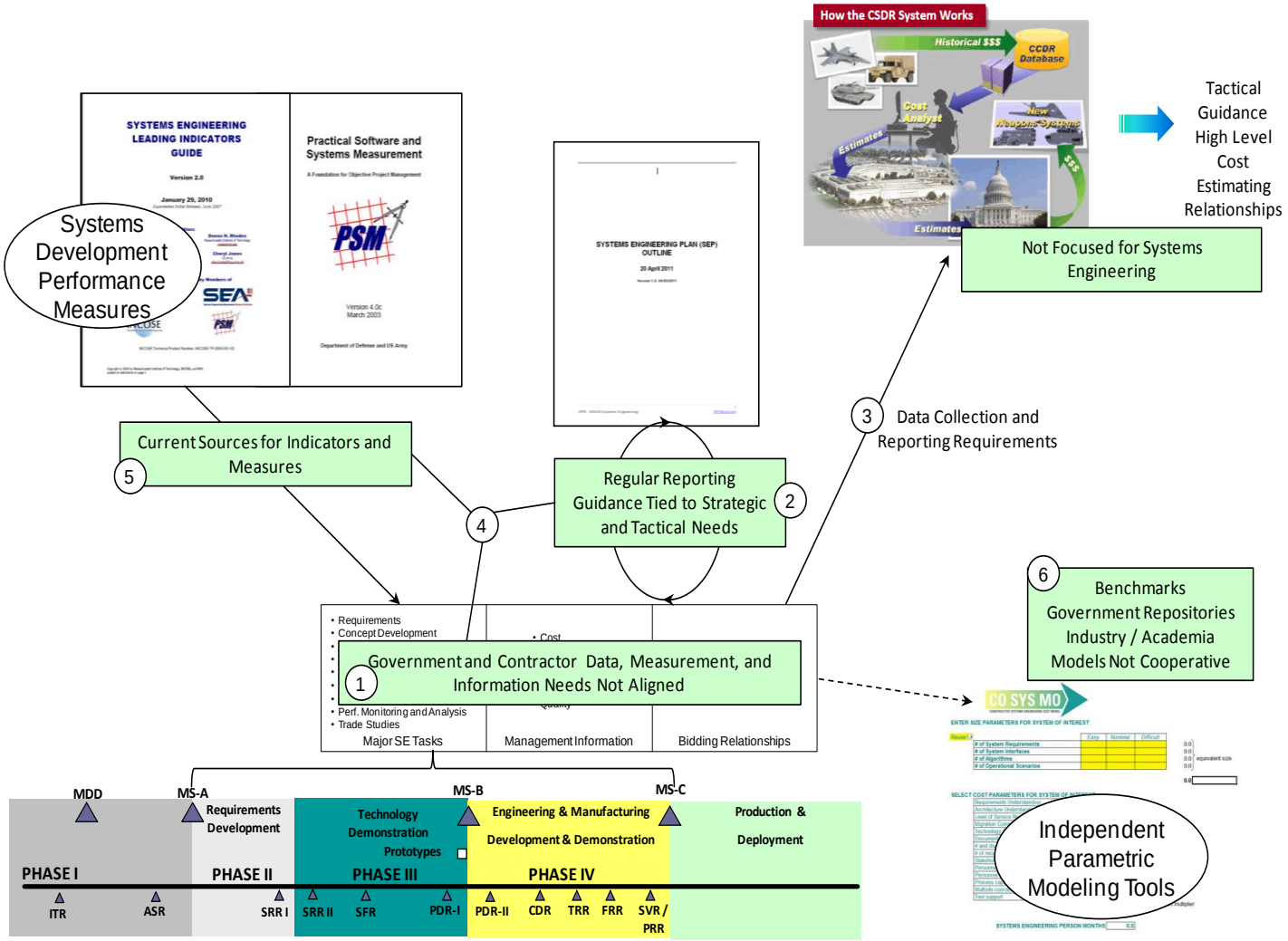
Some Things to Keep in Mind

- The intent of the working group was not to invent new indicators but to determine an essential set addressing important system engineering issues
- Organizations need to determine how to meet the intent of each indicator (obtain the insights intended). Don’t dwell on the style of presentation suggested by the examples

Future Directions

- Determine leading indicators that address the other important information needs identified by the working group
- Build a relationship model for government and contractor information focusing on information needs, data alignment and measures
- Harmonize contractor reporting and government requirements
- Determine how to establish collaboration among government required data and repository mechanisms and contractor and academia repositories

The Road Ahead



Final Report – Table of Contents

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Current Status

- Working Group Report has been submitted to the NDIA Systems Engineering Division for Approval
- Expected availability: November

Points of Contact

- For further information on the Working Group, please contact any of the following:
  - Mr. Peter McLoone, NDIA SED, Working Group Industry Co-chair (peter.j.mcloone@lmco.com)
  - Mr. Martin Meth, representative for OUSD/DDR&E/MPS (mmeth@rsadvisors.com) and Working Group OSD Co-chair
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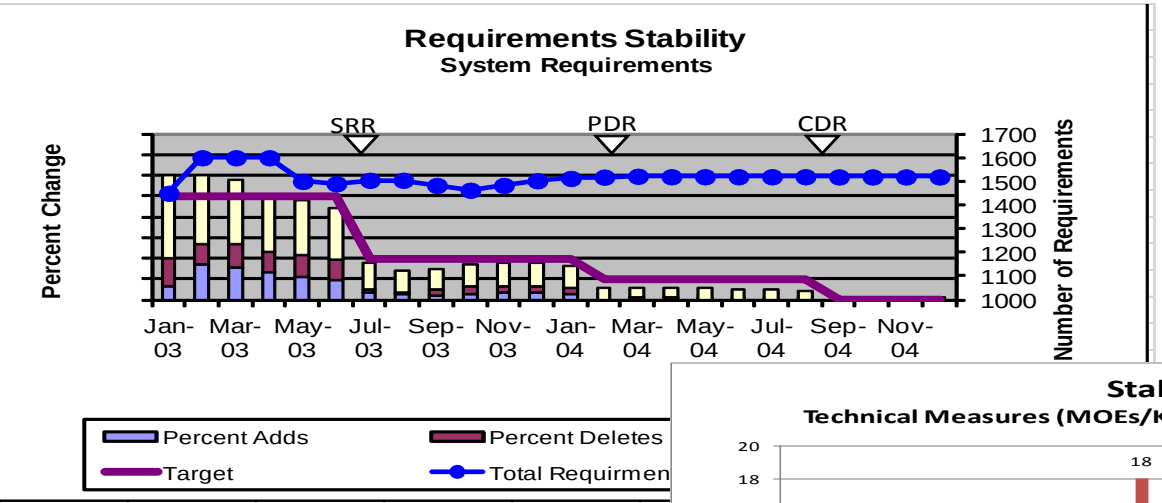
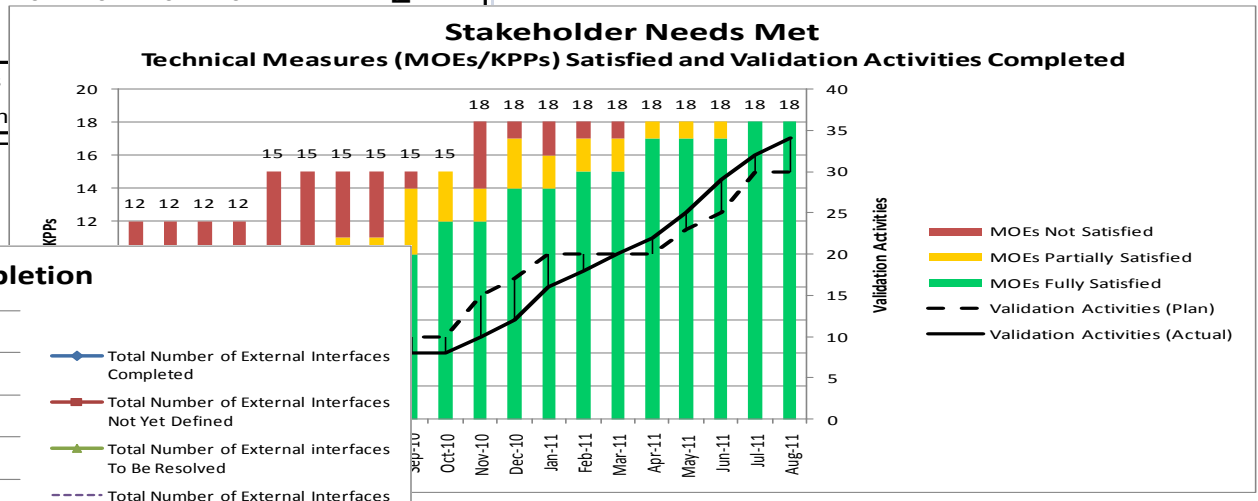
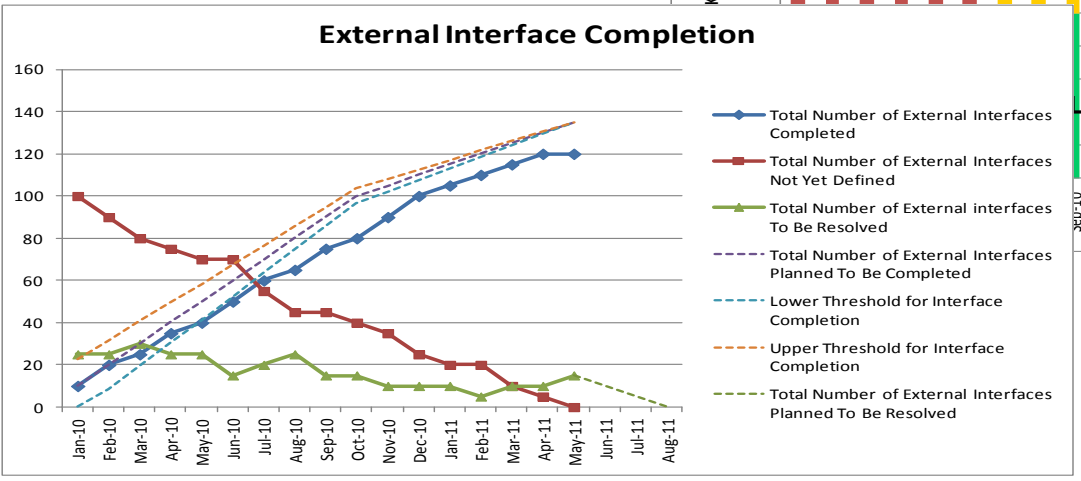
  - Mr. Bob Rassa, NDIA Systems Engineering Division (SED) Chair (RCRassa@Raytheon.com)
  - Mr. Alan Brown, NDIA SED Systems Engineering Effectiveness Committee (SEEC) Chair (alan.r.brown2@boeing.com)
  - Mr. Geoff Draper, NDIA Systems Engineering Division (SED) Vice-chair (gdraper@harris.com)

Backup

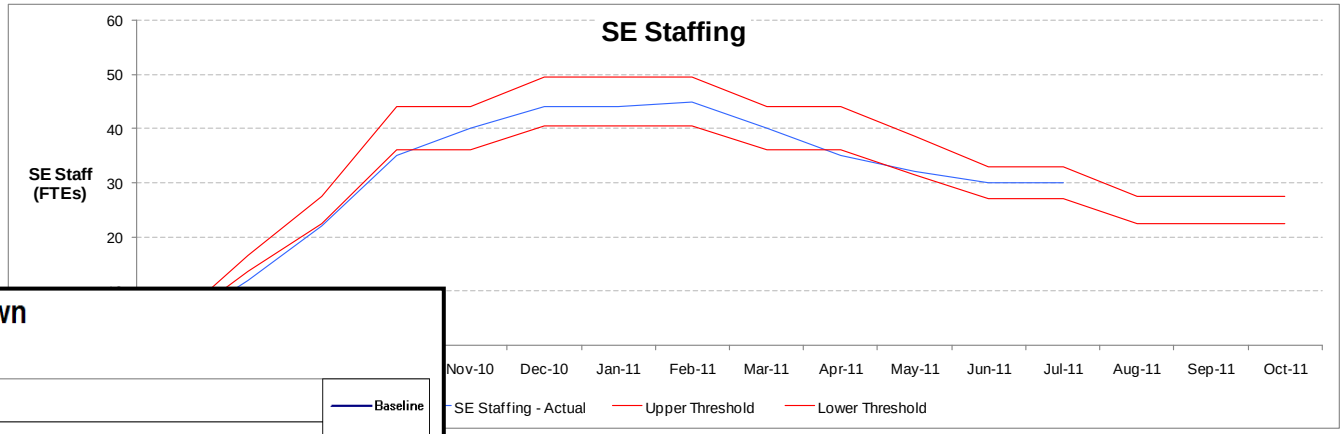
Requirements & Interfaces

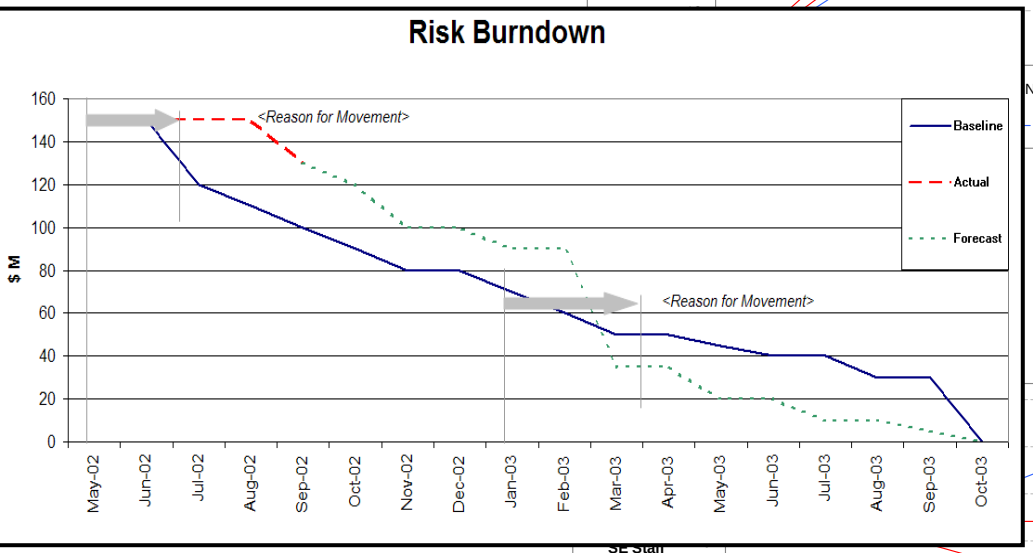


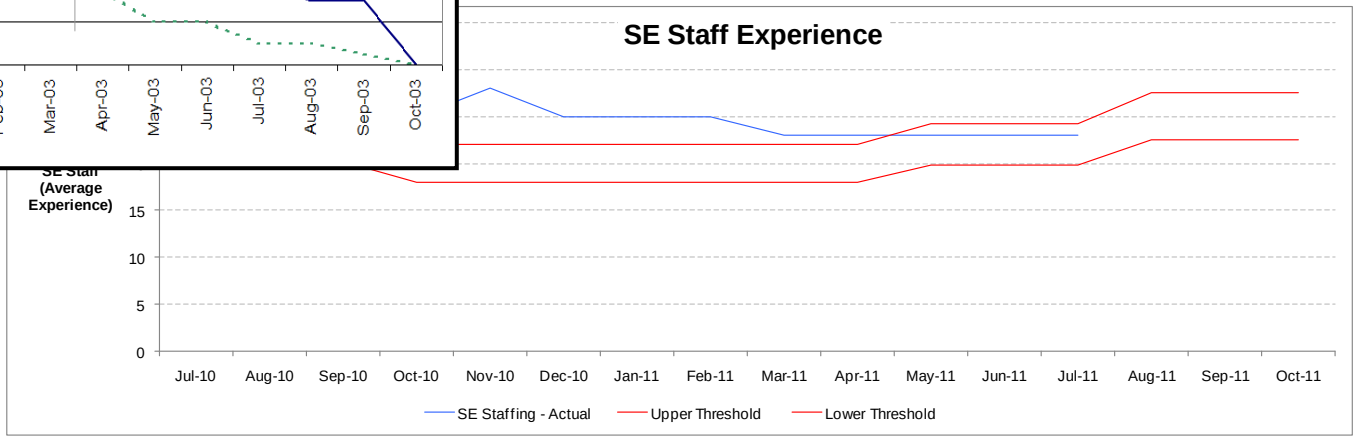




Staffing & Risk



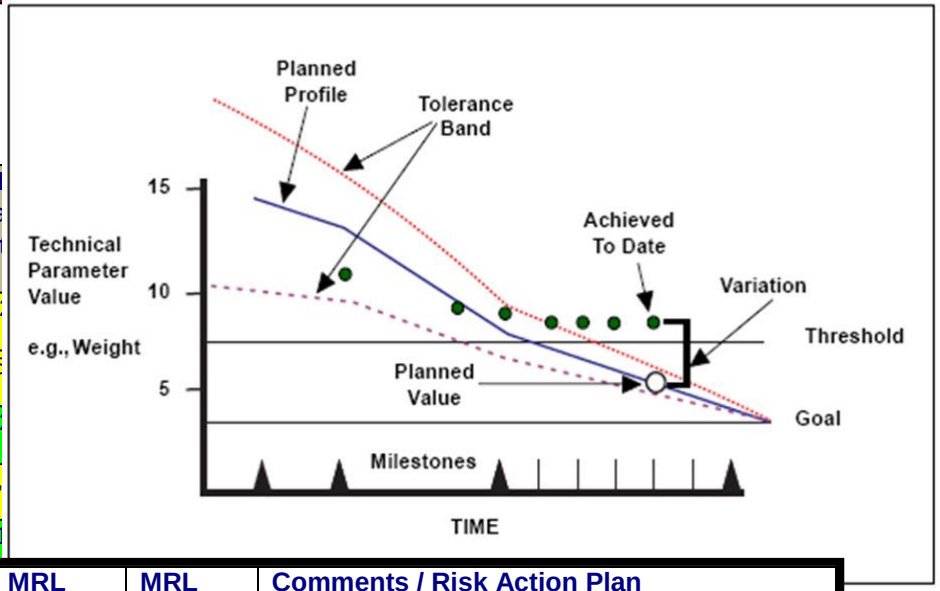




Technical Performance and Maturity Manufacturability

Name	Responsible Position /IPT	KPP or KSA	Performance Spec.	PDR Status Actual	MS B Status Actual	CI Sta Act
Aerodynamic Drag (count)	SE IPT		<222	225	223	2
Thermal Utilization (kW)	SE IPT		<60	56	59	5
Electrical Power Usage (kW)	SE IPT		<201	150	185	1
Operating Weight (lb)	SE IPT		<99,000	97,001	101,001	97,
Range (nm)	SE IPT		>1,000	1,111	1,101	1,1
Average Flyaway Unit Cost (number)	SE IPT					

*Note: Margin is 10%



System Milestone / Technical Review	TRL (Plan)	TRL (Actual)	MRL (Plan)	MRL (Actual)	Comments / Risk Action Plan
ITR	TRL 2	TRL 3	MRL 2	MRL 2	Analysis model based on ABC study
ASR	TRL 3	TRL 3	MRL 3	MRL 3	Lab validation of ASIC mfg concept
MS A	TRL 4	TRL 3	MRL 4	MRL 3	Study funding delayed 30 d. TRA completed.
SRR	TRL 5	TRL 4	MRL 5	MRL 3	Mechanical packaging ICD validation issues. Supplier facility contention elevated.
SFR	TRL 6	TRL 5	MRL 6	MRL 5	Prototyped XYZ subsystem w/ test bed I/F. Investigating low yield on lot 6 wafer fab.
PDR / MS B	TRL 6	TRL 6	MRL 6	MRL 6	Dwgs on plan. Tin whisker fab issue ok. Producibility plan approved.
CDR	TRL 7		MRL 7		Evaluating alternative µW feeds (risk #23).
TRR	TRL 7		MRL 8		
SVR (FCA PRR)	TRL 7		MRL 8		
MS C	TRL 8		MRL 9		
FRP Decision Review	TRL 9		MRL 10		