Practical Software and Systems Measurement

Objective Information for Decision Makers

OUTBRIEF

Adapting Systems Engineering Leading Indicators for Digital Engineering

September 20, 2019

Donna Rhodes, MIT

Workshop focus on prior MIT/INCOSE/PSM developed guide

SYSTEMS ENGINEERING LEADING INDICATORS GUIDE

Version 2.0

January 29, 2010
Supersedes Initial Release, June 2007

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Developed and Published by Members of

LAI MIT LEAN ADVANCEMENT INITIATIVE
SEA RI Systems Engineering Advancement Research Initiative
INCOSE International Council on Systems Engineering
PSM

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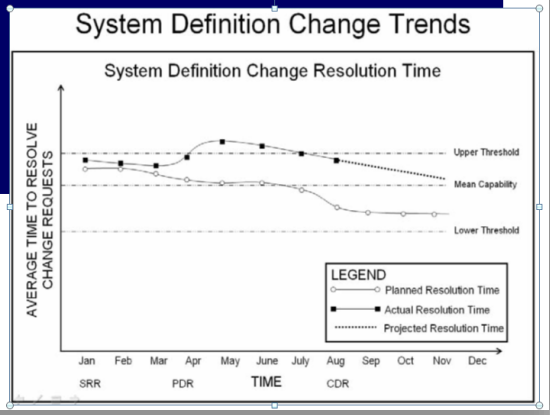
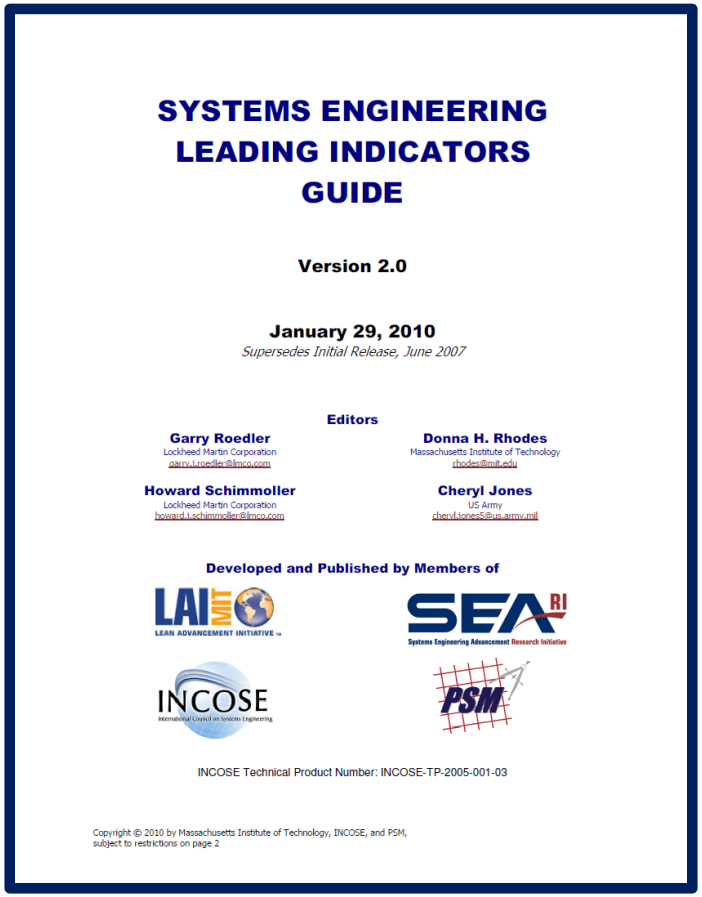
System Definition Backlog Trends

Illustrates average time to resolve change requests versus what is planned for program or historical data. Based on historical data and nature of program, a projection is made for future; In this case, actual data depicted through Program Period 2 warrants further analysis as it is significantly over expectations (it is neither to program plan or historical-based projects) and may not be trending appropriately over time.

Mature organizations should be able to identify lower and upper thresholds, as well as average time (organization's mean capability), to resolve.



DoD Digital Engineering Strategy (2018)



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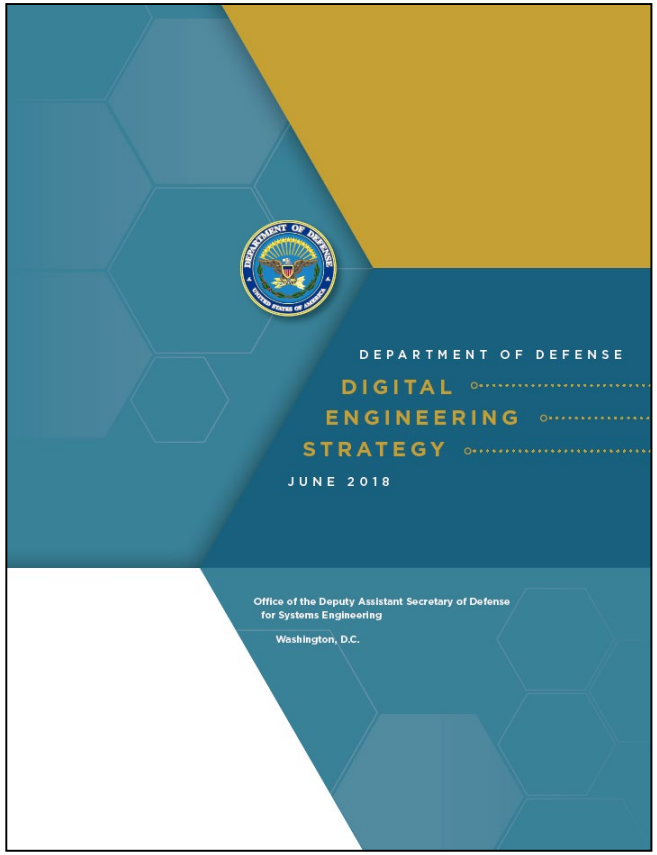

DEPARTMENT OF DEFENSE
DIGITAL ENGINEERING STRATEGY
JUNE 2018

Office of the Deputy Assistant Secretary of Defense for Systems Engineering
Washington, D.C.

2018

Workshop Goals

1. **Identify existing leading indicators (useful as-is and/or useful if adapted)** that are published in the current SE Leading Indicators Guide - perceived to be useful in model-centric/digital engineering programs

2. **Identify areas where potential new leading indicators could be beneficial** to program leaders in assessing systems engineering effectiveness in digital engineering programs

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Thinking About How Digital Engineering Impacts SE Leading Indicators (LI)

Potential approach is to use three categories to analyze how leading indicators will need to be adapted or newly created

Category 1	Digital engineering has minimal impact on the leading indicator	*Additional Information* section of measurement specification augmented with descriptive information
Category 2	Digital engineering results in significant changes and additions to leading indicators measurement specification	Modify and add information to all relevant areas of the measurement specification
Category 3	Digital engineering provides opportunities for novel leading indicators	Generate new measurement specification and illustrative graphics of displayed information

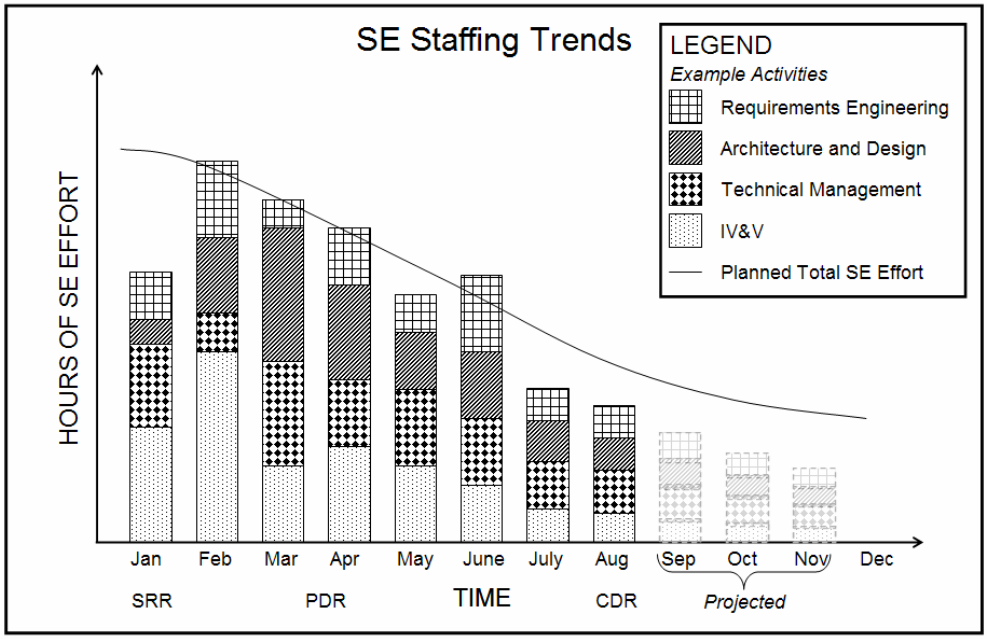
Staff and Skill Trends

Indicates whether expected level of SE effort, staffing, and skill mix is being applied throughout life cycle based on historical norms for successful projects/plans.

May indicate gap or shortfall of effort, skills, or experience that may lead to inadequate or late SE outcomes.

Planned staffing can be compared to projected availability through life cycle to provide an earlier indication of potential risks.

Systems Engineering Staff and Skill Trends



In this graph, effort is shown in regard to categories of activities. We can see at SRR the data would have shown actual effort was well below planned effort, and corrective action must have been taken to align actual with planned in next month of the project.

Potential Leading Indicators (new or adaptation)

NEW/ADAPTED	Current Related Leading Indicator
Model Validation	*Requirements Validation*
Model Volatility	*Requirements Volatility*
Model Risk Exposure Trends	*Risk Exposure Trends*
Digital Eng. Infrastructure Trends	*Facility and Equipment Trends*
Model Representation Quality	
Model Integrability	
Model Reusability Trends	
Model Composability	

Key Takeaways

- Confirmed need to extend/adapt some existing leading indicators
- Identified unique measurement needs under digital engineering practice
- Use of adapted/new leading indicators will vary based on extent of digital engineering on program –
  - e.g., models to augment decisions or models as "authoritative source of truth"
- Models and model-based tools open new opportunities for measurement

Next Steps

- Potential to draw from other recent work
  - *New Opportunities for Architecture Measurement*, Carson and Kohl
  - Measurement for Digital Engineering (Schreiber)
  - NDIA M&S, DEIXWG
- Ongoing MIT research (NPS sponsorship) – aims to seed work for larger community effort
- Further planned discussions to define path forward with collaboration from relevant organizations (INCOSE, NDIA, PSM, DEIXWG)