Final Report on the Study to Determine the Essential Elements of the Digital System Model

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Presentation Outline

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- NDIA Systems Engineering Modeling and Simulation Committee – Subcommittee on the Topic
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  - Participants
  - Process
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- Defining an Essential Element
- Modeling the Information
  - Overview of the Model
  - Model Excerpts
- Study Results and Benefits
- Availability of the Study Report and Model

Background on the Digital System Model

- **“The Digital System Model (DSM) is a digital representation of a defense system, generated by all stakeholders, that integrates the authoritative technical data and associated artifacts which define all aspects of the system for the specific activities throughout the system lifecycle.”***

- **Evolving, cohesive representation and unifying instantiation of the system across the acquisition lifecycle**
  - **Increase efficiency of activities and confidence in decisions**

- **Creation and evolution of the DSM will not require new methods or artifacts**

*** From the Defense Acquisition University Glossary**

Subcommittee on the Essential Elements of the Digital System Model – Charter

- **Define the essential elements of the Digital System Model as it evolves over the Defense Systems Acquisition Life Cycle**

- **Using the Identification of Modeling & Simulation Capabilities by Acquisition Life Cycle Phases as a basis:**
  - **For each major acquisition activity of each phase identify:**
    - The data the digital system model must contain to support initiating that activity
    - The new (or updated) information that can be put in the digital system model at the conclusion of that activity
  - **For each M&S capability that can support the major acquisition activities identify:**
    - The data for running that M&S capability that should come from the digital system model
    - The data from the M&S results that should get put into the digital system model

- **Identify existing standards, if any, for each essential element**

- **Provide a final report on the findings of the subcommittee**

Subcommittee Members

- Jeff Bergenthal (JHU/APL, Study Lead)
- Tyesia Alexander (Engility)
- David Allsop (Boeing)
- Bill Beavin (Boeing)
- Curtis Blais (NPS)
- Alex Boydston (AMRDEC)
- David Bottcher (Boeing)
- Christina Bouwens (MSCI)
- Jim Coolahan (Coolahan Associates)
- John Daly (BAH)
- Steve Dam (SPEC Innovations)
- Bob Epps (Lockheed Martin)
- Tracee Gilbert (System Innovation)
- Allen Harvey (ARA)
- Greg Haun (AGI)
- George Hazelrigg (NSF)
- Craig Hugger (emSOLVE)
- David Kaslow (self)
- Jack Kelly (BAH)
- Claudia Kropas-Hughes (AFRL)
- Andrea Lora (Deloitte)
- Frank Mullen (SimVentions)
- Jane Orsulak (Raytheon)
- Chris Oster (Lockheed Martin)
- Greg Pollari (Rockwell Collins)
- Tim Tritsch (Engility)
- Crash Konwin (BAH)
- Hans Polzer (self)
- Frank Salvatore (Engility)
- Jayne Talbot (Raytheon)
- Bill Warner (Boeing)
- Beth Wilson (Raytheon)

Subcommittee Process

- **Initial subcommittee formation at 20 August 2013 NDIA SE M&S Committee meeting**
  - **Formal Study Kick-Off at 11 February 2014 NDIA SE M&S Committee Meeting**
- **Sub-teams formed, one for each Phase of the DoD Acquisition Life Cycle**
- **Data collection spreadsheet designed and distributed**
- **Bi-weekly teleconferences scheduled**
- **Face-to-face meetings at numerous NDIA SE M&S Committee meetings**
- **Formal modeling of information initiated in May 2014**

Data Collection Template (1 of 2)

Phase	Data Inputs	Level 2 Acquisition/SE Activity	Data Outputs
Technology Maturation and Risk Reduction	cost data for design, build, sustainment	Development & technology risk reduction	update cost model and ID cost reduction initiatives
	expected reliability		update reliability growth curves and
	success criteria		validate or correct the KPPs
	Functional Architecture	System integration	Validated Functional Architecture
	Physical Architecture		Validated Physical Architecture
	Functional Interface Definition		Validated Functional Interface Definition
	Physical Interface Definition		Validated Physical Interface Definition
	Operational Concept		Validated Functional Transformations
	Functional Transformations		
	Performance Requirements/Constraints		
	Operator Interface Definition		
	size, power, weight allocations to subsystems	Design	rebalanced size,weight and power allocations
	performance data		updated performance data
	allocations of reliability to subsystems		
	characteristics of usability		
	non-combat usecases		
	predicted non-recurring, recurring, and sustainment costs		
	tolerances (tooling) and variations (commonality)		
	material constraints		
	test cases		
	functional allocation to prototype	Prototyping	feedback from characterizing functions and
	performance expectations for prototype system		validated or corrected performance
	SOS architecture, interfaces		identify emergent behaviors
	operational environment, CONOPS, validated scenarios, mission description, threat representation	Military utility assessment	validated performance or performance gaps

Data Collection Template (2 of 2)

Level 2 Acquisition/SE Activity	Data Inputs	M&S Capability	Data Outputs
Development & technology risk reduction		Engineering-level simulation	
		Virtual system simulation	
		Mission-level simulation	
		Modeling of the natural environment	
System integration		Engineering-level simulation	
		Mission-level simulation	
		Virtual system simulation	
Design		Engineering-level simulation	
		Virtual system simulation	
		Modeling of the natural environment	
		Mechanical design modeling	
		Software modeling	
		Manufacturing process modeling/simulation	
		Reliability modeling	
		Maintenance simulation	
		Survivability simulation	
		Life-cycle cost modeling	
Prototyping		Engineering-level simulation	
		Mission-level simulation	
		Virtual system simulation	
Military utility assessment		Mission-level simulation	

Defining an Essential Element

- **“Use” characteristics of a DSM essential element:**
  - **Required by an acquisition activity or M&S capability for all types of systems**
  - **Required to make decisions during the lifecycle**
  - **Used in more than one acquisition activity during the lifecycle**
  - **Used by more than one organization, or discipline, during the lifecycle**

- **“Impact” characteristics of a DSM essential element:**
  - **Required by DoD acquisition policies and/or best practices**
  - **If it is changed, it will impact other elements or the system**
  - **Required to complete all activities in the acquisition process**

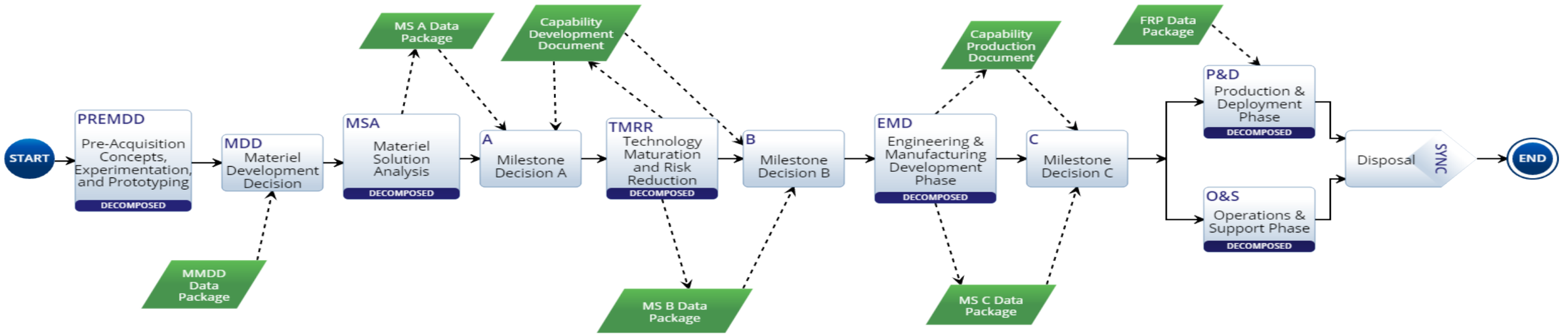
- **An essential element of the DSM is information and/or data that:**
  - **if missing, prevents subsequent acquisition activities from being performed; or**
  - **is required to make decisions at formal Decision Points and Milestone Decisions identified in the acquisition life cycle.**

Modeling the Information

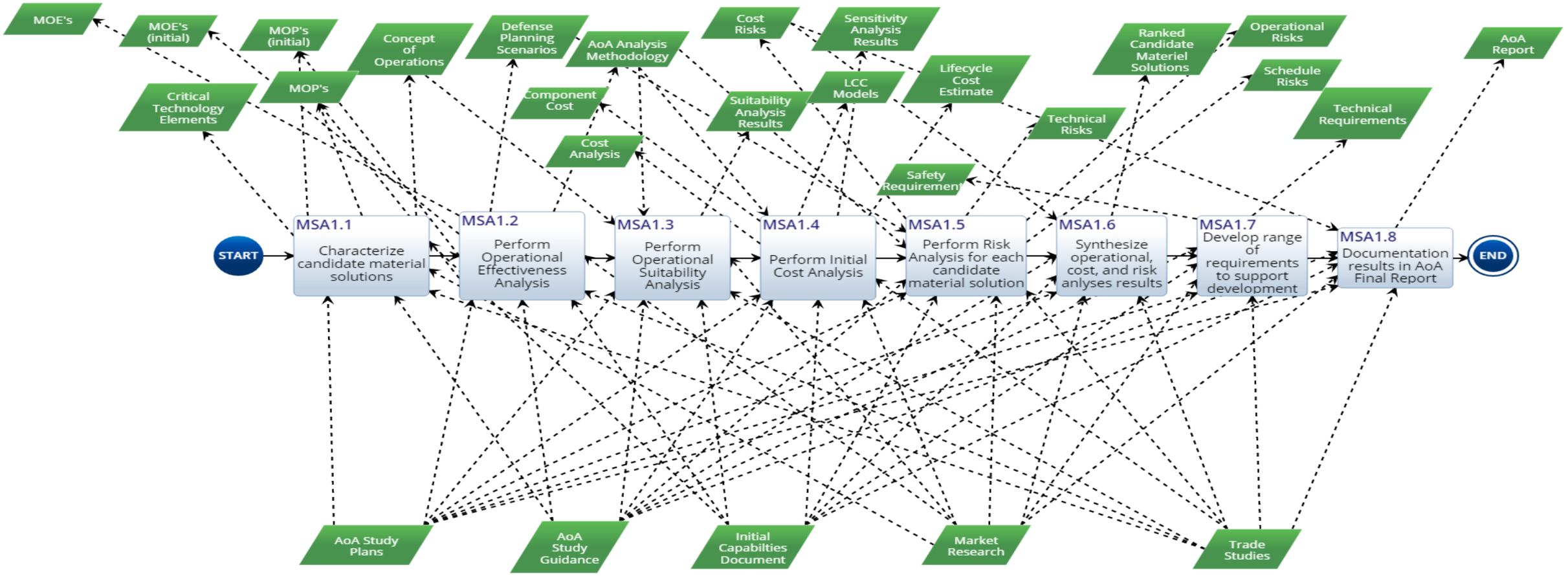
- **Spreadsheets quickly became too cumbersome**
  - **Integrating the data was challenging**
  - **Analyzing the data was difficult**
- **Offer from Steve Dam, SPEC Innovations, for free use of Innoslate® by the entire Study Team**
- **Demonstration session and development of initial set of modeling conventions**
  - **Modeling conventions have continued to evolve**
- **Technical interchange with MITRE on the Acquisition Guidance Model (AGM)**
  - **Useful information contained in AGM that can be folded into the model the Study Team is developing**

Overview of the Model

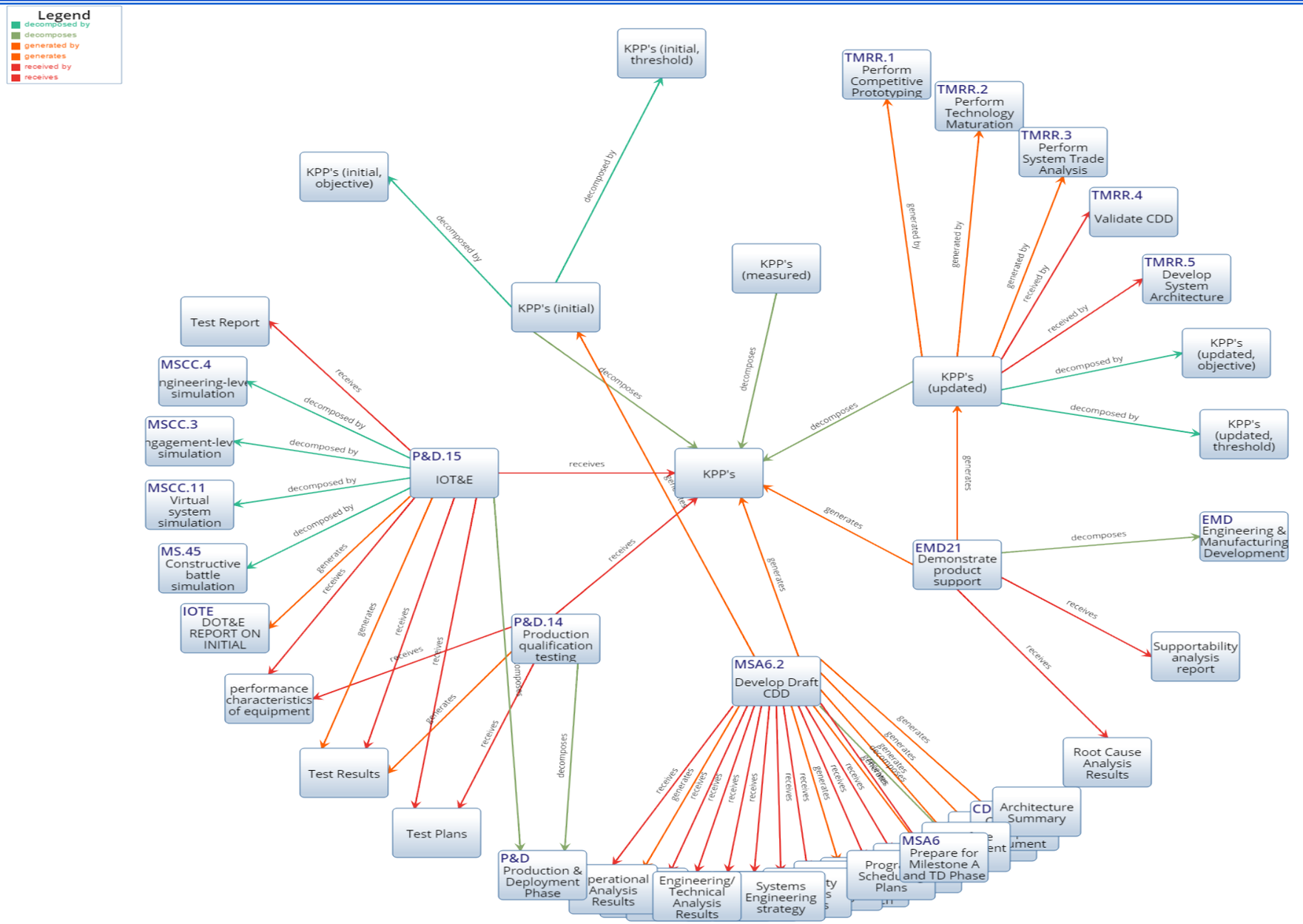
- All phases of the DoD acquisition lifecycle
- 283 distinct acquisition and modeling & simulation activities
- 7 milestones / decisions
- 588 distinct input/output items
  - 211 of which have been tagged as “essential elements”



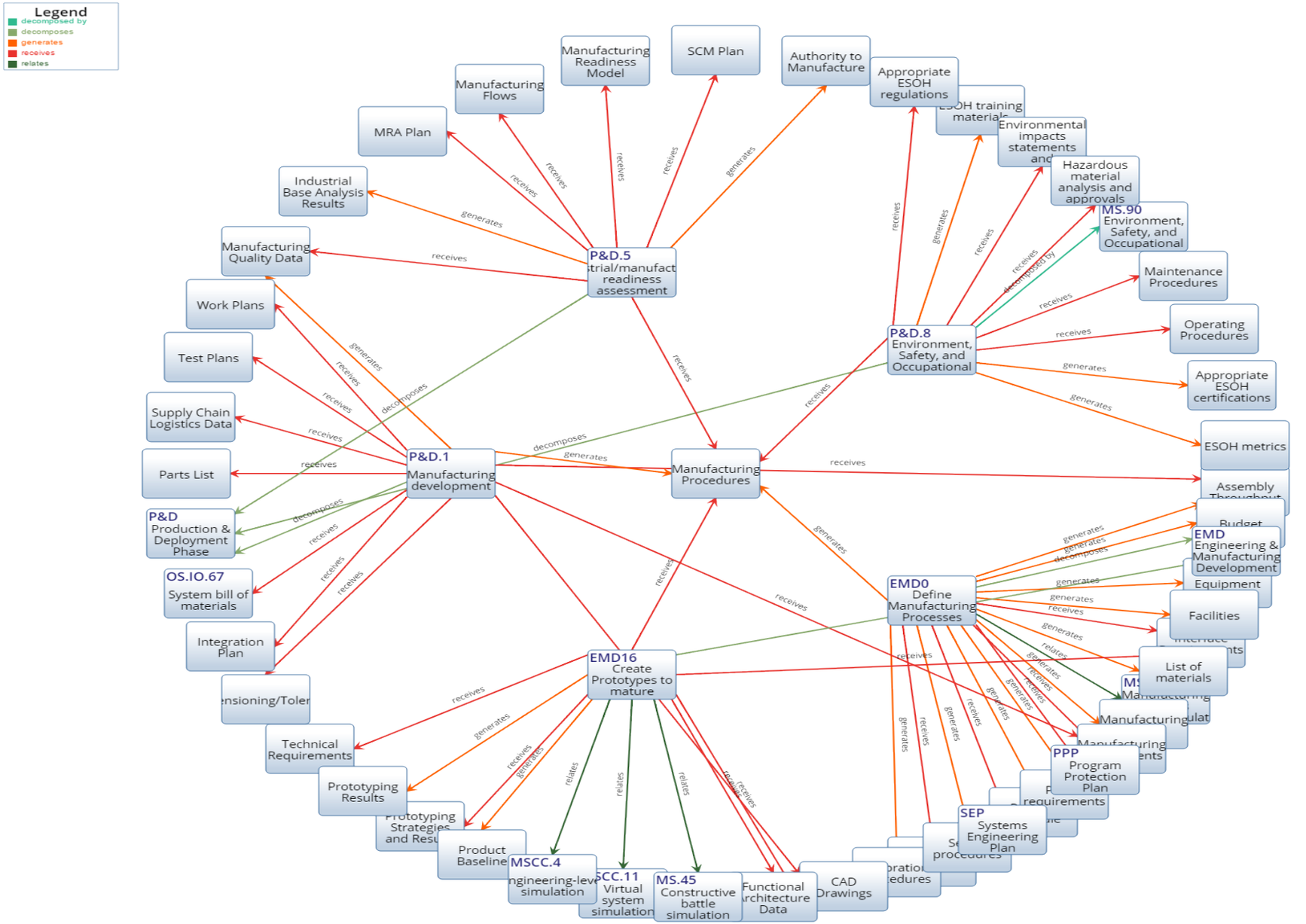
Conduct Analysis of Alternatives



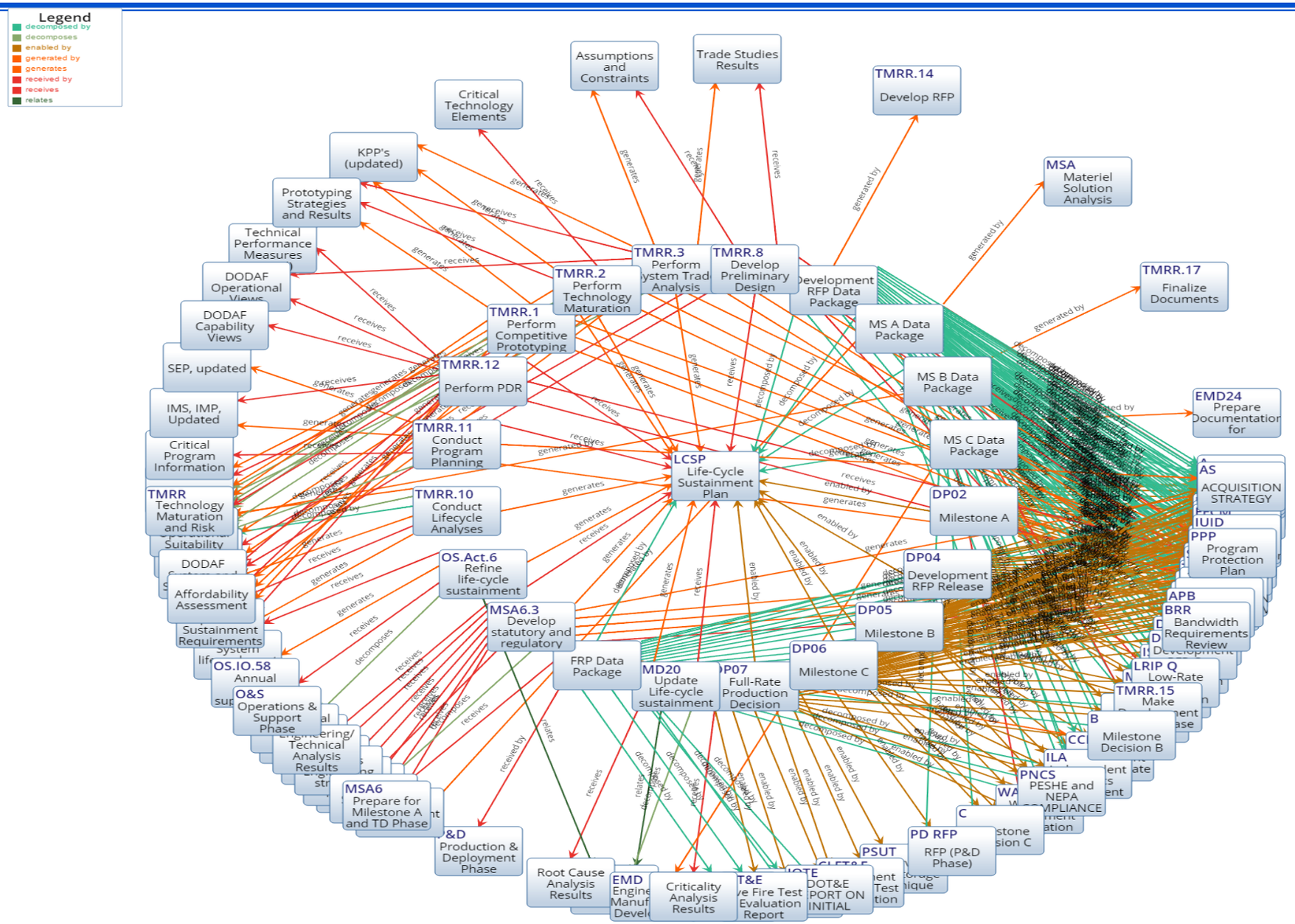
Key Performance Parameters



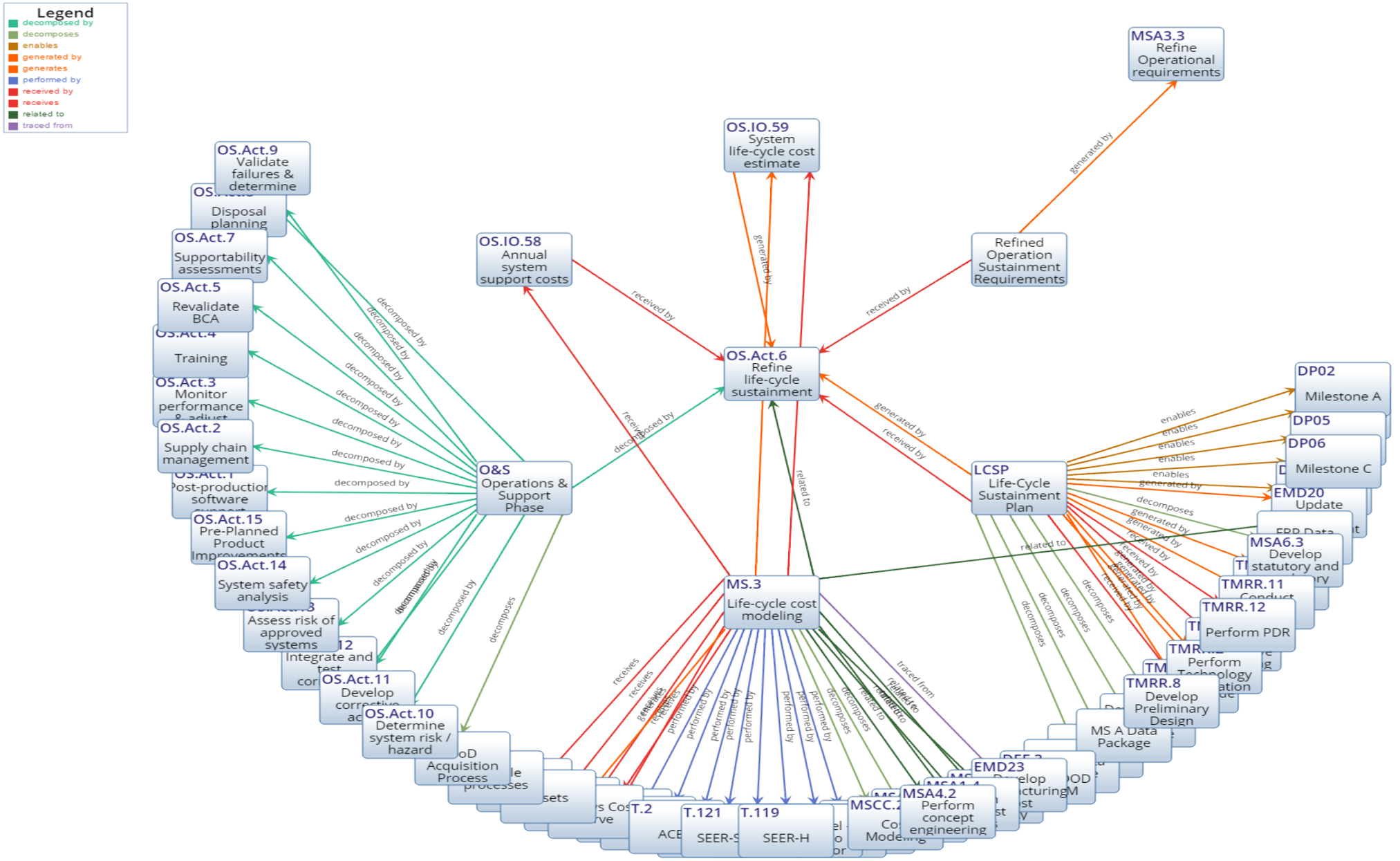
Manufacturing Procedures



Life Cycle Sustainment Plan (LCSP)



Refine LCSP


Legend
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performed by
received by
receives
related to
traced from
MSA3.3 Refine Operational requirements
OS.IO.59 System life-cycle cost estimate
OS.Act.9 Validate failures & determine
Disposal planning
OS.Act.7 Supportability assessments
OS.Act.5 Revalidate BCA
Training
OS.Act.3 Monitor performance
OS.Act.2 Supply chain management
Post-production software
OS.Act.15 Pre-Planned Product Improvements
OS.Act.14 System safety analysis
Assess risk of approved systems
Integrate and test
OS.Act.11 Develop corrective ac
OS.Act.10 Determine system risk / hazard
OS.IO.58 Annual system support costs
Refined Operation Sustainment Requirements
OS.Act.6 Refine life-cycle sustainment
O&S Operations & Support Phase
LCSP Life-Cycle Sustainment Plan
MS.3 Life-cycle cost modeling
DP02 Milestone A
DP05
DP06 Milestone C
EMD20 Update
MSA6.3 Develop statutory and
TMRR.11
TMRR.12 Perform PDR
TMRR.8 Develop Preliminary Design
MS A Data Package
EMD23
MSA4.2 Perform concept engineering
Acquisition Process
T.2
T.121
T.119
SEER-H
receives
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Study Results and Benefits

- **Provides guidance to Government contracting officers and program managers:**
  - **Identifies the data and information that Government produces and Industry needs**
  - **Identifies the data and information that Industry produces and the Government needs**

- **Formal model provides a platform for further analysis:**
  - **Identifying areas where the digital system model can impact the effectiveness of the acquisition process**
  - **Guiding improvements in how modeling and simulation capabilities and data can better support the digital system model and the acquisition process**
  - **Assessing how potential changes to the acquisition process will affect the generation and use of the data and information contained within the digital system model**

Availability of the Study Report and Model

- **Complete the Study Final Report**
  - **Anticipate completion in December 2015 followed by the NDIA internal review / approval process**
- **The model will be made available in two forms:**
  - **A static view for those who want to look at the model – most likely in .pdf format**
  - **A format that will allow individuals to use the model data – most likely in MS Excel format**
- **Anticipate making annual updates to the model to incorporate feedback provided by the community**
- **Approved Final Report and the model will be posted on M&S Committee website**

Questions?