

Systems Engineering Gold: Digital Acquisition, IV&V and Space Capability Development Use Cases

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Bottom Line Up Front



- Systems Engineering (SE) is about finding integrated solutions to problems
- A problem at National Security Space Launch (NSSL) is to successfully conduct more launches with fewer people
- What are we briefing?
 1. The basics of acquiring a Capability
 2. Use case examples based on SE discipline:
 - Digital Acquisition
 - Independent Verification & Validation (IV&V)
 - Space Capability Development
 3. Examples of facilitating Government-Industry communication
- This Conference is all about learning from each other; we welcome your suggestions, ideas, and perspectives.



“The **power or ability** to do **something**”

- In Engineering, that “**something**” is defined by *requirements*
- The “**power or ability**” is the function achieved upon *compliance* with the requirements

Keep Requirements at the core and Compliance as the controls



Digital Transformation Can Be Hard - Or Not

Setting expectations is key to progress

- Holistic view of processes and why they exist: *Workflow products*
 1. SE drives digital use cases that produce lean and synergistic systems *versus processes subjectively established*
 2. SE use cases are not new; we've championed challenges using this discipline for decades. Now *we can capitalize in the digital age.*
 3. SE metrics *reveal gaps* easily captured by automated queries
- Win-win scenarios for Government-Industry
- “Automate” processes, not “replace” people
- “1% for 100 days” - stop firefighting; start doing things by Intent



Digital Transformation Can Be Hard - Or Not

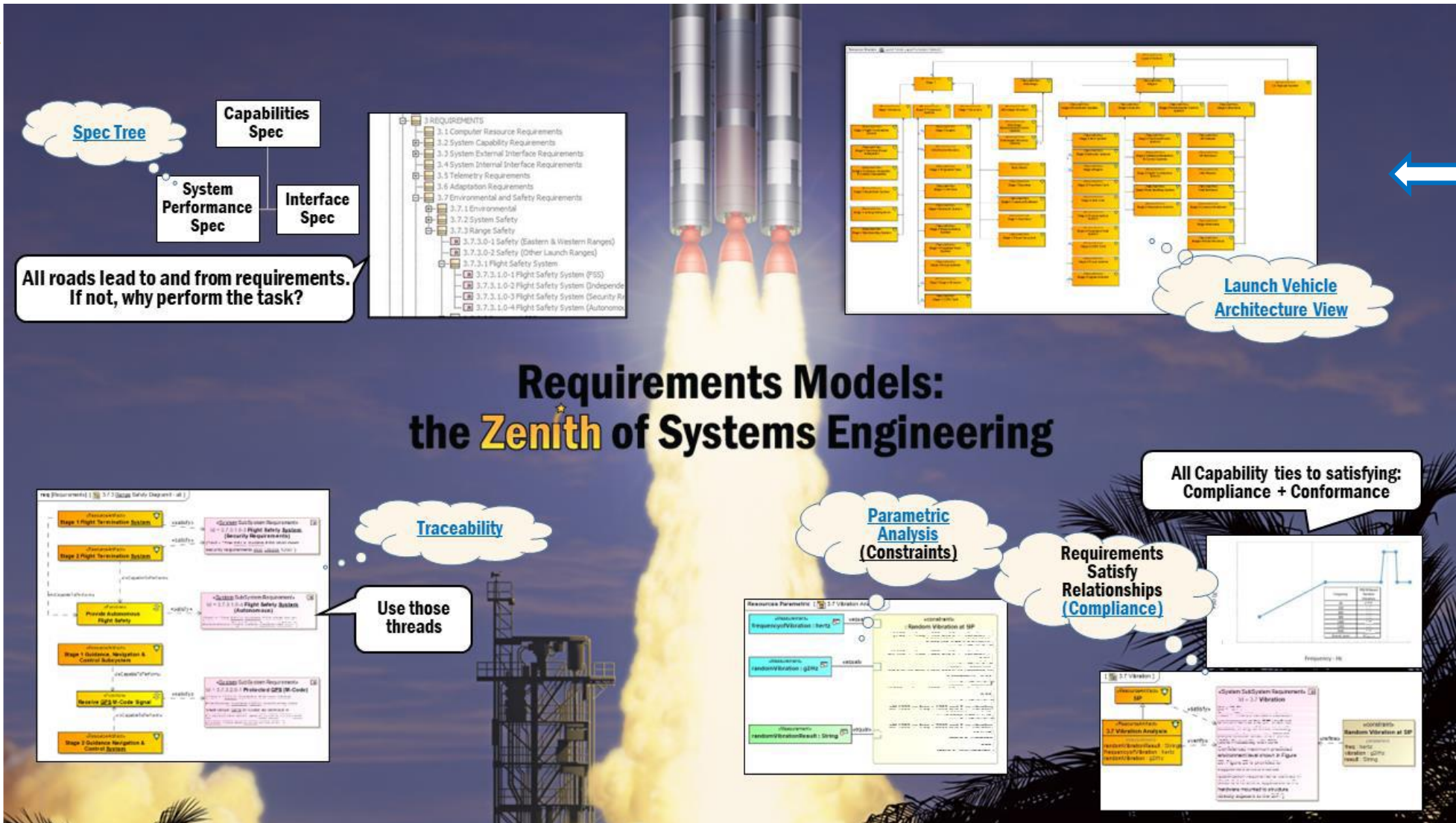
Government struggles with Digital Engineering (DE) stem from:

- Engineering often NOT the critical path in current workflow processes, but can speed up the overall production
- Culture: far too many contributors to describe here

Digital Acquisition



SE-Based Transformation



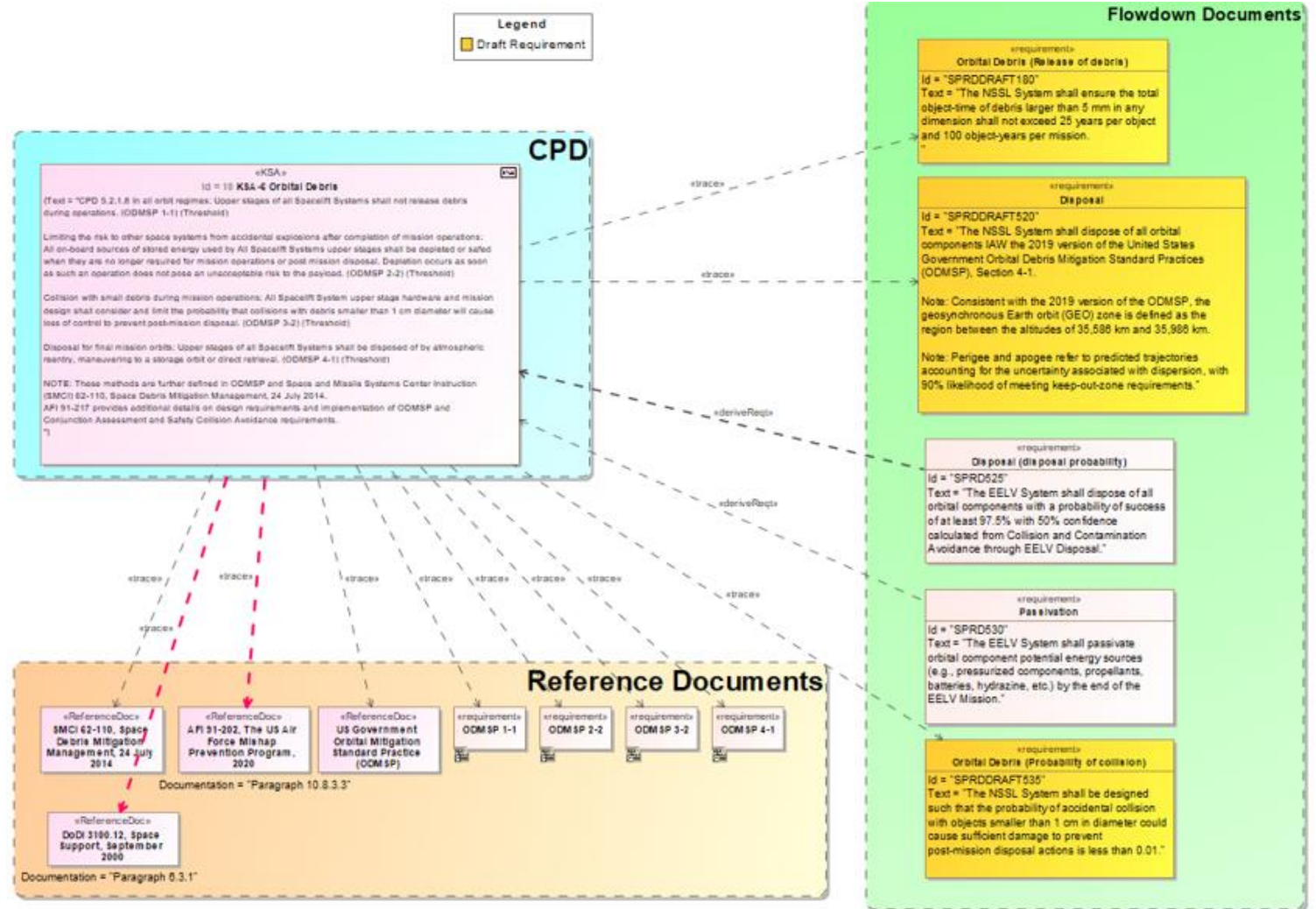
← **Reference Model:**
A framework for understanding significant relationships among entities



SE-Based: Tool and Implementation Agnostic

Unclassified

- Requirements model as [ASoT]
 Authoritative Source of Truth:
- Generate specifications in conventional formats (MSWord, Excel, MDZIP) stamped with model version
 - Stakeholders assimilate specifications in unique requirements management tools and architectures
 - Trace like-requirements among specifications and standards to readily identify impact of changes



Unclassified

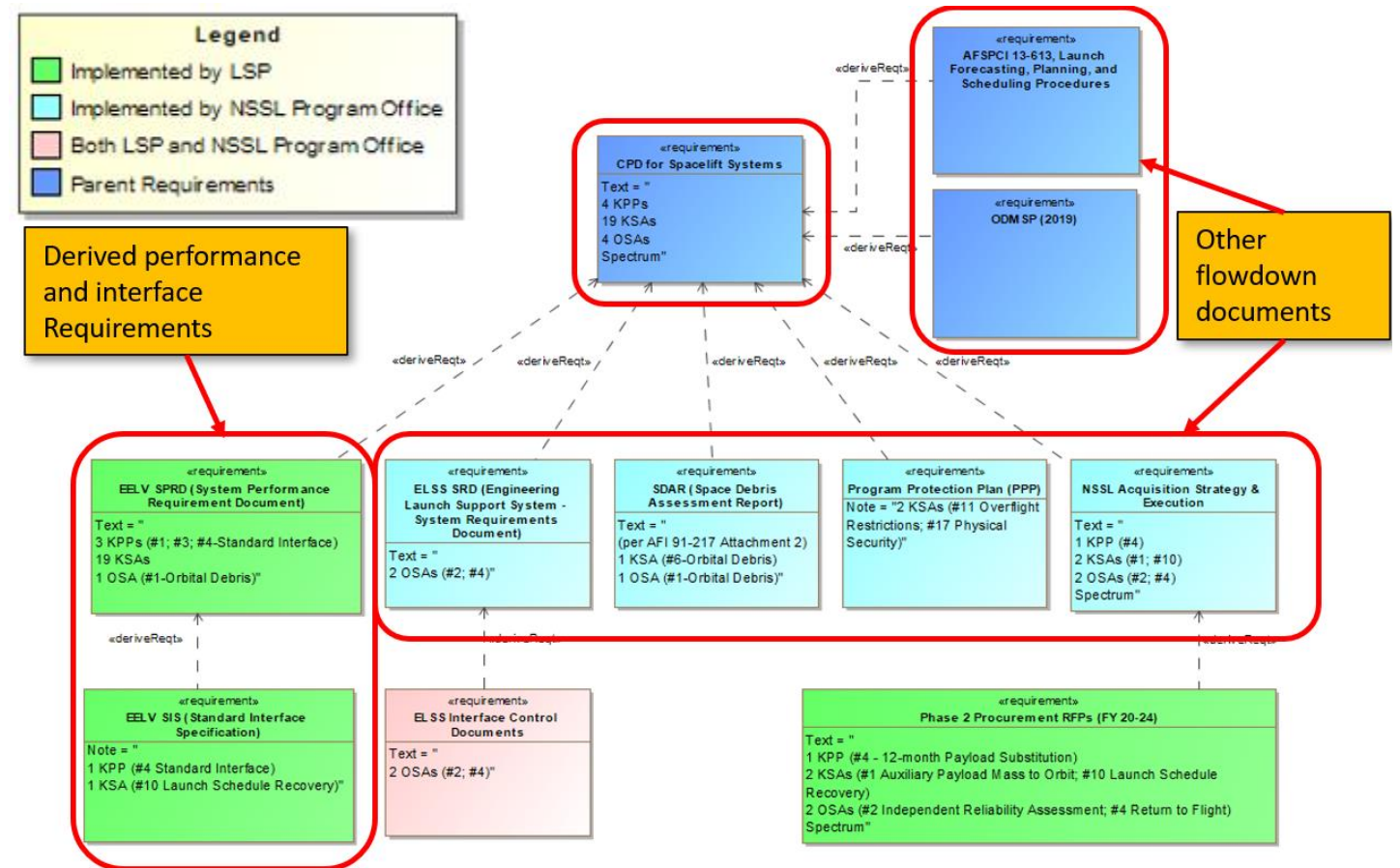


SE-Based Transformation: System Traceability

- **Digital Acquisition** kicks off with stakeholders receiving and delivering digital formats that integrate well with their practices (tools and implementation)

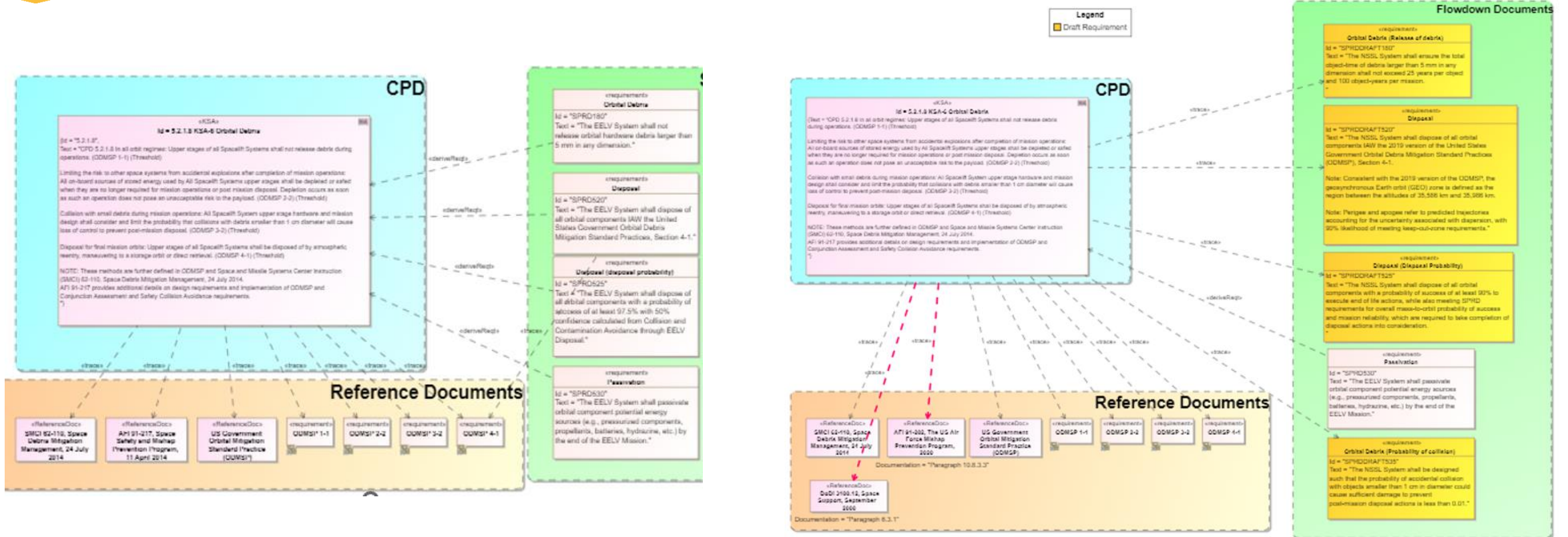
Bidders attach verification artifacts to requirements as early as proposal submittal and mature them on contract to demonstrate compliance, including integration [IV&V]

- SE-based use cases are digital and implementation agnostic
- Digital threads are invaluable: Show; don't tell





SE-Based Transformation: System Traceability



Automation-Enabled “Was-Is” Reports:

- Diagram traces to Derivations in multiple specifications and guidance
- Trace Diagrams provide Visual Comparison of released and proposed requirements



Model-Based Improvements at NSSL

- Requirements Management Action:
 - NSSL put key specifications in Cameo and directed cutover to use it
 - **Gains:**
 - Technical Review Board prep notes imbedded in the model
 - Review traceability with the Chief Engineer
 - *Impact is a huge reduction in time and follow up actions/scheduling*
 - Regrets: Few.
 - Format issues when autogenerating documents *as prescribed*.
 - Ensuring an approach, including plug-in, to generate documents
- **Machine Readability** (specification graphics)
- Government Reference Architectures (SSC integration)
- PWS Model and Linkages are in an **Authoritative Source of Truth**
 - Potential for faster industry red teaming
 - Verification of proposals using artifacts
 - Fewer transcription errors



SE-Based Transformation: Data-Driven Decisions

Validation tool affords *quantitative* stakeholder review of requirements rather than generating or receiving qualitative narratives:

- Validation function receives “Fail” ratings for requirements that do not meet industry-standard attributes:
 - Necessary
 - Accurate
 - Appropriate
 - Unambiguous
 - Complete
 - Feasible
 - Verifiable
 - Independent
 - Conforming
- Each selected rating entry requires a comment by the reviewer

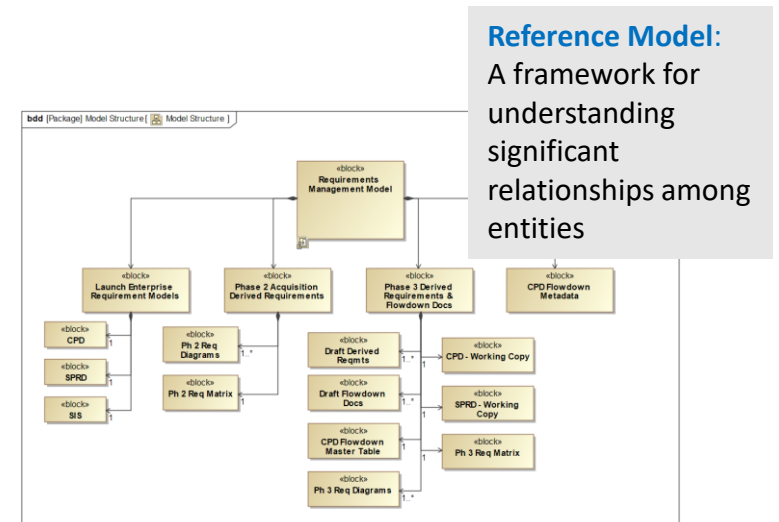
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Inform Capability Development



SE-Based: Tool and Implementation Agnostic

- **Independent Verification & Validation (IV&V):** Requirements-based (direct) IV&V becomes Mission Assurance, confirming compliance, integration, conformance (workmanship requirements-based pedigree reviews), and post-flight analyses
- Metadata from SE use cases identify technical risks such as:
 - the need to requalify hardware after a change in design or operating conditions
 - knowledge gaps revealed by linked development test and post-flight data or Test Like You Fly and system requirements
- **Inform Capability Development:**
 - All SE use cases feed capability development with Metrics to the directorate level, and at any level.
 - Internal and External Assessments from the validation tool feed quantified ratings to the directorate with rationale to evolve capability





Summary: Winning by Doing this Together

- Lessons:
 - **Use Modeling wisely:** System Model and Analytical Models
 - **Requirements at the core:** System thinking takes a top down rather than bottoms up approach to ensure capability and compatibility throughout the system, affording requirements-based mission assurance to verify it
 - **Approach problems holistically:** SE-based *structure* avoids redundancy and inefficiency by keeping verification of capability at the core
 - Implementation is always a challenge: **Address culture**
- Thank you for your time. Contact us at:

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