34th Annual INCOSE international symposium

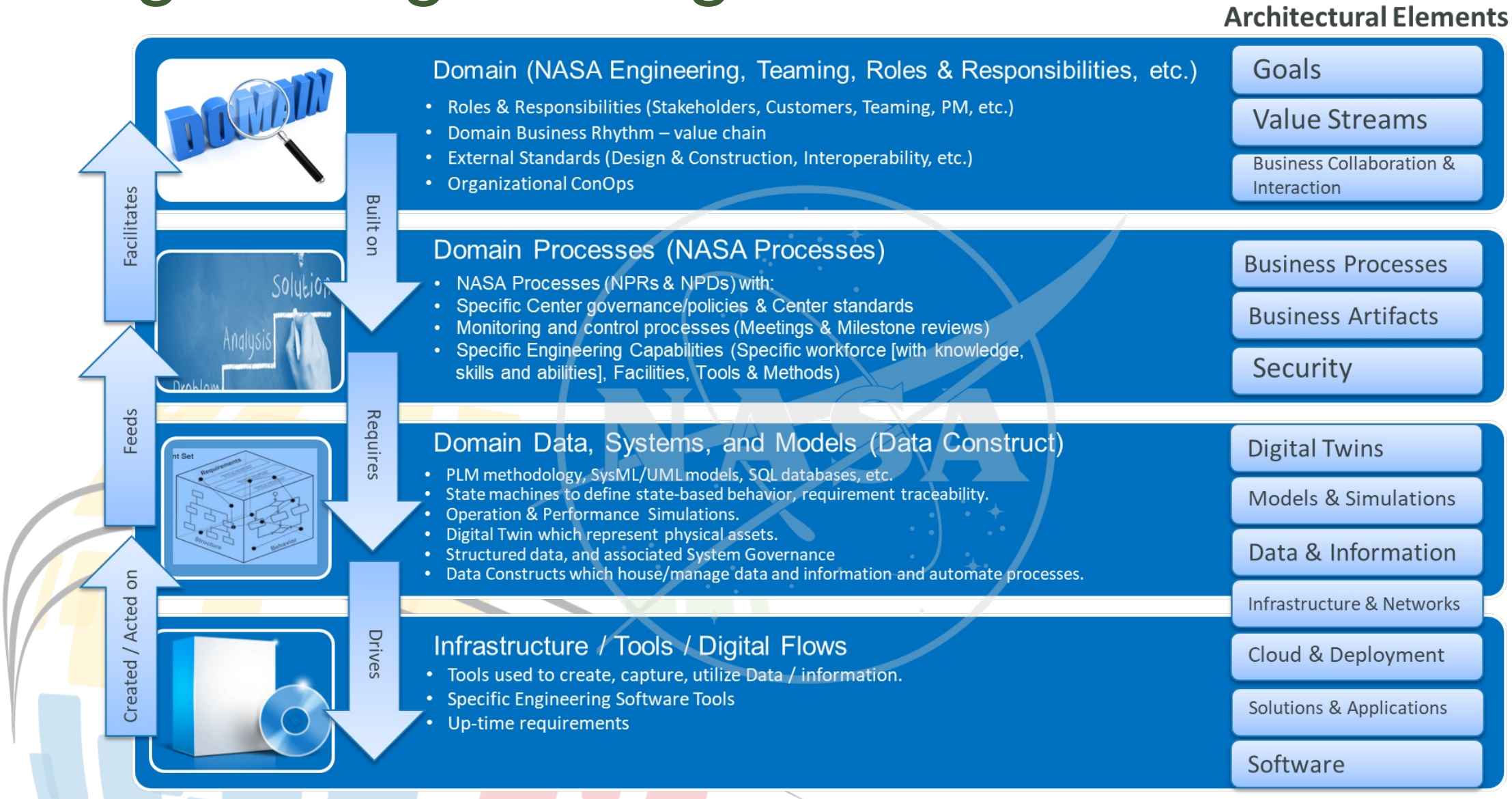
hybrid event

Dublin, Ireland
July 2 - 6, 2024

Modeling NASA's Procedural Requirement Processes – Implications for a Digital Future

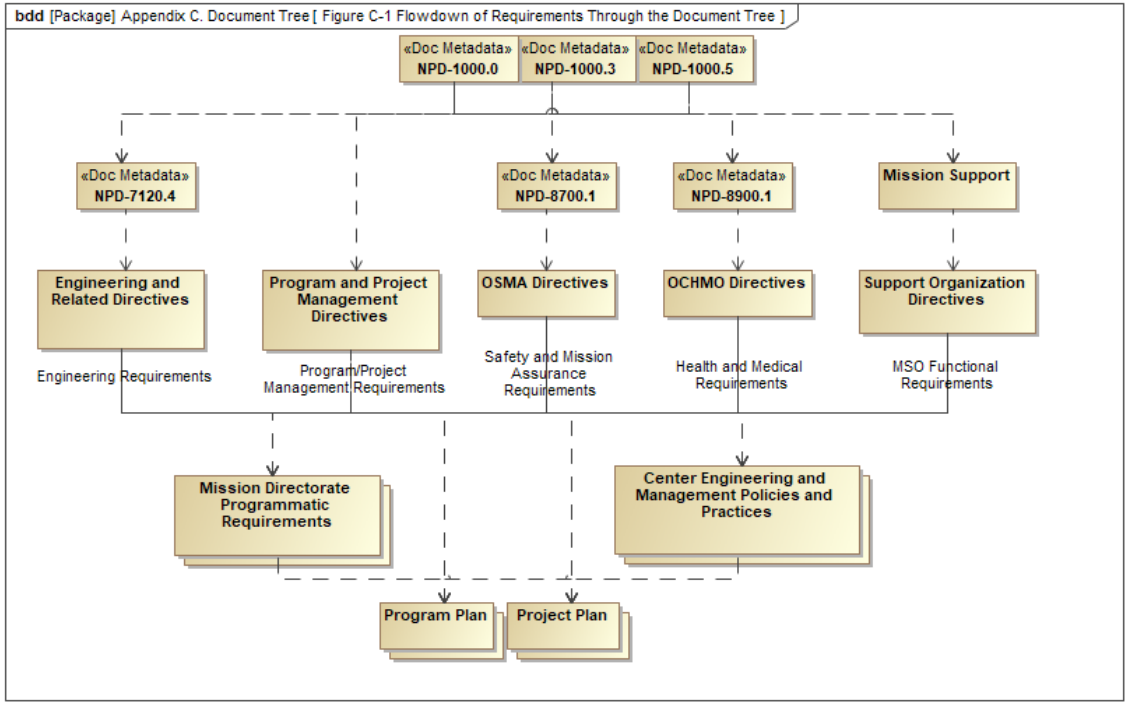
BACKGROUND

Digital Engineering Transformation



NPDs and NPRs: NASA Guidance

- NASA's success has been built upon well-established policies and procedures that evolved from best practices and lessons learned
  - NASA Policy Directive (NPD)
    - Provides broad vision and goals
    - Intended as guidance
  - NASA Procedural Requirements (NPR)
    - High-level implementation guidance for the workforce
- Provides guidelines on how work should be performed
- Aligns with the Organizational Structure
  - Programmatic Authority
  - Technical Authority
  - Institutional Authority
- Modeling effort focused on Program/Project Management, Systems Engineering, and Safety and Mission Assurance



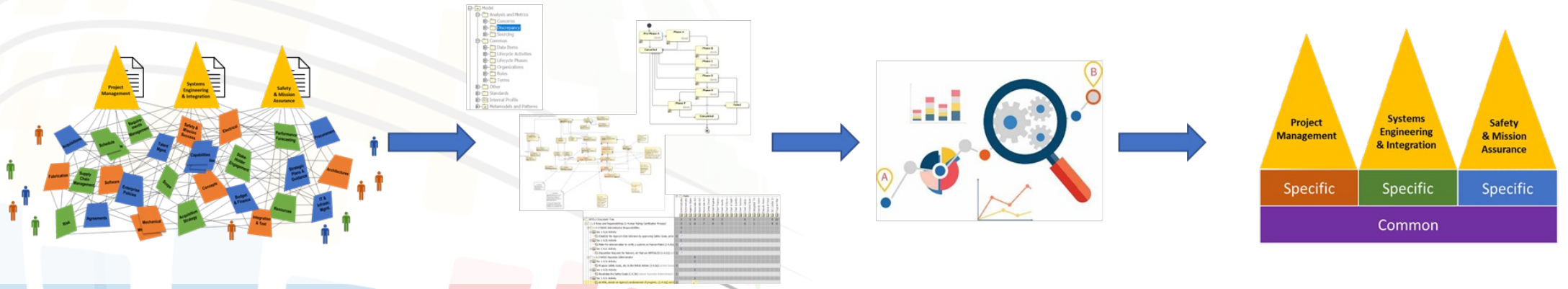
APPROACH:

BREAK IT DOWN TO THE DATA & INFORMATION LEVEL WHERE DECISIONS ARE MADE

As-Is
- Integrate PM, SE&I, and SMA into one model
- Establish commonality
- Model the lifecycle

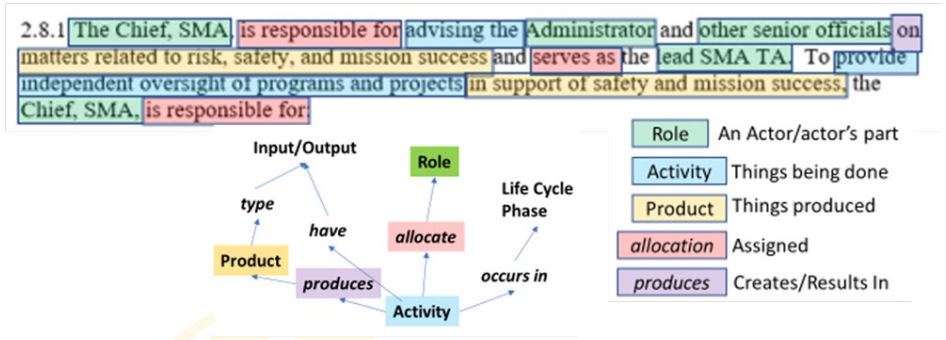
Analyze
- Capture Insights
- Resolve Discrepancies
- Stakeholder Views
- Plan Execution

Transform
- Clarity
- Interoperability
- Simplify
- Streamline



AS-IS CAPTURE & ANALYSIS

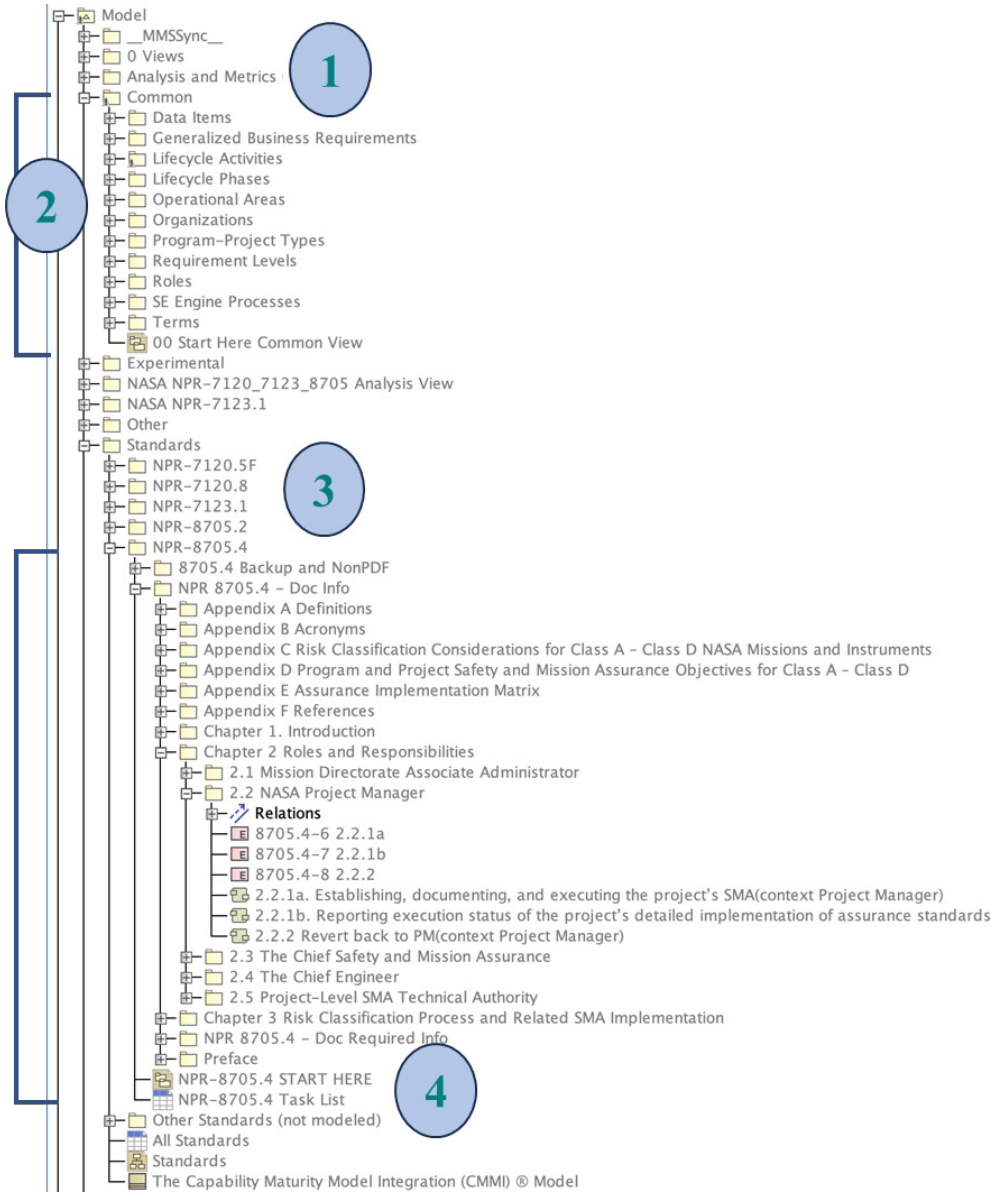
Parsing and Patterns



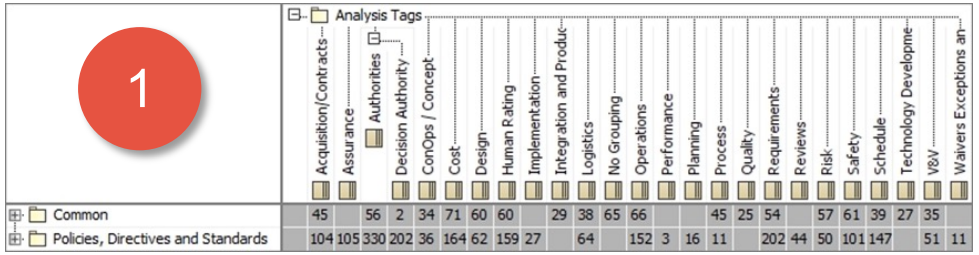
- Simple pattern focused on:
  - Allocating Roles to Responsibilities
  - Equating responsibilities into activities
  - Inputs/output of activities are the data/product
  - Putting them together visualizes the overall process
- Ability to produce human and machine readable from a single source
  - Machine-verification rules used to verify parsing and completeness
  - Human verification of format/layout
  - Additional views added to enable humans to verify parsing

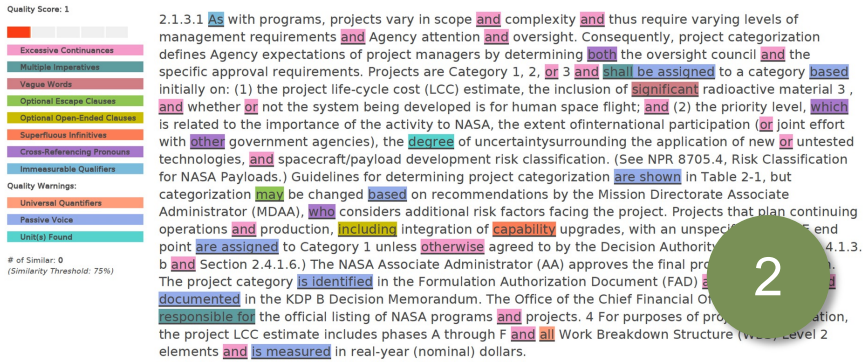
Model Structure

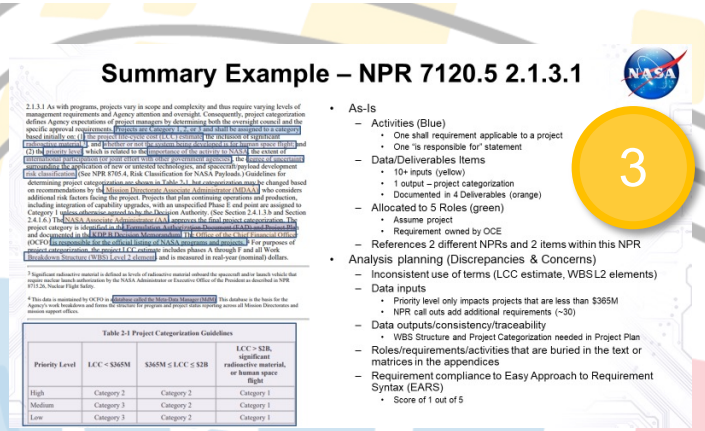
- Multiple documents are integrated into one common model
  - Area 1: Views and Metrics
    - What is exposed from the model during reviews
  - Area 2: Common
    - Terms or data items that are used in multiple documents
  - Areas 3: Modeled Documents
    - Contains text, activities, requirements, etc.
  - Area 4: Documentation that hasn't been modeled
    - Reference material



Analysis Process







- **Data Product Characterization** — Ability to tag data items and create alternate views of the textual data.
- **Requirement Quality Exploration** — Parsing allowed for use of COTS requirement quality tool that highlighted issues quickly
- **Integrate Processes and Explore Utilization** — Explored overlapping processes, terminology inconsistencies, and stakeholder interpretations

FINDINGS & RECOMMENDATIONS

Data-Centric Views of Common Items

Terminology

Easy to find discrepancies between terms. Method created for extending definitions.

Roles & Responsibilities

Role expectations are documented in multiple NPD/NPRs. View created based on roles.

Milestone Reviews

Integrated data-centric views makes it easier to tailor and make decisions.

References

Defined metadata necessary for reference data. Easier to find references and ensure that they are current.

Data/Deliverable Hierarchy

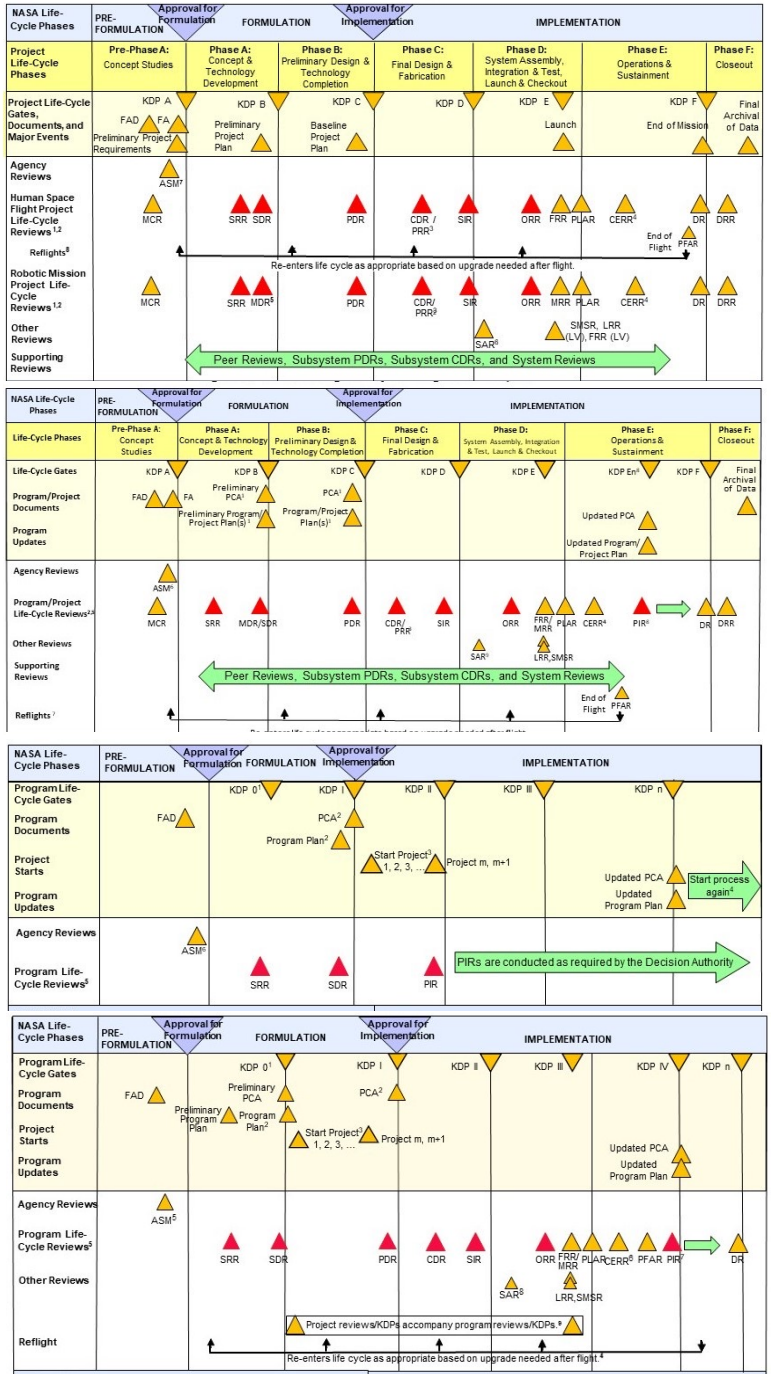
Document-centric deliverables were broken into the required data elements which allows for re-use and traceability.

Requirements

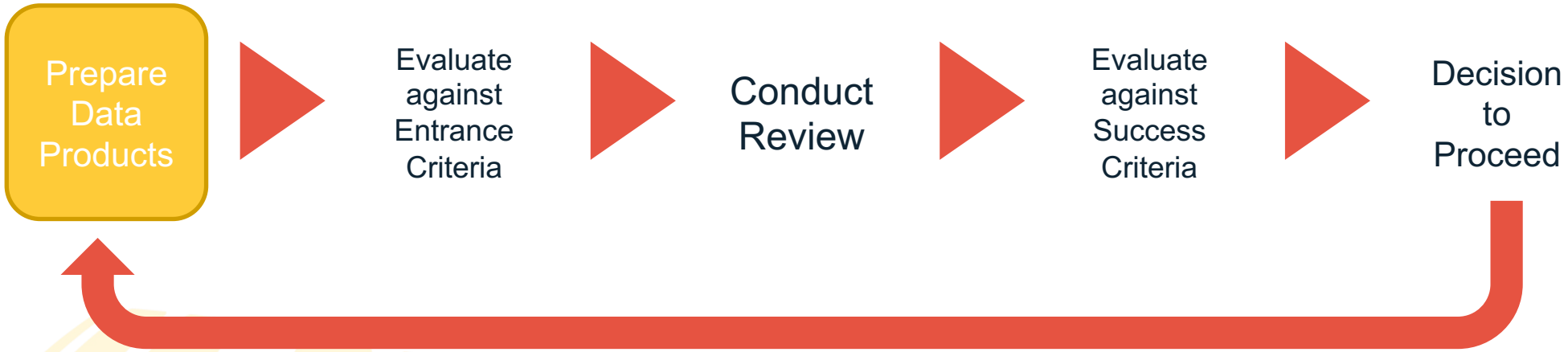
Defined metamodel that breaks text into data elements and process flows allows orchestration of large/complex processes.

Assess Lifecycles

- NASA currently has numerous lifecycles
- Data-centric views allow for assessment of:
  - Complexity vs. Flexibility
  - Codified vs. Guidance
  - Traceability to Centers vs. Program/Project
  - Missing details/allocations
- Recommendations for changes based on:
  - Accuracy and consistency
  - Efficiency
  - Risk management
  - Data patterns and trends
- Enable attribute-based customizations



Data-Centric Review Process Pattern



Data/Deliverable hierarchy and consistent terminology along with consistent processes make this easier to produce

Accurate data collection and management ensure the data is available and at the appropriate maturity

Data from various source can be integrated and standardized into views for various Stakeholders. Allows the ability to drill into available data/information.

Evaluations rely on data and information, increasing objectivity

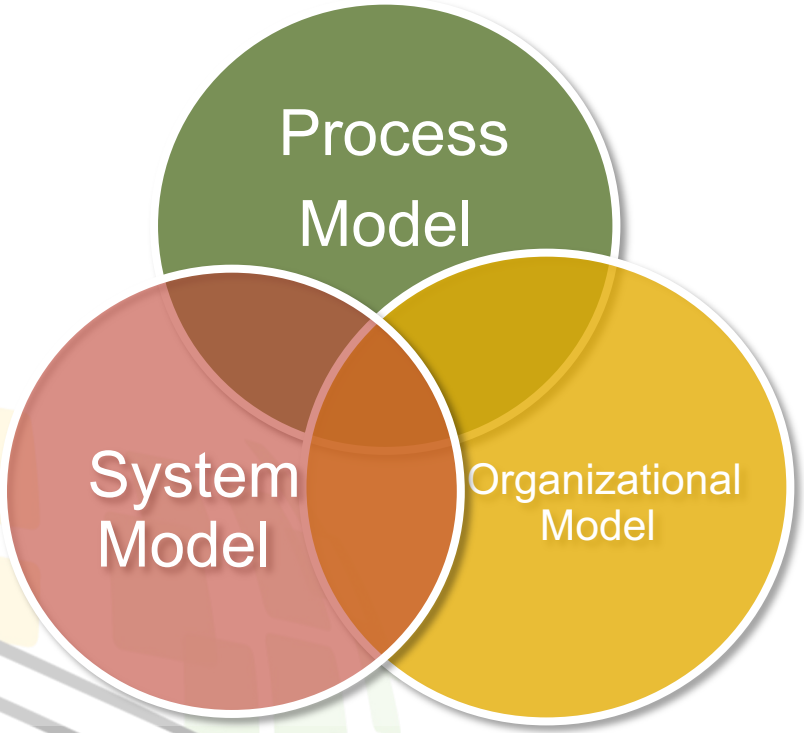
Risk-informed decisions are made

Summary

Digital Engineering – Next Steps

Simplify & Streamline

Data-centric views that focus on collection, integration, and management of data



Data-centric views to focus on roles and responsibilities

Integrate and align input/outputs

Familiarization of data-centric views and models

Data-centric views that support design, development, and operations

Questions?

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