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Implementing Systems Engineering for Early Stage R&D Projects INCOSE Crossroads of America Chapter Meeting

PRESENTED BY

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Introduction to Sandia National Laboratories (SNL) and Our Role in R&D*

Our unique responsibilities in the nuclear weapons (NW) program create a foundation from which we leverage capabilities, enabling us to solve complex national security problems.

For more than 60 years, Sandia has delivered essential science and technology to resolve the nation's most challenging security issues.

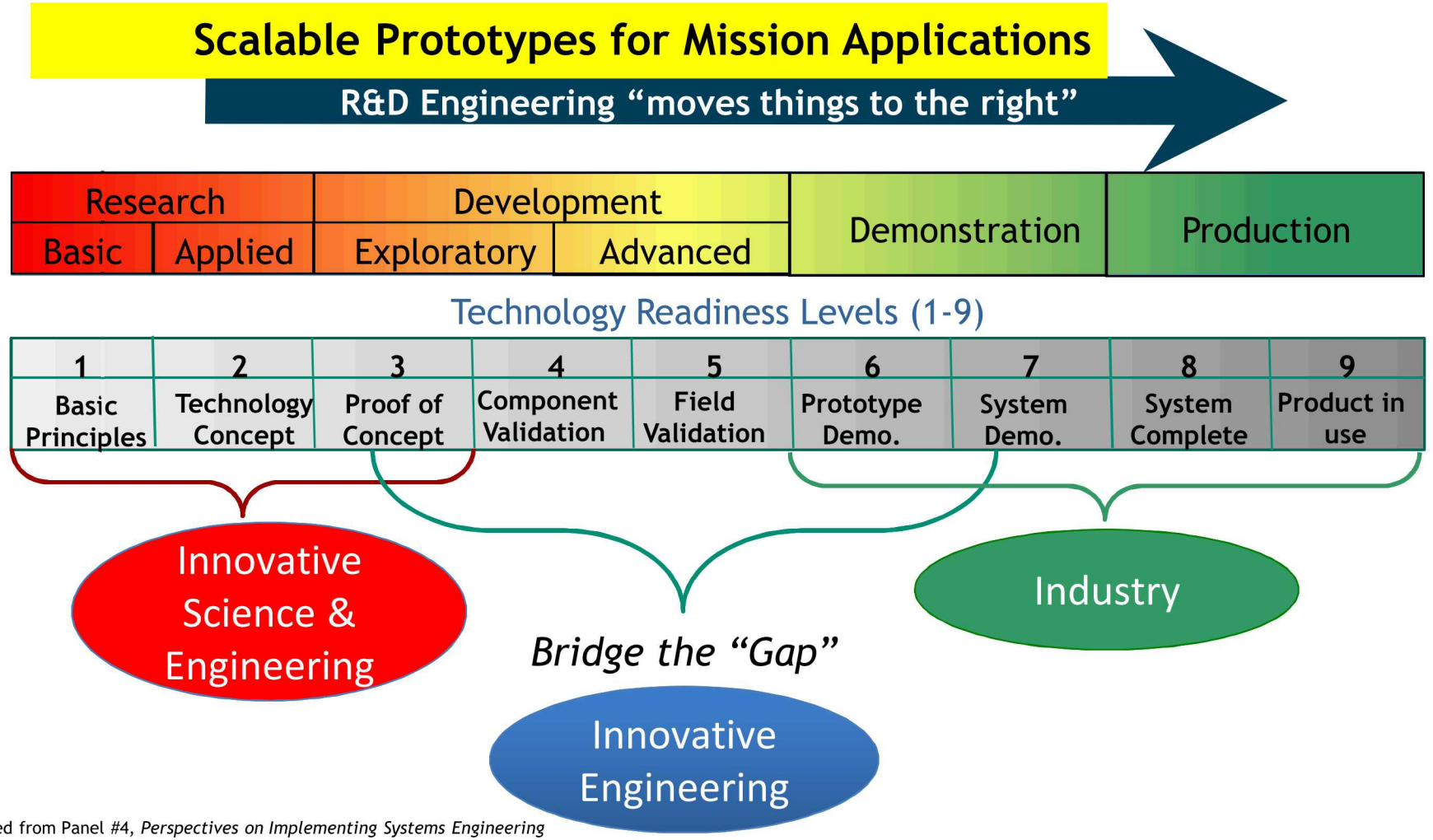
We work with other government agencies, industries, and academic institutions to accomplish our missions in the following areas:

- Nuclear Weapons
- National Security Programs
- Energy & Climate
- Global Security

Work ranges from basic research to operational systems development and operations

*Adapted from https://www.sandia.gov/about/index.html

Typical R&D Engagement of National Laboratories*



*Extracted from Panel #4, *Perspectives on Implementing Systems Engineering in Early Stage R&D Projects*, Dr. Heidi Hahn, Los Alamos National Laboratory, IS2019

SNL has received 124 R&D 100 awards since 1976 ("Oscars of Invention")

SNL's Implementation of Systems Engineering (SE)

SNL has implemented a risk-informed graded approach to mission assurance

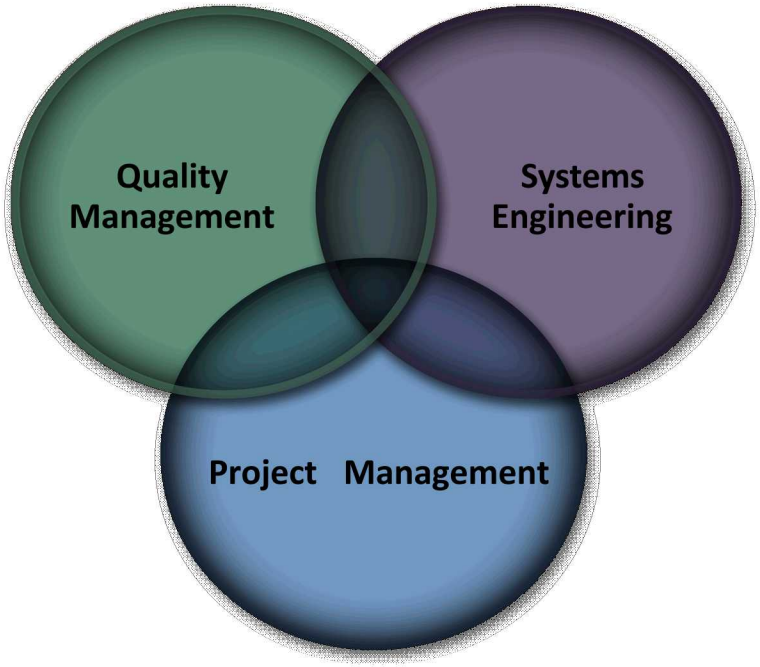
- the integrated right-sized application of SE, program/project management and quality management

… for the purposes of

- delivering quality products and services to our customers to achieve mission success, and
- provide management clear insight into the *health of the project* and the *health of the product*

Initially developed for a large business unit, and is being propagated to the rest of SNL

Mission Assurance – Integration of SE, QM, PM



SE/QM Focus = Health of Product

PM Focus = Health of Project

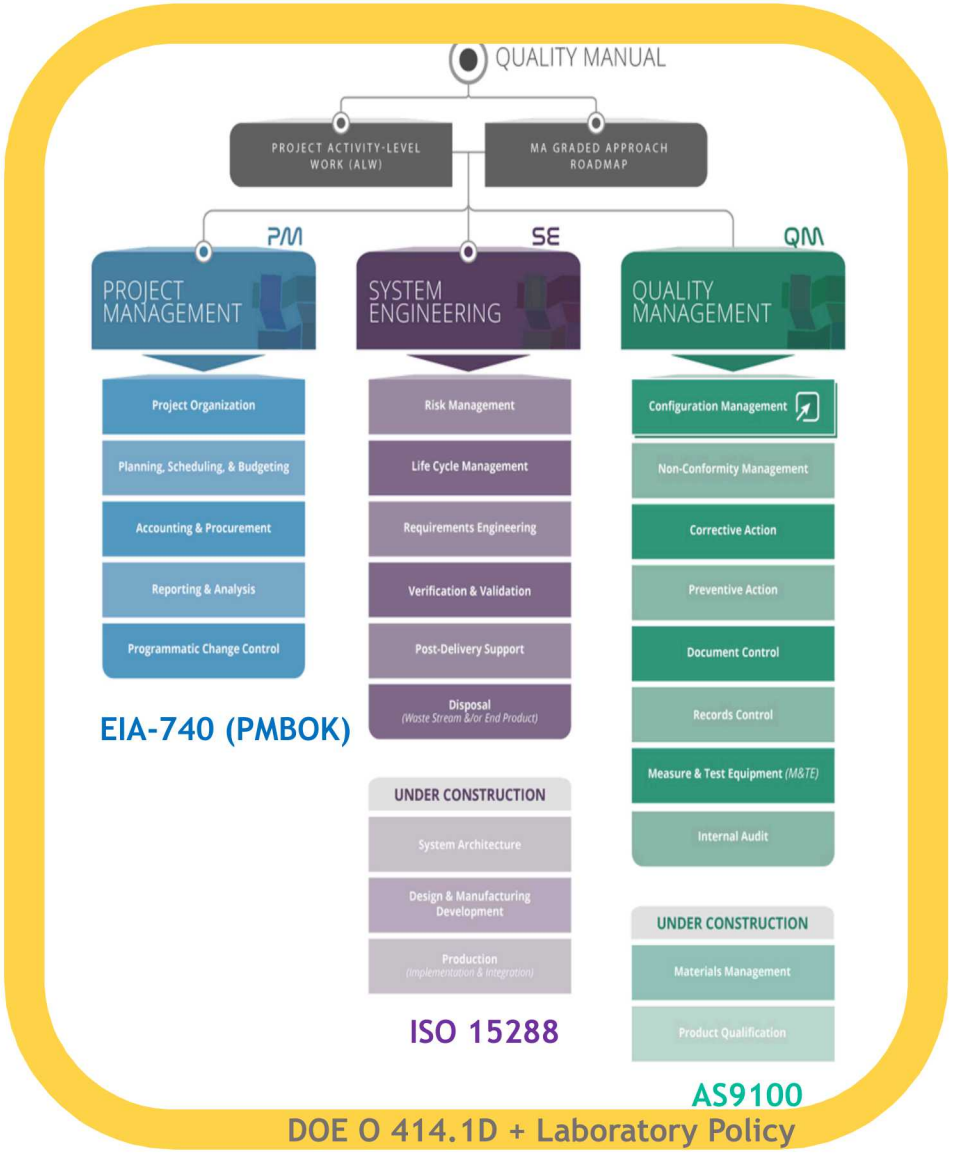
Inception of Mission Assurance was in July 1998

Has Taken Time To Analyze, Develop, Socialize, Get Buy In, Obtain Authority and Execute

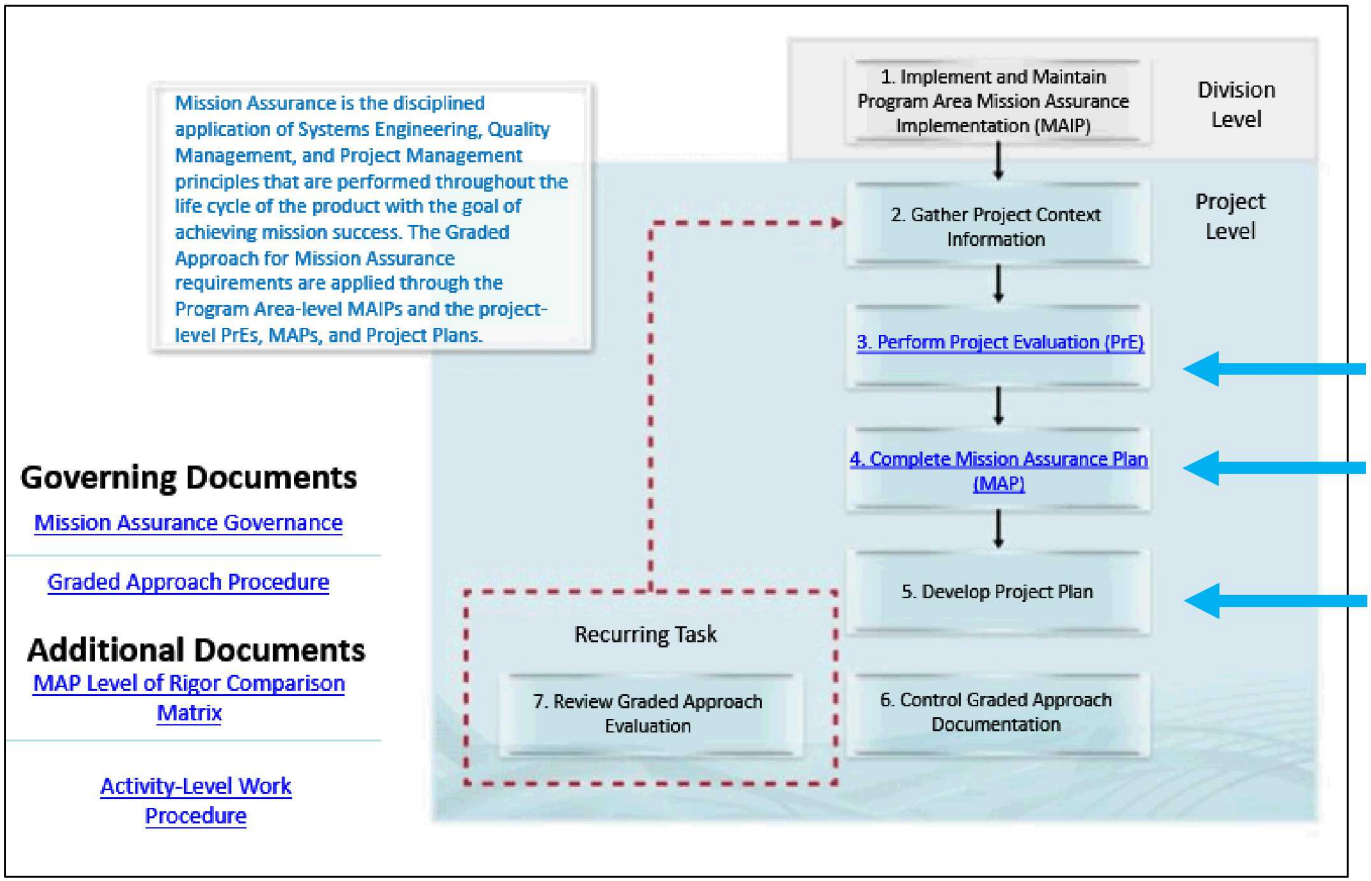
Based on Industry Standards and Lessons Learned

Mission Assurance Engineering System

- Science and Engineering Management Framework
- Science and Engineering Management Solutions
  - Recommended rigor determination (Project Evaluation)
  - Mission Assurance Plan (for determined rigor)
  - Measures and Metrics
  - Aras Engineering Management Solutions – CM/PLM
  - Risk Engineering Management System



Graded Approach Roadmap



What Category
High/Medium/Low

What Rigor to Consider/Selected
Timing/Scope/Formality

How Implementing Selected Rigor
Project Document

Further Right Sizing

- Waive and tailor to fit business needs
- Core mission assurance requirements cannot be waived
  - Follow mission assurance framework graded approach
  - Project charter
  - Milestone list
  - WBS
  - Budget
  - Financial reporting and analysis
  - Change control
  - Requirements management approach
  - Risk management approach
  - Configuration management approach (includes document and record control)
  - Non-conformance/issues management

Determining core set of practices that every project follows was a challenge for a portfolio spanning basic research ←→ operational systems

What are the challenges in applying SE to an early stage R&D project?

- SE practices may be unfamiliar to researchers
  - Need to reframe
- Determine set of right-sized practices that support future maturation and scalability
  - Right level of rigor
  - Nurture creativity and exploration
  - Preserve research quality, defensible research
- SEs more familiar with high rigor

When should SE be applied to early stage R&D? Are there triggers that could identify when SE should be applied?

- As early as possible
- Should be done for all projects

Is there a compelling value proposition for "selling" the idea of applying SE to early stage R&D projects?

- Right-sized rigor
  - Timing
  - Scope
  - Formality
- Develop "pull" vs. "push"
  - What are researchers' ideas for practices that preserve research quality?
  - Reframe practices to R&D terminology
  - Coach PI, technical team leads in practices
- Templates and examples
  - Don't start with a "blank sheet of paper"

What SE concepts have the biggest "bang for the buck" in these types of projects? What SE practices, when applied early in an R&D project, support future growth if there is a desire to "productionize" the R&D's focus area?

- Core mission assurance requirements
  - Project charter
  - Milestone list
  - WBS
  - Budget
  - Financial reporting and analysis
  - Change control
  - Requirements management approach
  - Risk management approach
  - Configuration management approach
  - Non-conformance/issues management

Are these the right set of requirements?
Need your help – *participate in the ESRD Working Group!*

How to tailor SE for early stage projects?

- Risk-informed graded approach
- Right-sized rigor
  - Timing
  - Scope
  - Formality
- Templates, examples

Project types will facilitate “inheriting” rigor level, templates
Doesn’t replace critical thinking!

Summary

SE for Early Stage R&D:
Questions and responses

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