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Importance of Systems Engineering to Support Risk-Informed Performance-Based Methods

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Outline

What is systems engineering?

Key concepts

Value of systems engineering to support RIPB methods

Tailoring and best practices
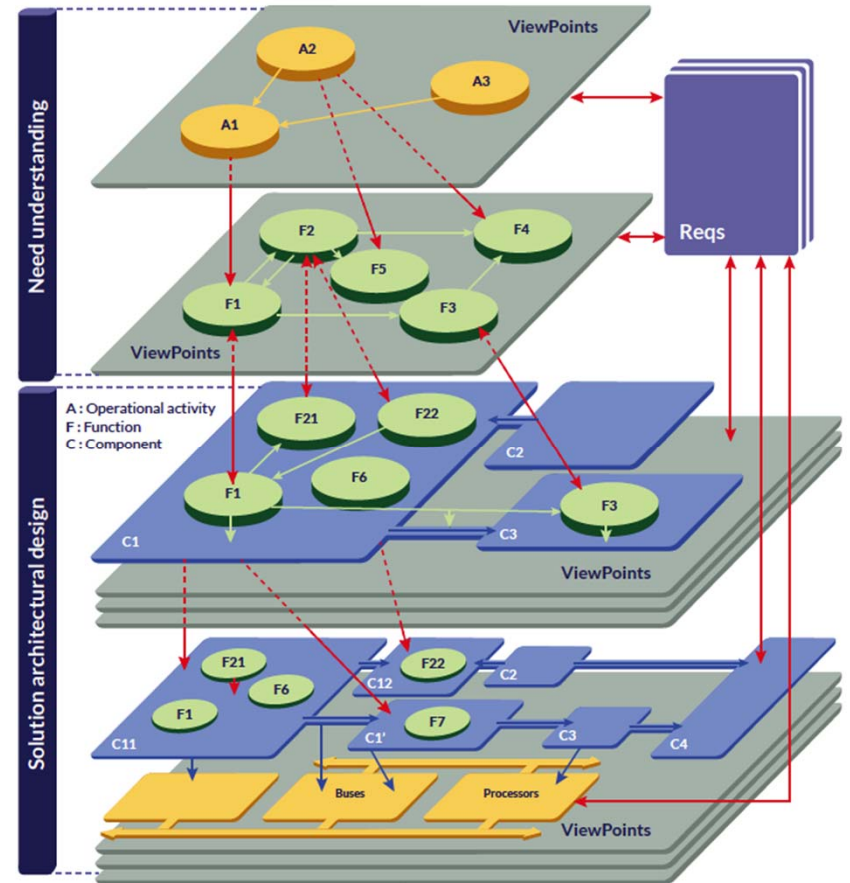
Effective program management

Additional resources

What is systems engineering?

A set of proven tools and techniques for managing the complexity of large projects/products in order to control cost, schedule, and quality.

Arcadia Model-Based Systems Engineering Method

System engineering standards

ISO/IEC/IEEE 15288:2015 Systems and software engineering -- **System** life cycle processes

ISO/IEC/IEEE 12207:2017 Systems and software engineering -- **Software** life cycle processes

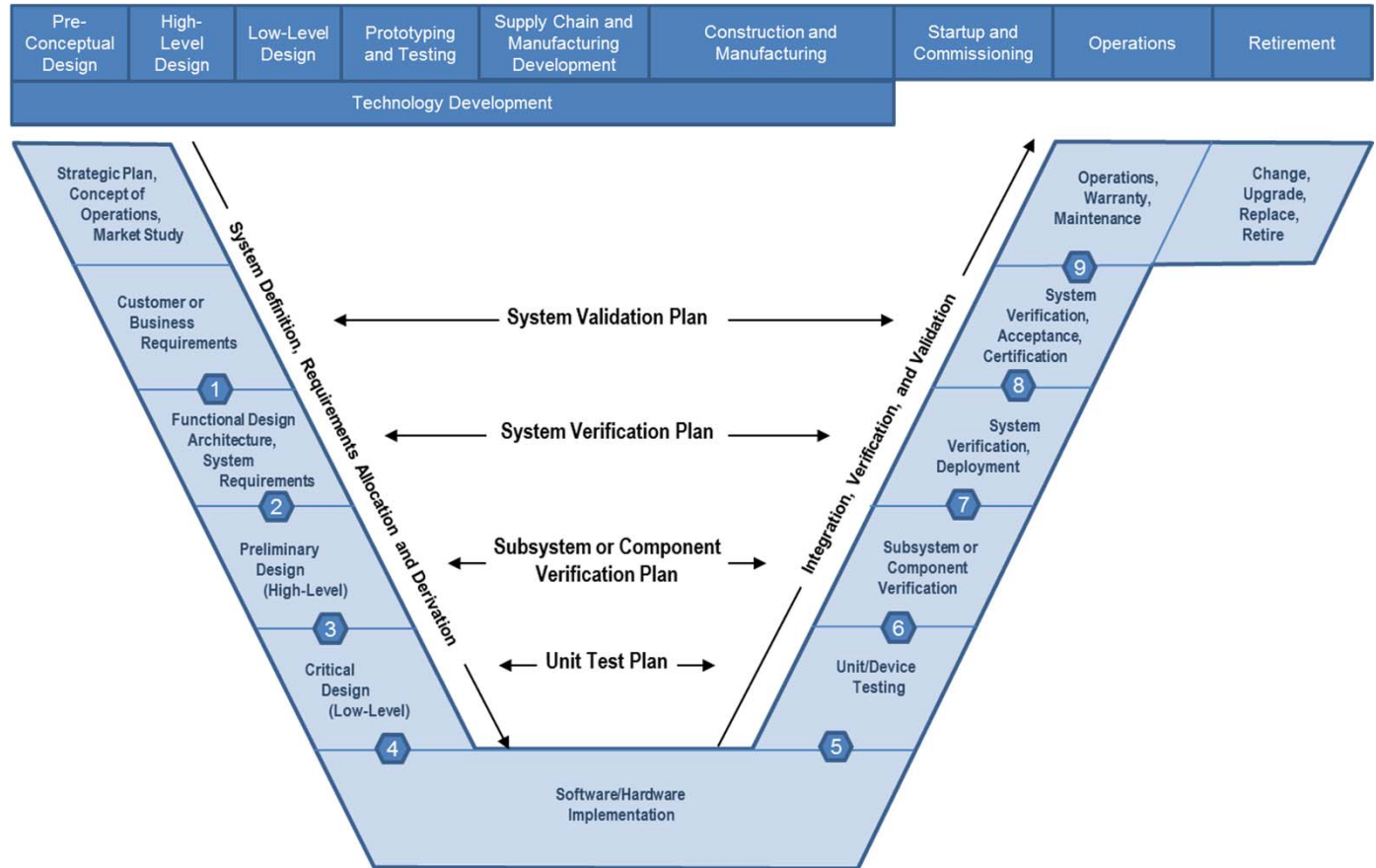ISO/IEC/IEEE 24748 Systems and software engineering
-- Life cycle management

- 2018 -- Part 1: Guidelines for life cycle management
- 2018 -- Part 2: Guidelines for the application of ISO/IEC/IEEE 15288 (**System** life cycle processes)
- 2011 -- Part 3: Guide to the application of ISO/IEC 12207 (**Software** life cycle processes)
- 2016 -- Part 4: **Systems** engineering planning
- 2017 -- Part 5: **Software** development planning
- 2016 -- Part 6: System integration engineering

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System lifecycle and V-model

Systems engineering processes

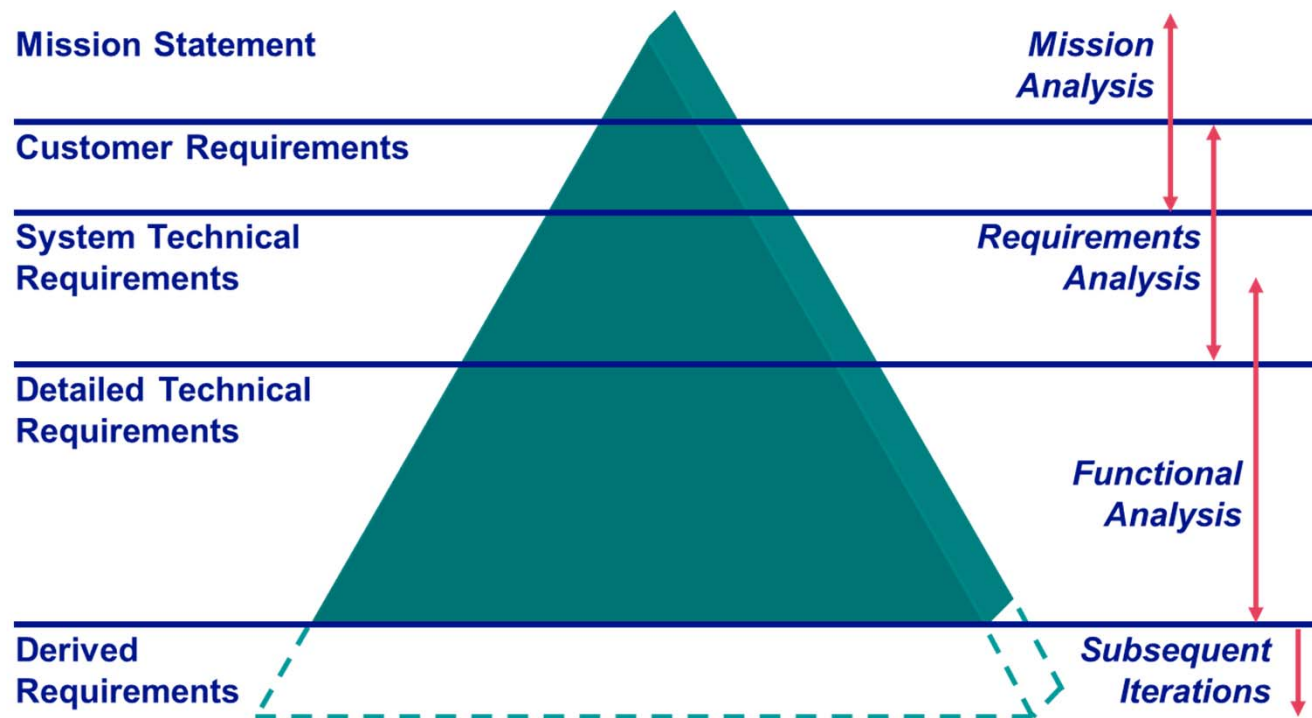| System Design |
|---|
| Stakeholder Expectations Elicitation and Validation |
| Technical Solution Definition |
| Integration of Specialty Engineering (Systems Analysis) |

Technical Management and Control
Technical Planning
Integration of the Systems Engineering Effort
Configuration Management
Technical Risk Analysis
Technical Assessment
Technical Data Management
Technical Decision Analysis

5. Product Realization
Product Implementation
Product Integration
Product Verification
Product Validation
Product Transition

Typical requirements set
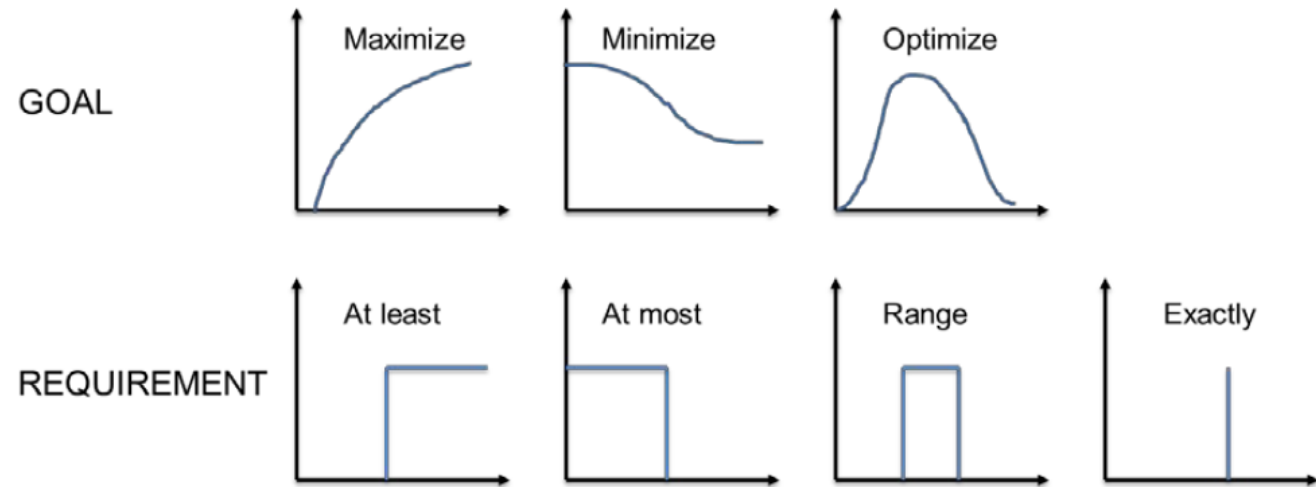

- Mission Statement
- Customer Requirements
- System Technical Requirements
- Detailed Technical Requirements
- Derived Requirements

- Mission Analysis
- Requirements Analysis
- Functional Analysis
- Subsequent Iterations

Goal vs requirement
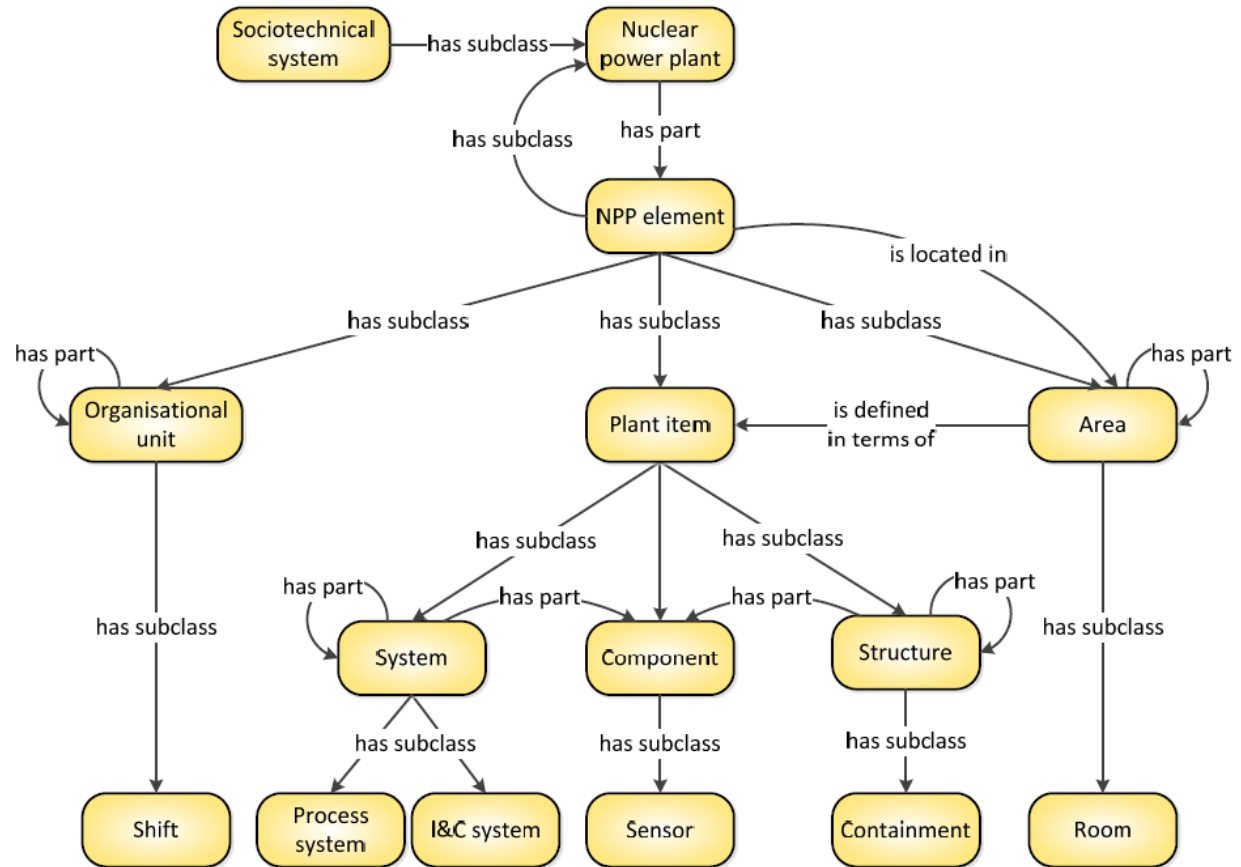

GOAL: Maximize, Minimize, Optimize

REQUIREMENT: At least, At most, Range, Exactly

Product structure modeling

Conceptual model for safety requirements specification and management in nuclear power plants, VTT TECHNOLOGY 238, Copyright VVT 2015

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Value of systems engineering to support RIPB methods

Without a robust SE infrastructure, organizations will face challenges successfully implementing RIPB methods into the following key processes

- Requirements engineering and management
- Decision making
- Configuration management
- Technical assessment

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Tailoring and best practices

SE programs should be tailored to the organizational needs and lifecycle phase of the system or product

One size does not fit all when tailoring SE programs

Outside experts need to work closely with internal change leaders

The nuclear industry can learn a lot from other industries regarding SE best practices (e.g., aerospace)

Effective program management

After initial establishment of SE programs, they need to be actively maintained and adjusted

Initial programs typically focus on supporting one or two products or projects, but then grow to support the entire enterprise

SE resources should be planned and tracked as a percentage of total project resources to evaluate effectiveness

Additional SE resources

ISO/IEEE

INCOSE

NASA

DOD

DOE

IpX

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