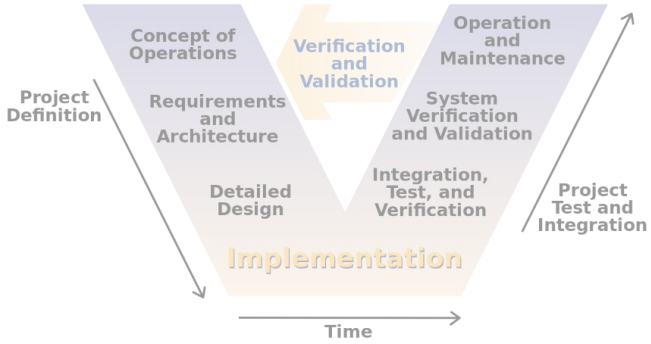


The 6 Vs and 3 Ts of Systems Engineering

David Long, ESEP
President, Vitech
INCOSE Past President and Fellow
david.long@vitechcorp.com

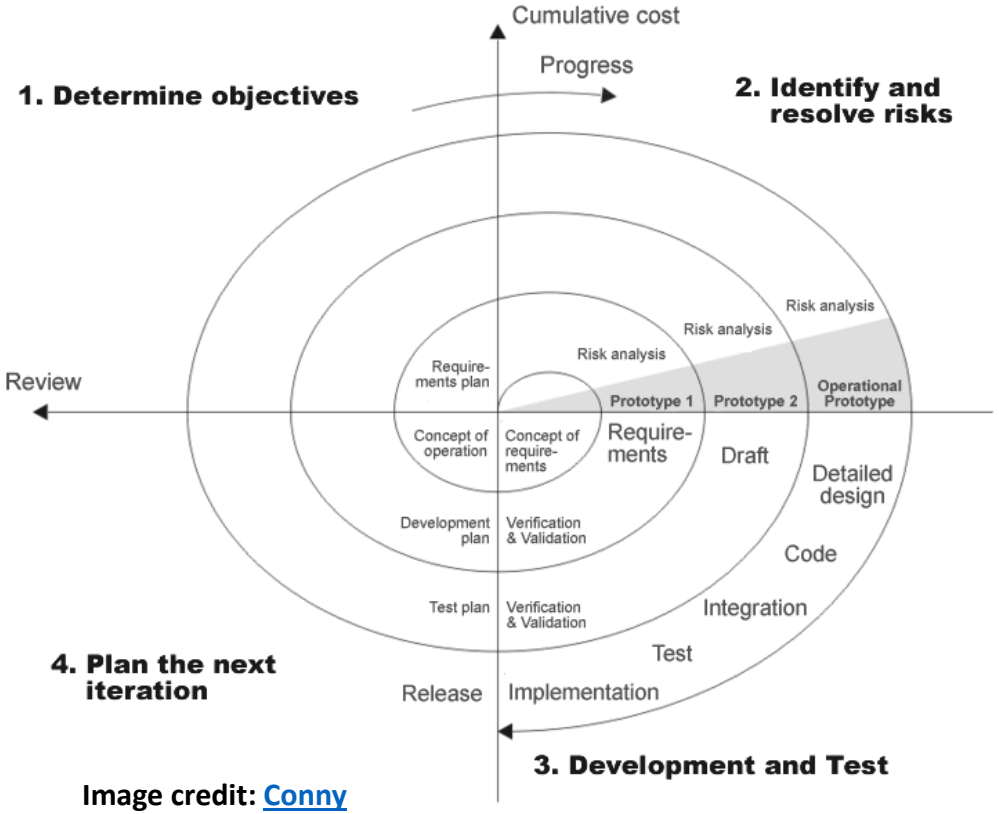


Image credit: [Conny]

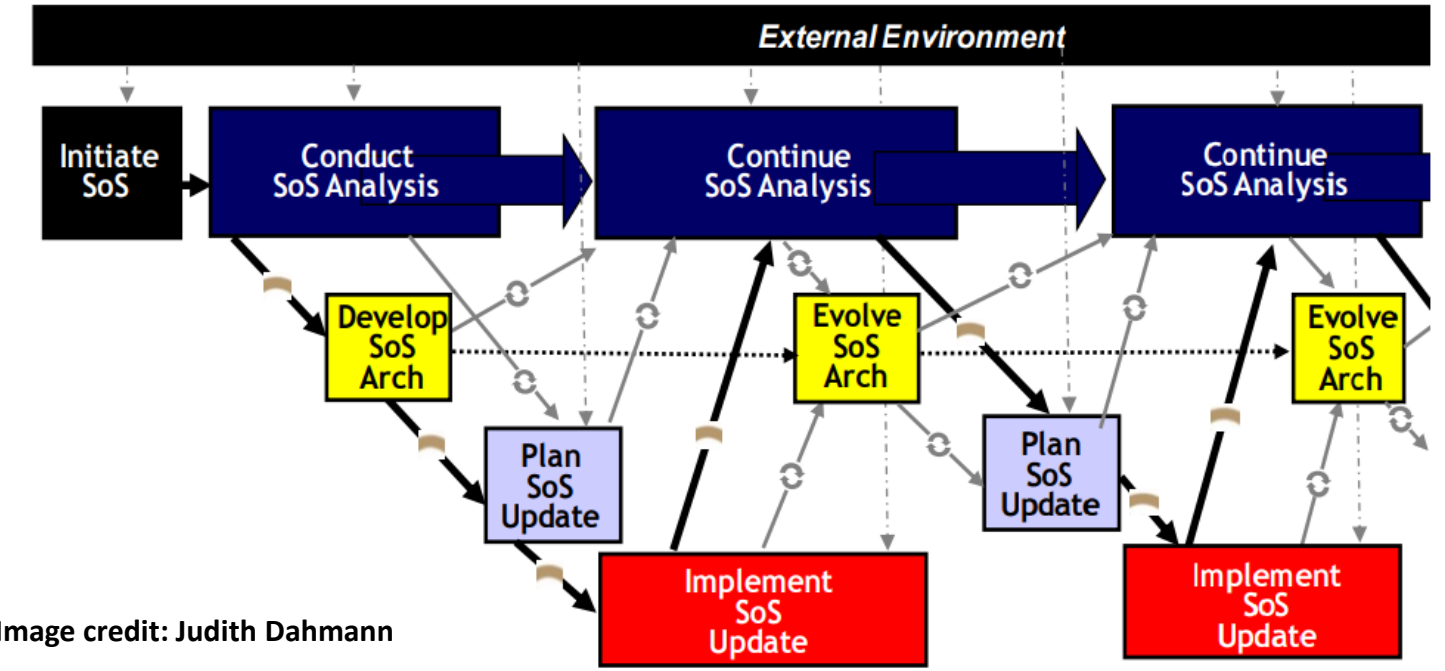
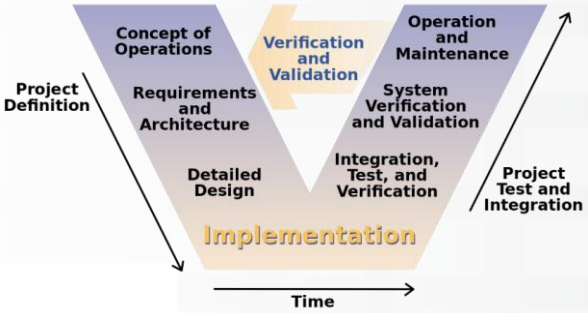
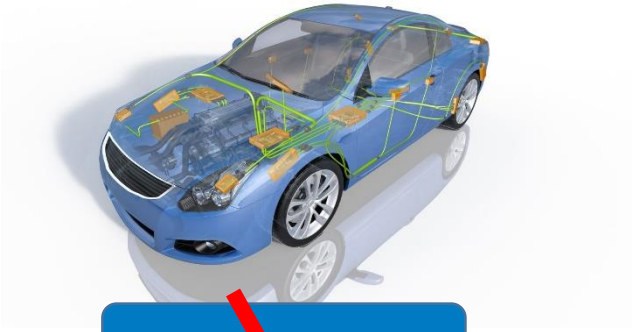


Image credit: Judith Dahmann

VALIDATION & VERIFICATION

The First V: Beginning with Misunderstanding





System Purpose

System Requirements

Subsystem Requirements

Subsystem Architecture Design

Electrical/Electronic

Software

Mechanical

Implementation

Unit Verification

Unit Integration

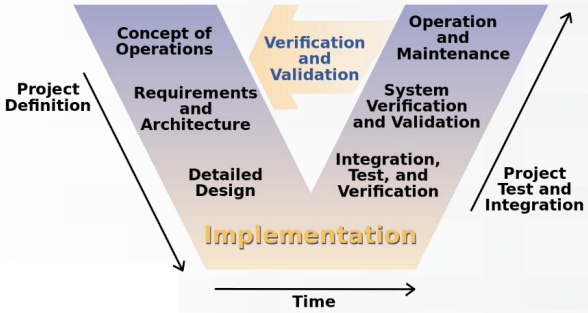
Integration Verification

Subsystem Verification

System Verification

System Validation

The Second V: Returning to Intent



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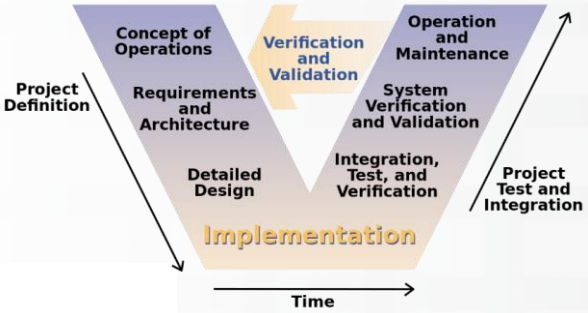
The Third V: Executing Classical Design



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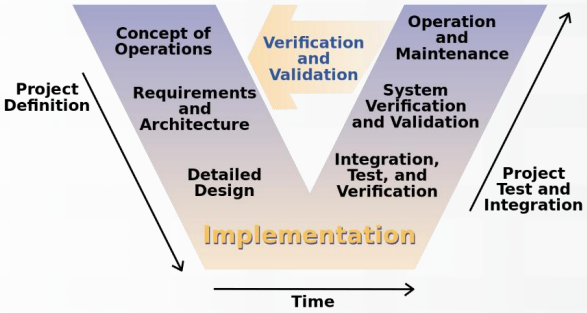

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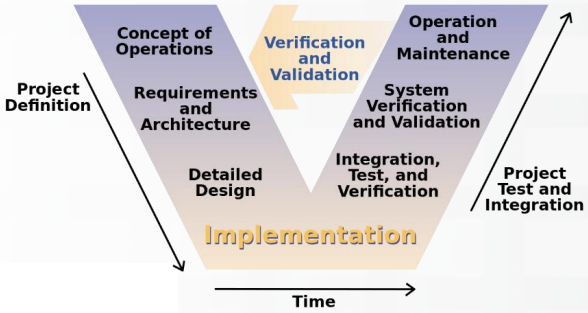
The Third V: Executing Classical Design



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A Sidebar:
Systems Engineering Vision 2025

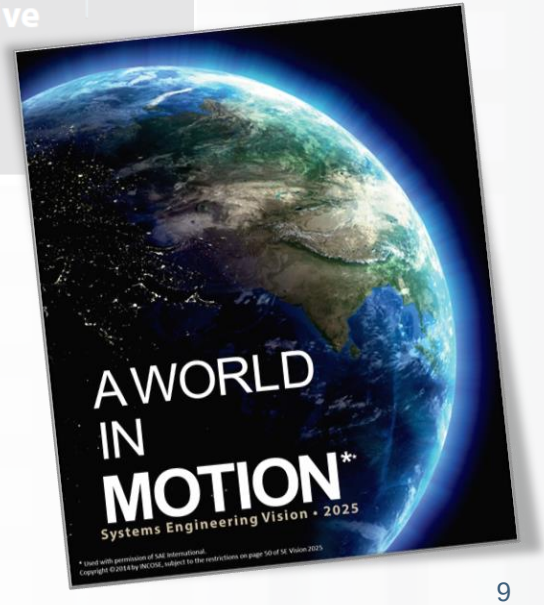
1 Mission complexity is growing faster than our ability to manage it . . . increasing mission risk from inadequate specifications and incomplete verification.

2 System design emerges from pieces, rather than from architecture . . . resulting in systems that are brittle, difficult to test, and complex and expensive to operate.

3 Knowledge and investment are lost at project life cycle phase boundaries . . . increasing development cost and risk of late discovery of design problems

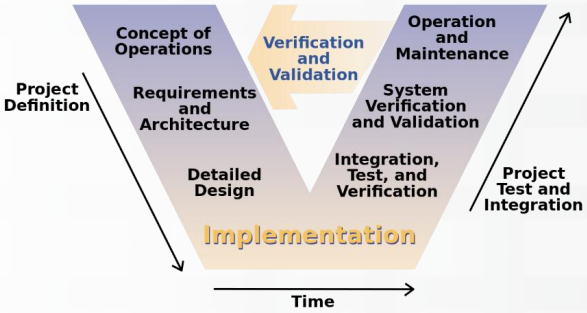
4 Knowledge and investment are lost between projects . . . increasing cost and risk: dampening the potential for true product lines.

5 Technical and programmatic sides of projects are poorly coupled . . . hampering effective project risk-based decision making.



Vitech

The Fourth V:
Impacting Integration & Test



System Purpose

System Requirements

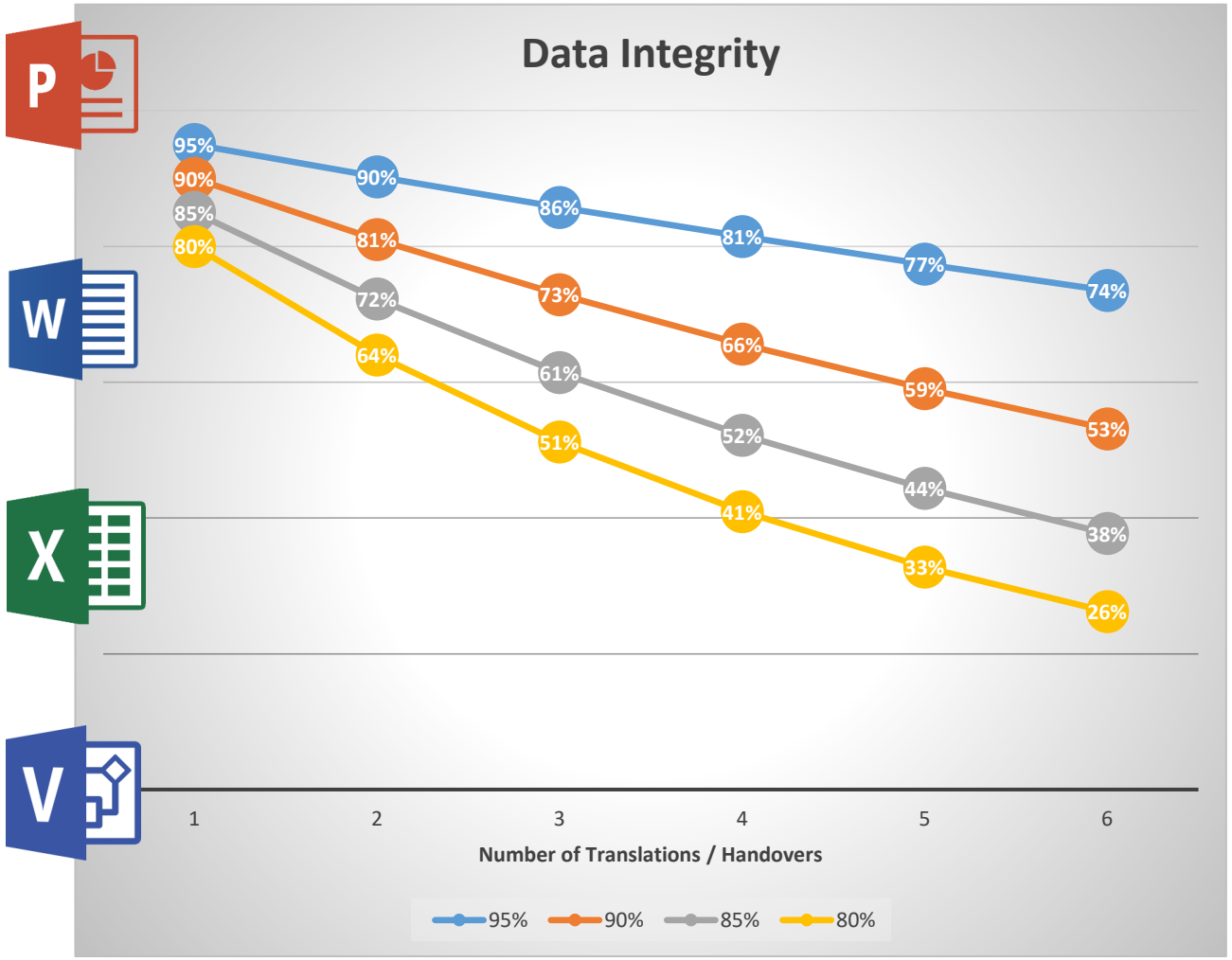
DEFECTS

Subsystem Requirements

Subsystem Architecture Design

Vitech

Appreciating the Cost of Miscommunication



Any organization that designs a system (defined broadly) will produce a design whose structure is a copy of the organization's communication structure

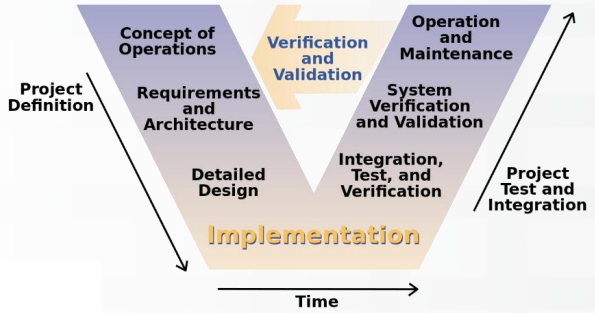
Melvin Conway, 1967

Flaws in the communication structure of an enterprise will manifest as defects in the system under development

Long's Corollary, 2020

Credit Henrik Balslev, Systems Engineering A/S

The Fourth V: Impacting Integration & Test



System Purpose

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System Validation

System Validation

System Requirements

System Requirements

System Verification

System Verification

System

Subsystem Requirements

Subsystem Requirements

Subsystem Verification

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A Sidebar Redux: Systems Engineering Vision 2025

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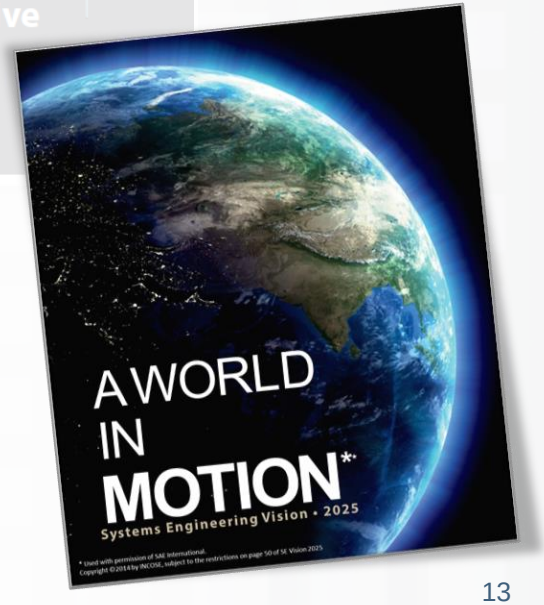
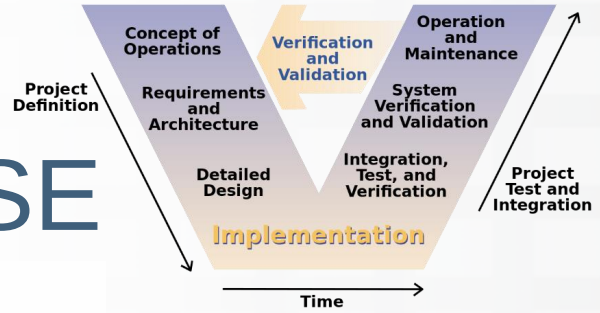


Vitech

The Fifth V: Transforming Engineering thru Good MBSE



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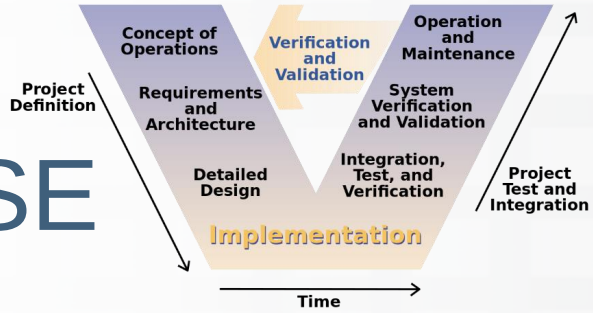

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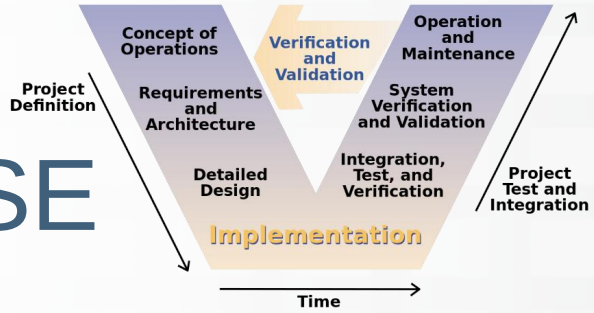
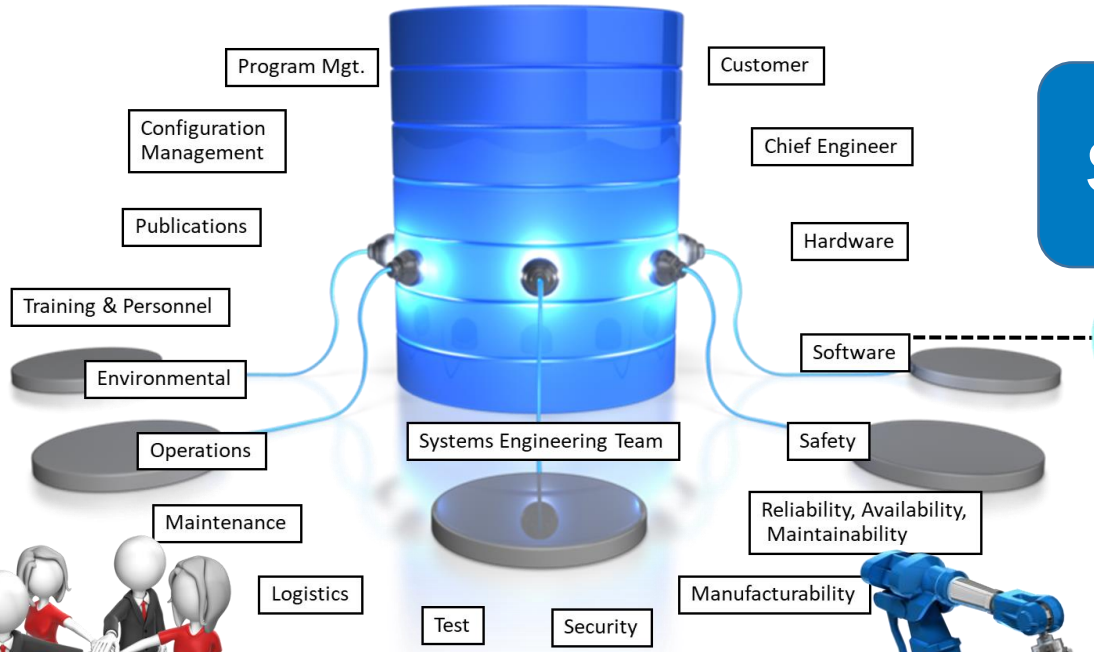


System Purpose

System Requirements



Subsystem Requirements

Subsystem Architecture Design

Vitech

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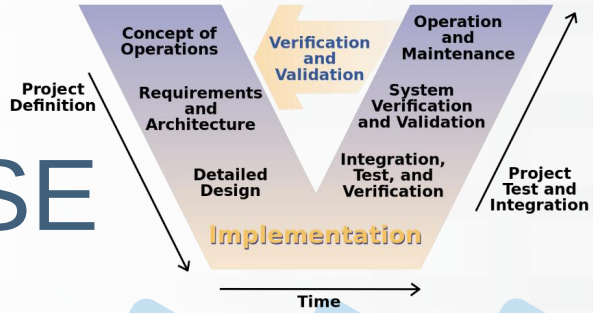


System Purpose

System Requirements

Digital Verification

Digital Verification

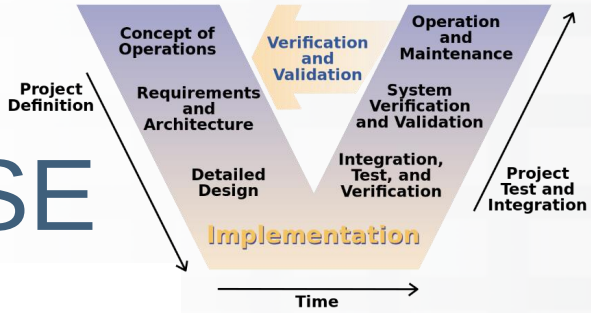
Digital Verification

Subsystem Requirements

Subsystem Architecture Design

Vitech

The Fifth V:
Transforming Engineering thru Good MBSE



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Vitech

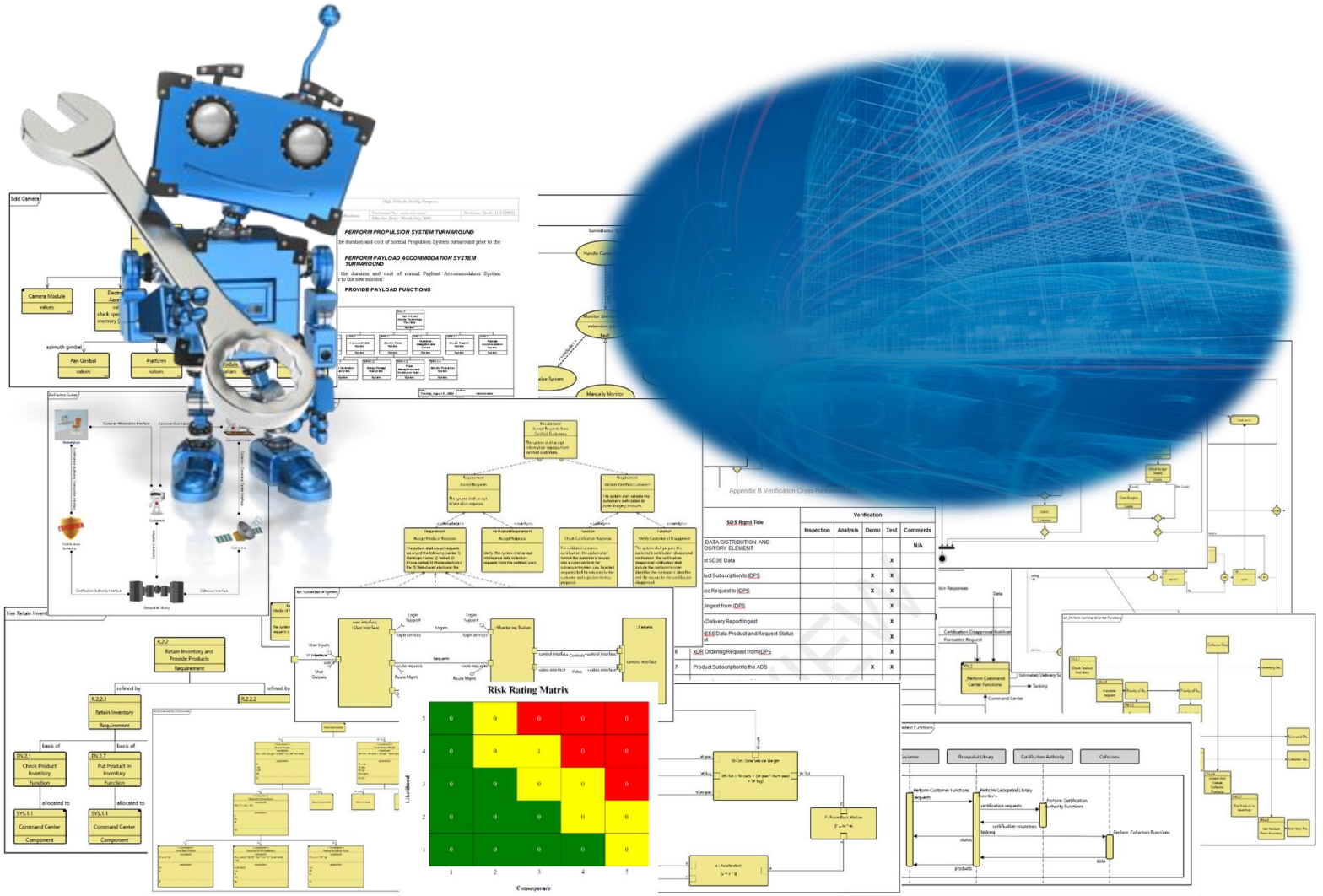
Expanding our alphabet

(Hokies know that the best letter to go with V is always T)

The First T:
Looking to Ourselves, Appreciating All

Core SE principles	Systems Thinking
	Lifecycles
	Capability Engineering
	General Engineering
	Critical Thinking
	Systems Modelling and Analysis
Professional Competencies	Communications
	Ethics and Professionalism
	Technical Leadership
	Negotiation
	Team Dynamics
	Facilitation
	Emotional Intelligence
	Coaching and Mentoring
Technical Competencies	Requirements Definition
	System Architecting
	Design for…
	Integration
	Interfaces
	Verification
	Validation
	Transition
	Operation and Support
SE Management Competencies	Planning
	Monitoring and Control
	Decision Management
	Concurrent Engineering
	Business & Enterprise Integration
	Acquisition and Supply
	Information Management
	Configuration Management
	Risk and Opportunity Management
Integrating Competencies	Project Management
	Finance
	Logistics
	Quality

The Second T:
Leveraging Information, Enabling Action



The Third (and most important) T: Exposing Our Thinking

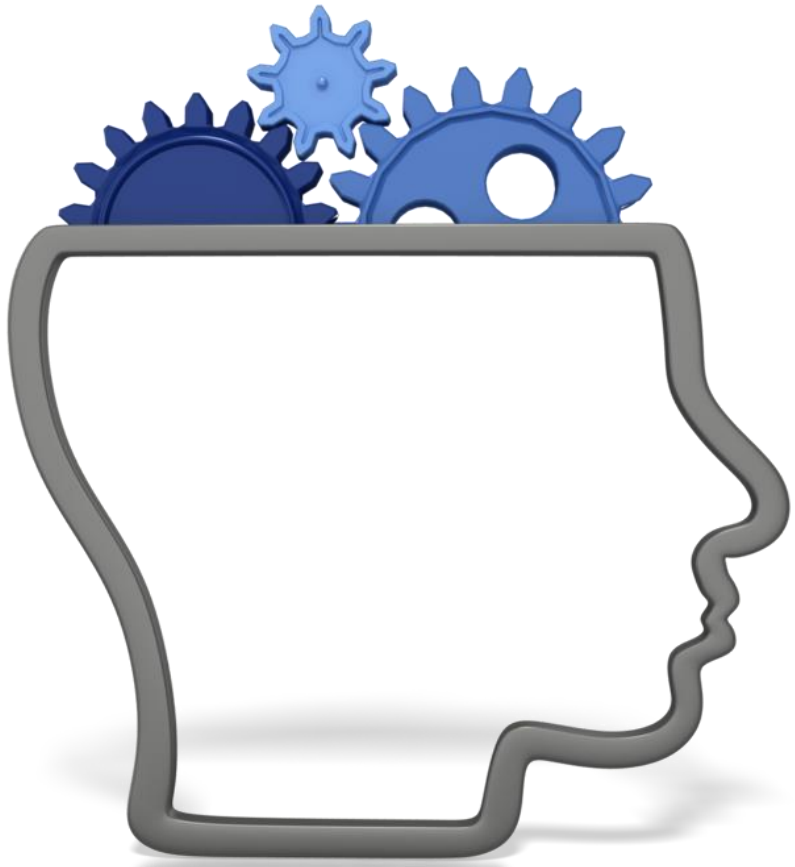
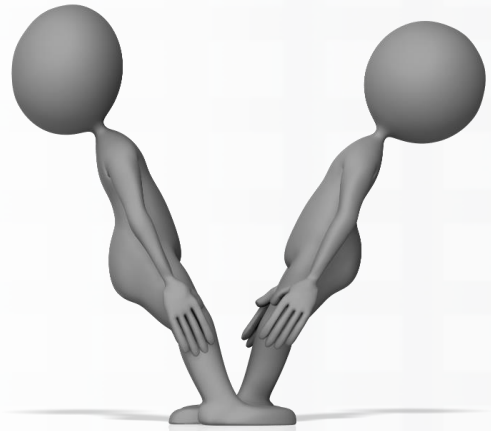


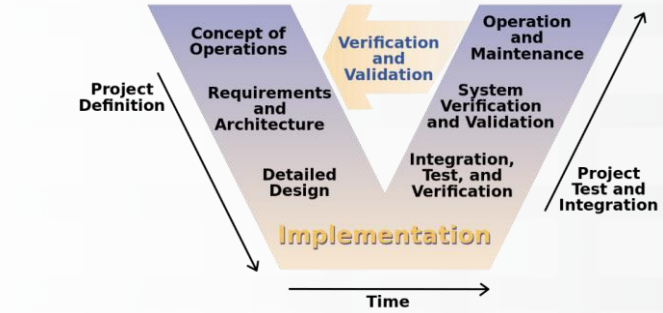
Image credit: Tom Cherry

Returning to our favorite

The beloved V, one last time



The Sixth (and most important) V: Unlocking Collective Intelligence



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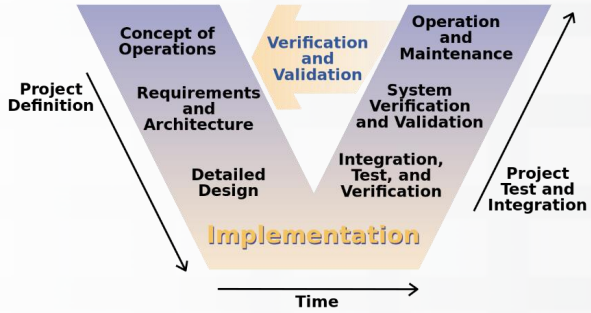


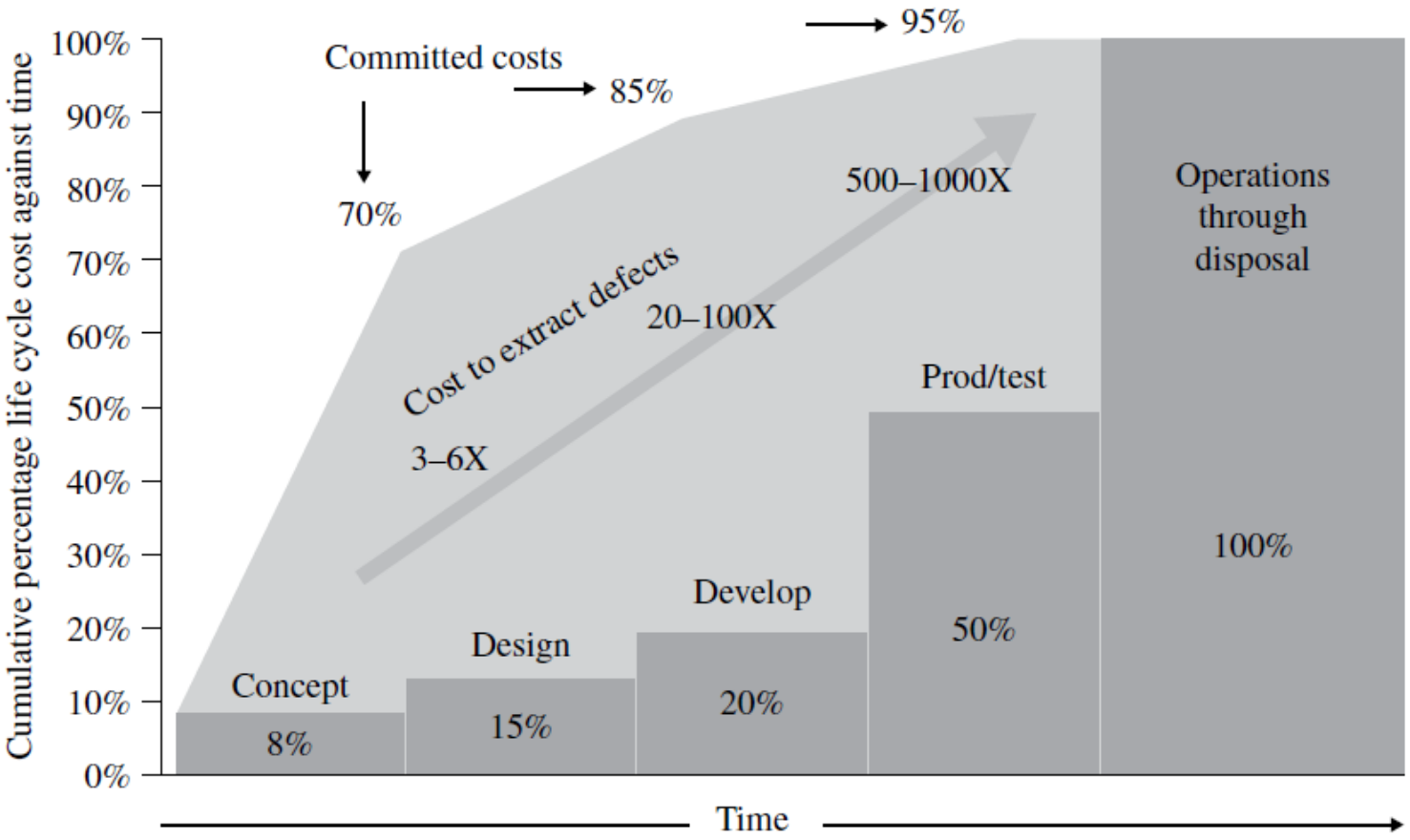
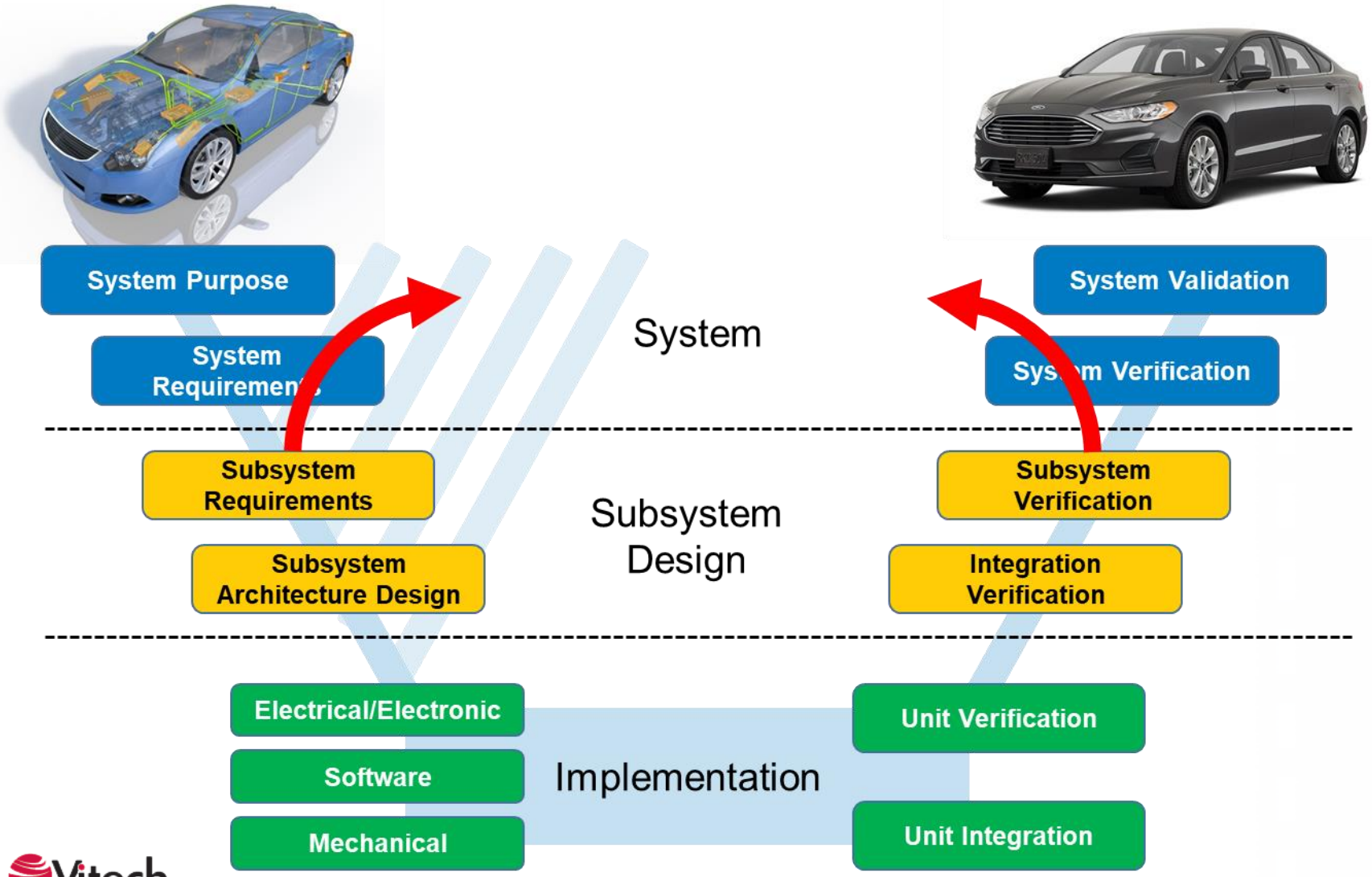


Image Credit: Defense Acquisition University

Tightening the V: SE, MBSE, and Digital Engineering



Digital Engineering

critical enabler for the modern engineering enterprise

MBSE

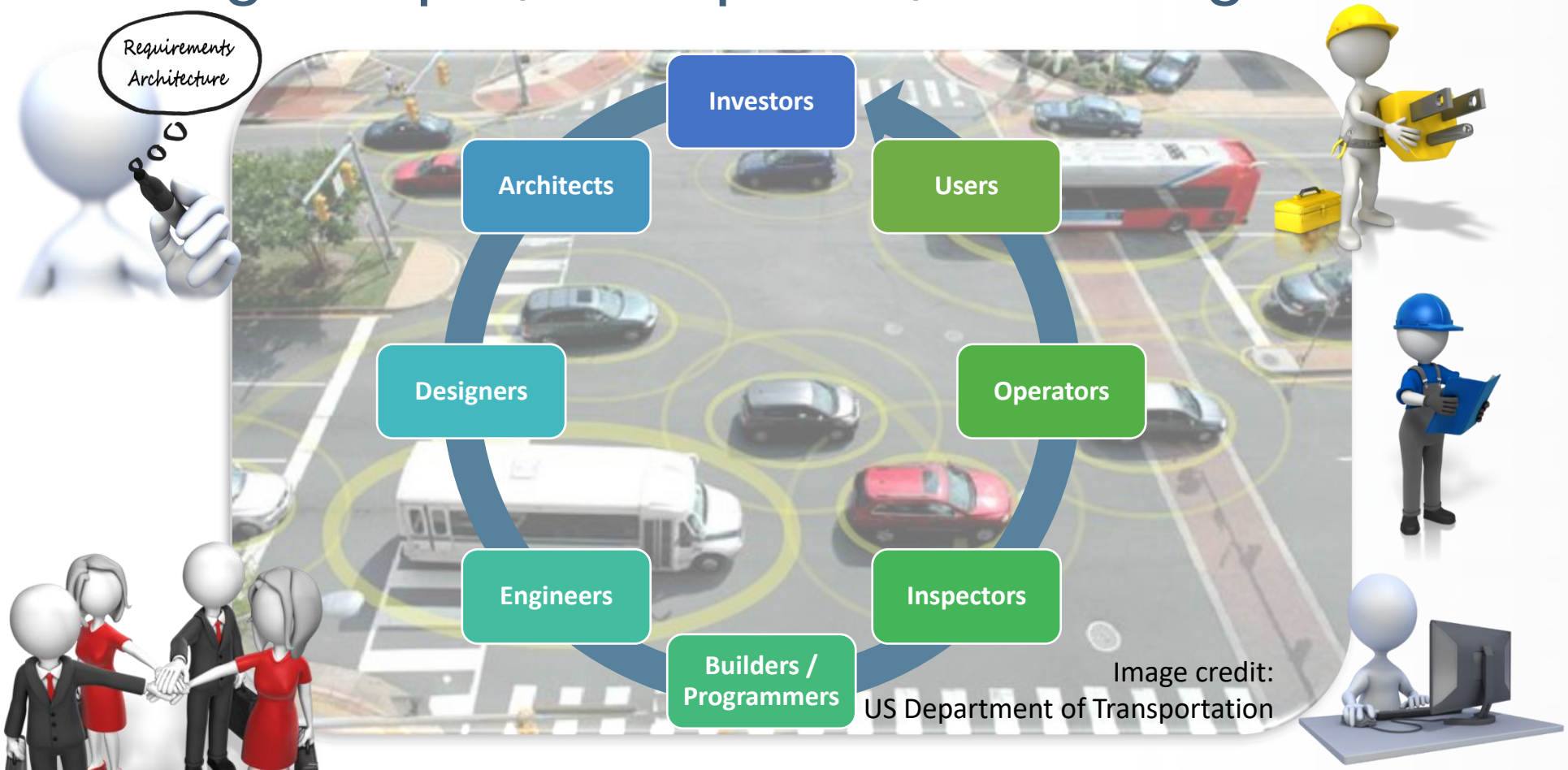
connective tissue of the Digital Engineering environment

Systems Engineering

technical connective tissue of the project team

Vitech

…but the Foundation is Neither Process nor Technology: Connecting People, Disciplines, and Insights



Systems engineering focuses on ensuring the pieces work together to achieve the objectives of the whole.

Questions and Discussion

Vitech
Insight through integration

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