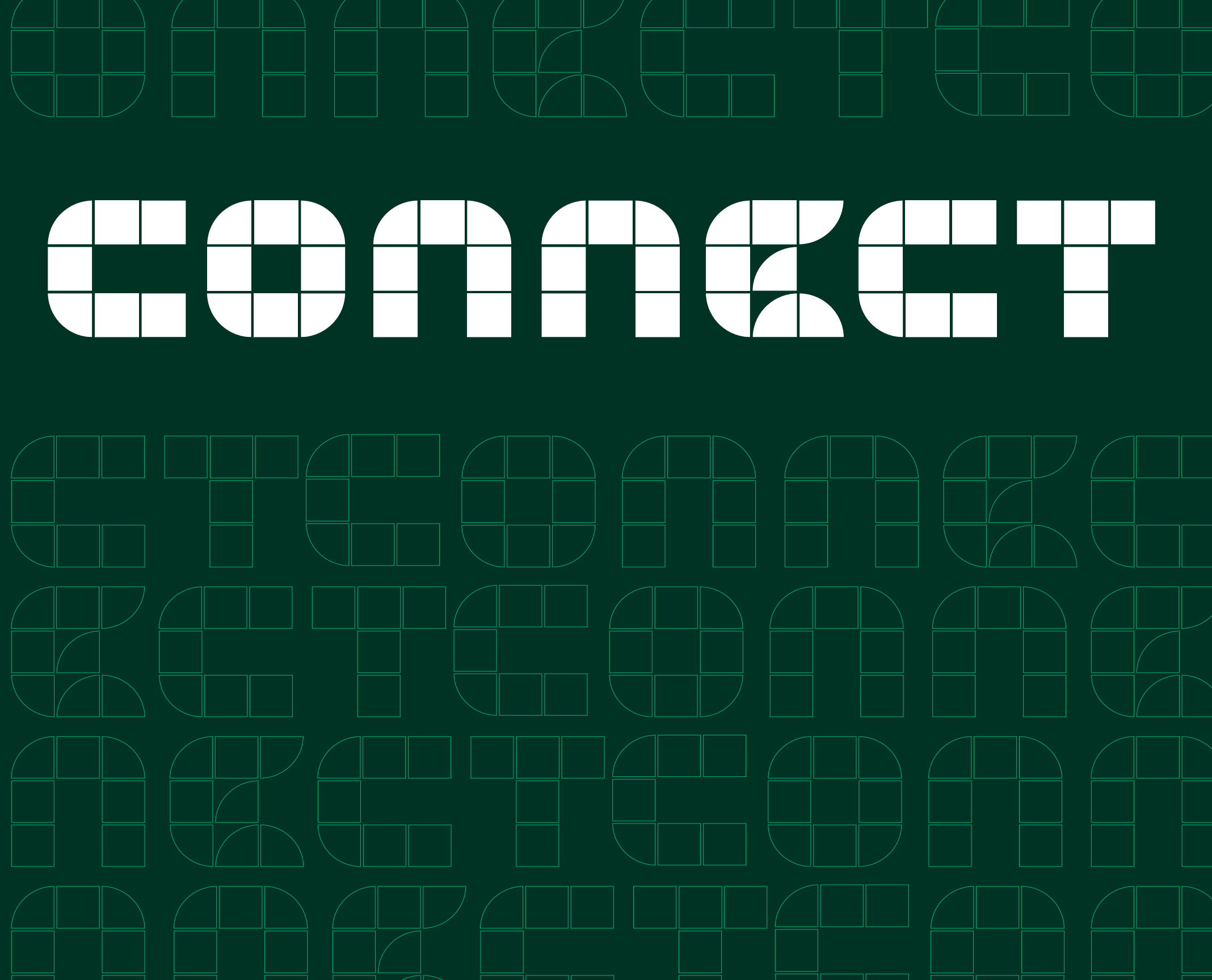


connect



2	0
2	4

testcon

Using System Models to Generate Software Test Capability

Greg Sussman
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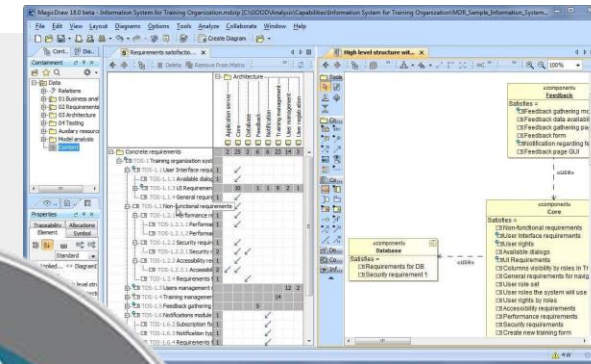
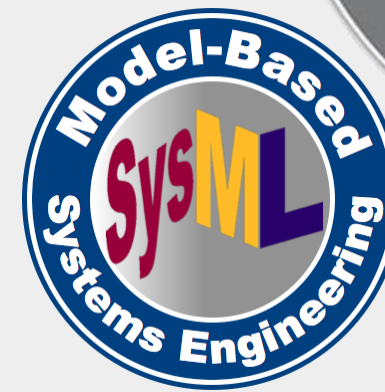
Agenda

- Model Based System Engineering
- Document Based Systems Engineering (DBSE)
- Future model-based workflow in Test Engineering (MBTE)
- What can we do today
- What is SoD
- What is needed for test
- Signal Based Coverage
- Cascading System of COTS
- SoD Case Study

MBSE for DoD Programs

MBSE is the standard for DoD programs

- MBSE has been an ongoing effort in the DoD for 20+ years
- In other DoD areas (mission planning, supply chain, sustainment) MBSE has a large community of practice.
- Proven successful for systems engineering, managing information flow, and resource utilization on highly complex and large organizations.
- Only recently is this DX strategy flowing down the world of hardware systems engineering and more impactfully test engineering.
- The Document Based Systems Engineering (DBSE) paradigm that has been the staple of test engineering is antiquated and almost wholly incompatible with MBSE workflows



Ready, Set, GO!

DoD Instruction 5000.97 (12/21/2023)

- Programs started after the date of the policy **will incorporate digital engineering during development** unless the program's decision authority provides an exception.
- Programs started before the date of the policy **should incorporate digital engineering**, to the maximum extent possible, when it is practical, beneficial, and affordable.
- Digital engineering should be addressed in the Acquisition Strategy and in the Systems Engineering Plan.
- Digital engineering methodologies, technologies, and practices support a comprehensive engineering program for defense systems.



DoD INSTRUCTION 5000.97

DIGITAL ENGINEERING

Originating Component: Office of the Under Secretary of Defense for Research and Engineering
Effective: December 21, 2023
Releasability: Cleared for public release at <https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/500097p.pdf>
Incorporates and Cancels: Department of Defense Simulation (M&S) M
Approved by: Heidi Shyu, Under Secretary of Defense for Research and Engineering

Purpose: In accordance with the authority in DoD 5000.01, the Department of Defense assigns responsibilities, and provides procedures for development and sustainment of defense systems.



SYSTEMS ENGINEERING & ARCHITECTURE

SUMMARY OF:
DoD INSTRUCTION 5000.97, "DIGITAL ENGINEERING"
PUBLISHED DECEMBER 21, 2023

Purpose

The Department of Defense is transforming its engineering practices to incorporate digital technology and innovations into an integrated, digital, model-based approach. This instruction establishes policy, assigns responsibilities, and provides procedures for implementing and using digital engineering in the development and sustainment of systems.

THE POLICY DIRECTS . . .

- Programs started after the date of the policy will incorporate digital engineering during development unless the program's decision authority provides an exception.
- Programs started before the date of the policy should incorporate digital engineering, to the maximum extent possible, when it is practical, beneficial, and affordable.
- Digital engineering should be addressed in the Acquisition Strategy and in the Systems Engineering Plan.
- Digital engineering methodologies, technologies, and practices support a comprehensive engineering program for defense systems.

Digital engineering transforms DoD systems engineering practice.

DIGITAL ENGINEERING

- Digital engineering supports the systems engineering process by moving the primary means of communicating system information from documents to digital models and their underlying data.
- Digital engineering:
 - Is a critical practice necessary to develop modern, complex systems in an environment of dynamic threats and rapidly evolving technologies.
 - Expands on current engineering practices to take full advantage of computation, visualization, and collaboration.
 - Uses computer systems to develop and manage models for use through all phases of system definition, design, development, test and evaluation, and sustainment.

Digital Twin

A computerized representation (integrated set of models) that serves as the real-time digital counterpart of a physical object or process.

Digital Thread Examples

- Requirements analysis
- Architecture development
- Design and cost trades
- Design evaluations and optimizations
- System, subsystem, and component definition and integration
- Cost estimations
- Training aids and devices
- Development
- Developmental and operational tests
- Product support
- Data

Data management should adhere to DoD Data Strategy goals – make data visible, accessible, understandable, linked, trustworthy, interoperable, and secure.

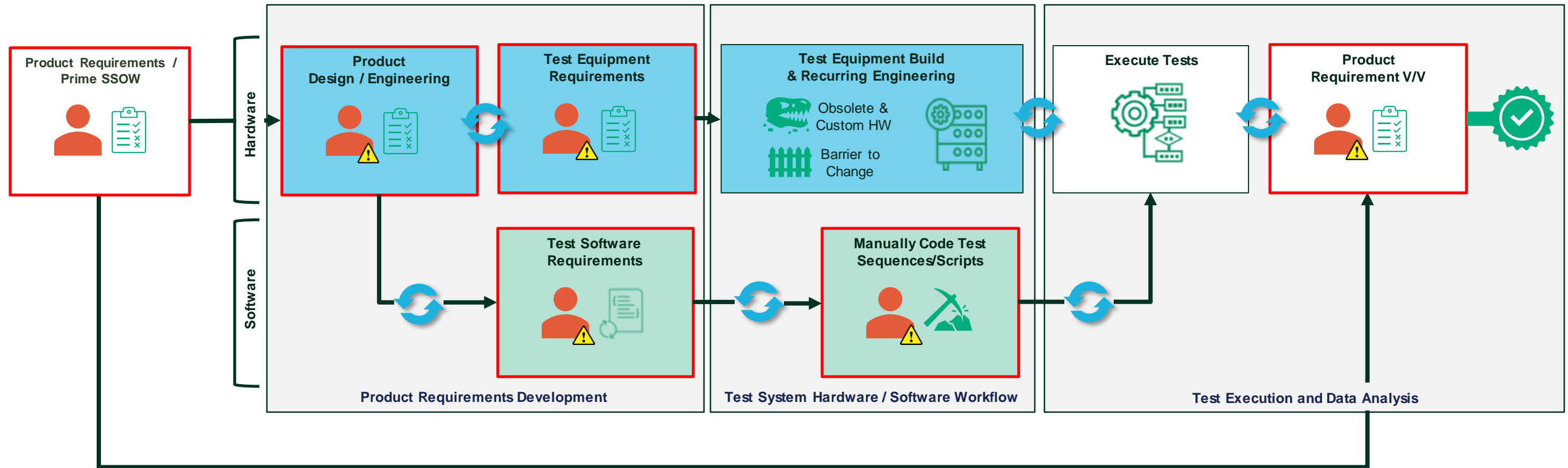
Figure 1. Digital Engineering Framework

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Document Based Systems Engineering

The Status Quo

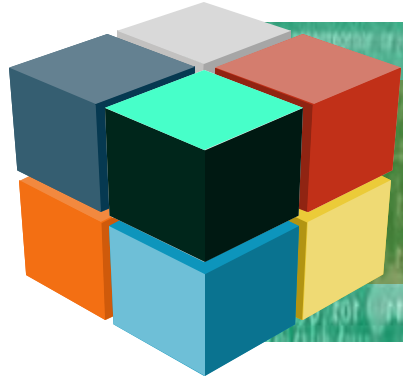
Document Based Systems Engineering (DBSE)



- High direct personnel interaction
- Product design iterations drive additional interaction
- Personnel bandwidth acts as phase gate
- Manual conversion introduces potential for information loss

- Enterprise/Program gating increased across multiple program and product types through shared resources

Models only get you so far...



A Model for a system, unit, and test descriptions does not in and of itself guarantee the desired outcome



To make the most of a model-based description format, automated workflows are required to remove personnel gated tasks and ensure continuous process flow

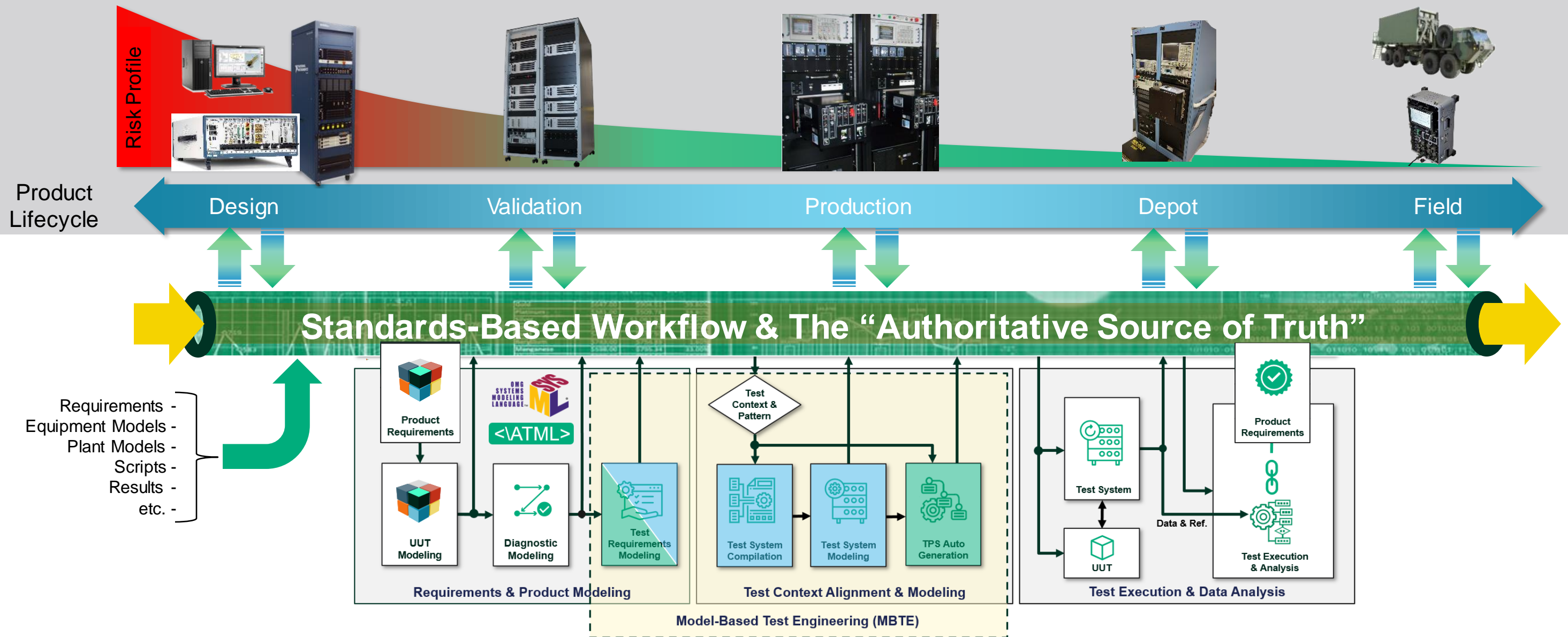


- Configuration Management
- Data Management/Traceability
- Cert/Qual/Communication
- Signal Integrity/Up-time/Debug
- Obsolescence/Lifecycle Management

Internally this is called Model Based Test Engineering (MBTE)

Model Based Test Engineering

Vision of an MBTE Workflow

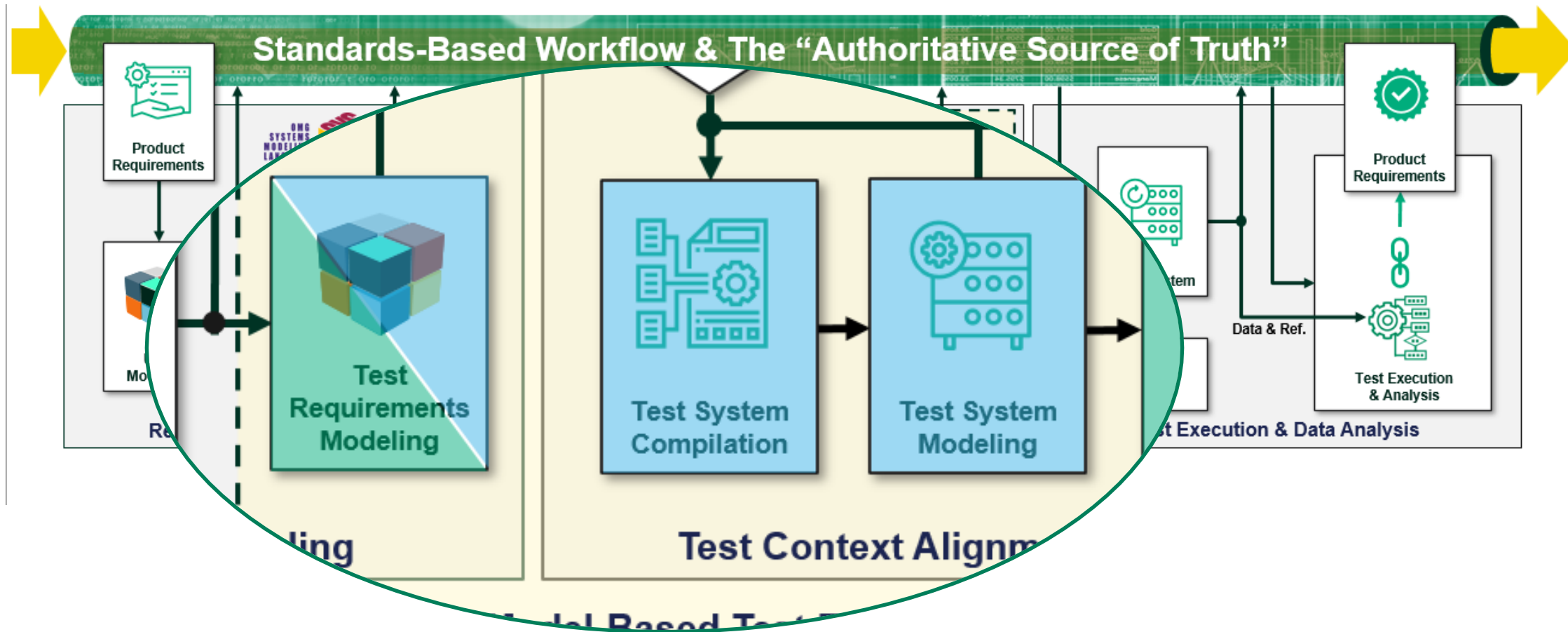


- Requirements flow down through automated tooling and workflow
- Industry standard interchange formats
 - SysML
 - ATML (IEEE 1641/1671)

- Low direct personnel interaction
- Product design iterations trigger automated workflows
- Personnel bandwidth has a low impact on workflow efficiency
- Requirements preserved through digital transfer

- Efficiencies scale across the Program/Product Lifecycle

How do we gain benefit TODAY



The **System on Demand (SoD)** platform provides a major step forward in establishing an MBSE/MBTE enabled test engineering workflow and driving down the cost of test **TODAY**

System On Demand Overview

What is System on Demand?

A modular test system architecture that captures and leverages hardware and engineering investments from previous systems/programs in a cost and schedule efficient manner.

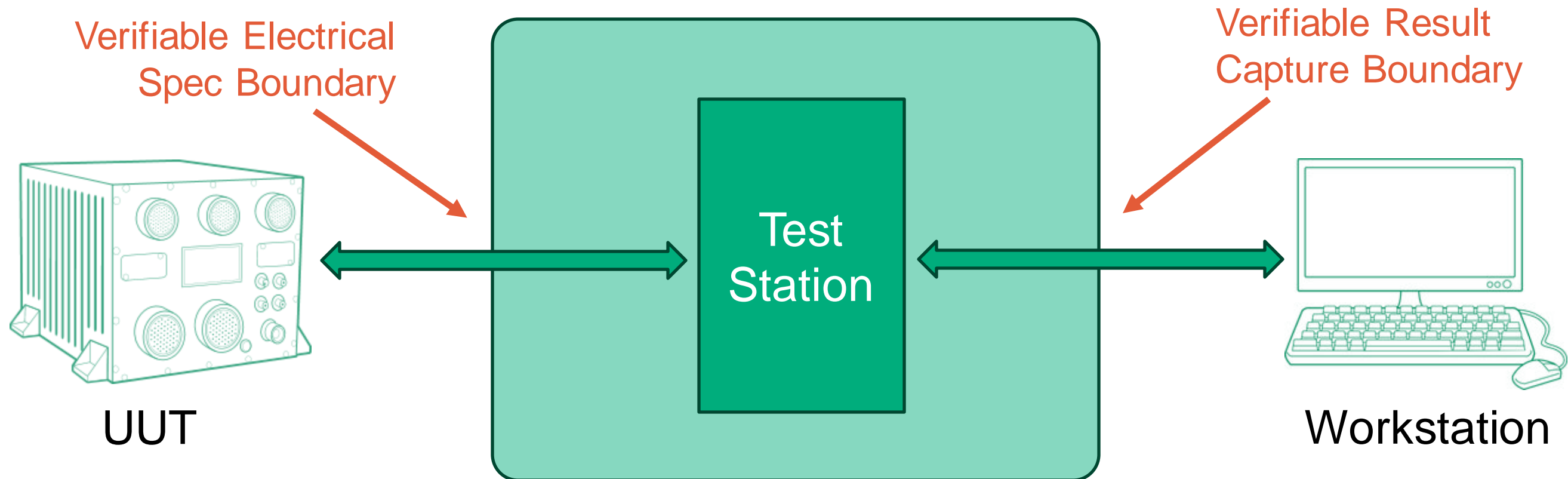
Objectives

- Reduce the total capital spend per program over the entirety of all programs.
- Provide positive ROI within 3 programs with a rapidly decaying per program spend for the life of the architecture.
- Increase the utilization of all test assets and avoid the costs and logistics of maintaining program specific assets over the asset lifetime.
- Provide a tech refresh for aging architectures and instrumentation platforms in the form of COTS platforms from NI
- Reduce the total time required to get test coverage to the pin for each program
- Actively manage technical and schedule risk.

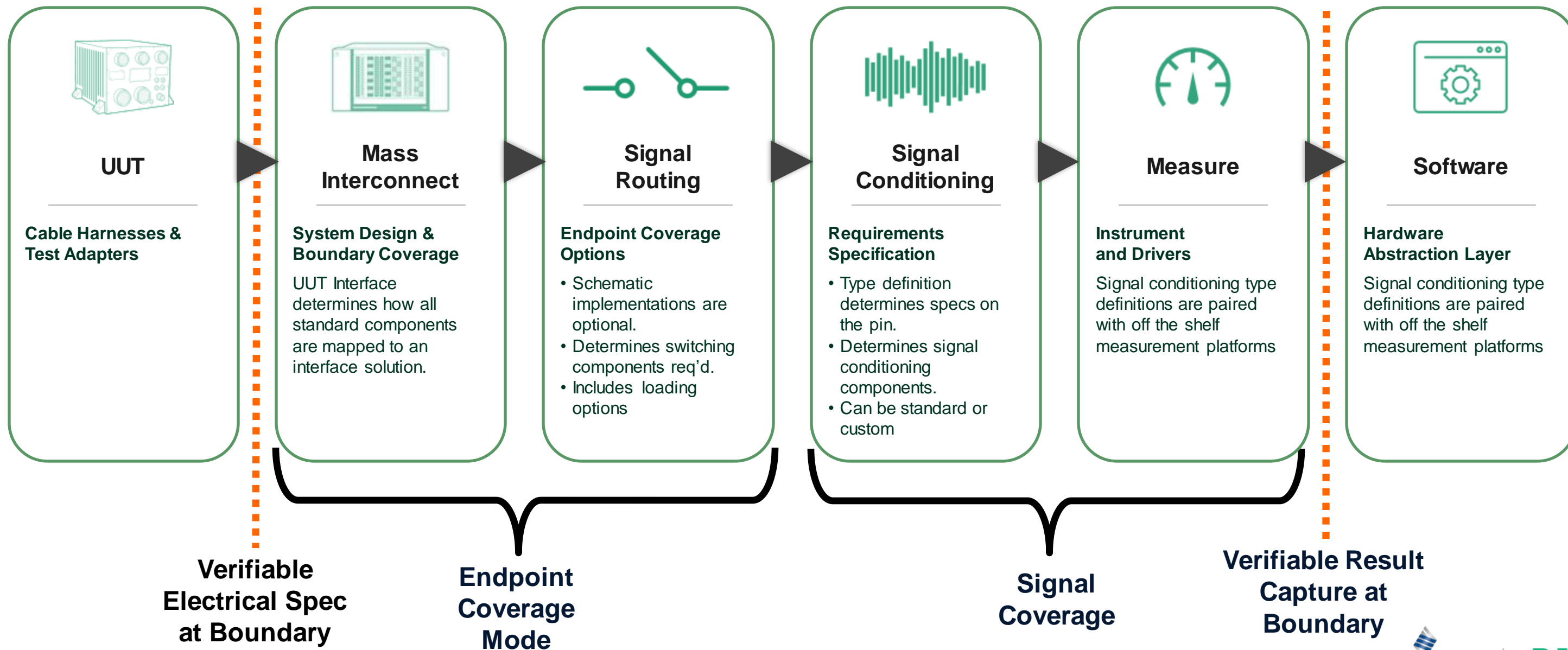
SoD: A new way to think about test systems

What do you really need for test?

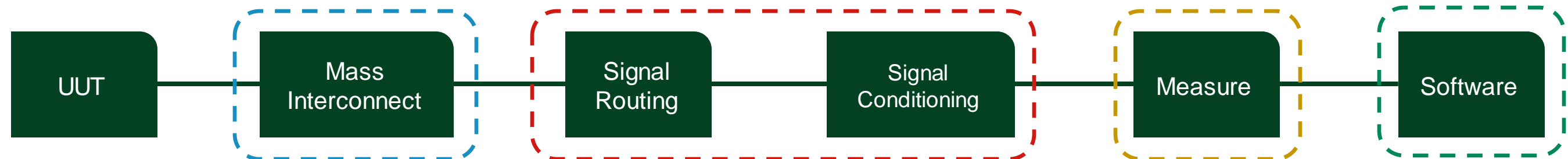
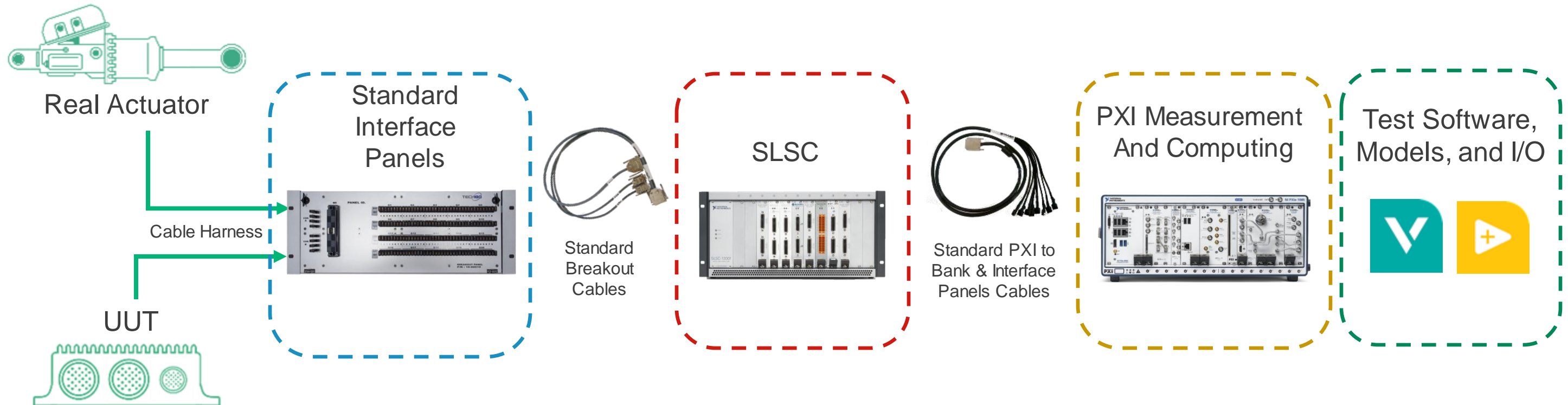
You need **REQUIREMENTS COVERAGE** at verified boundaries



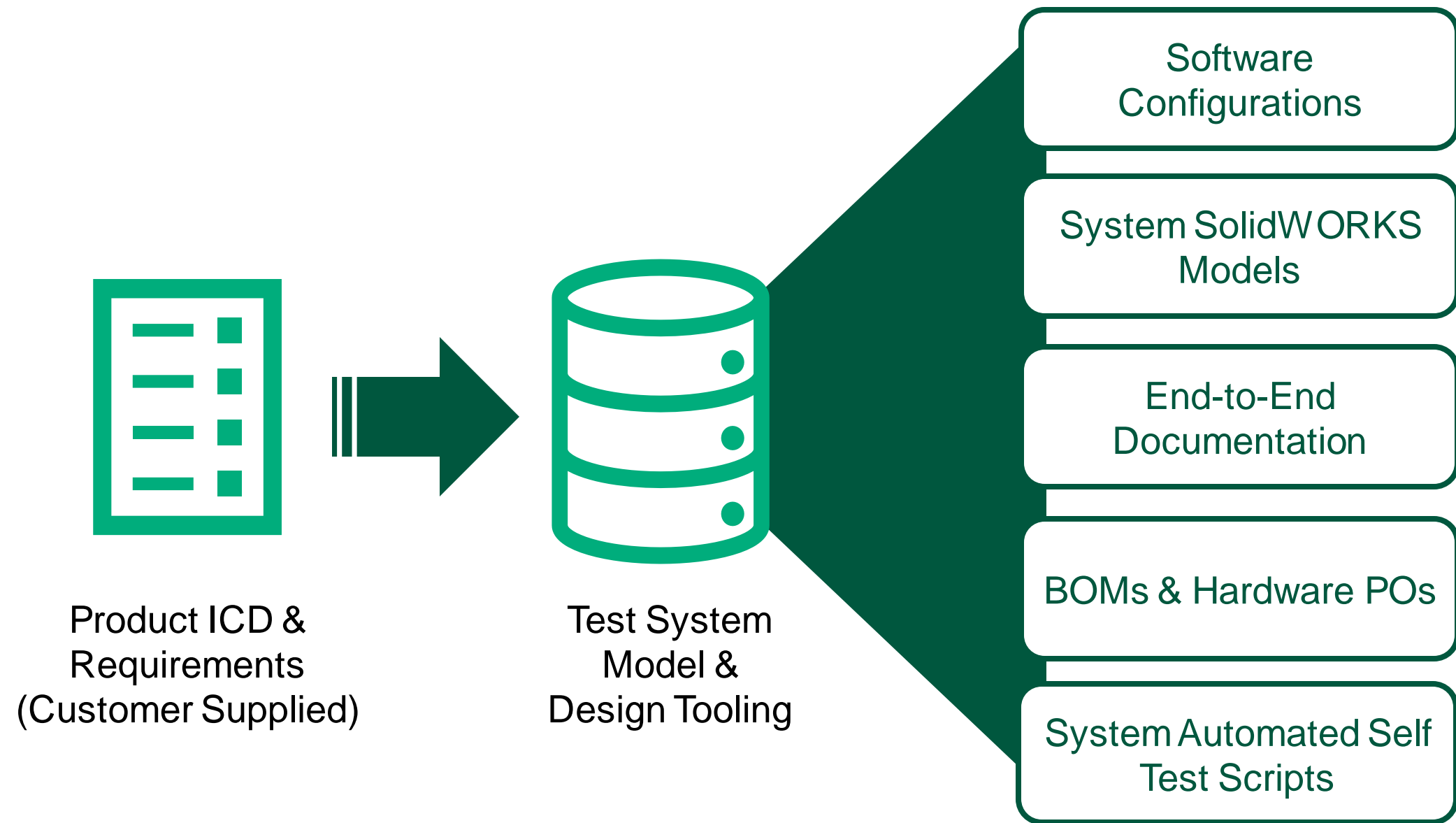
Signal Based Coverage



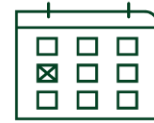
Cascading System of Off the Shelf Components



Automated Workflow



Success by the Numbers



2018

Initial Engagement



6

Core systems delivered



4

System reconfigurations completed



41%

Reduction in V/V system deployment costs



16-20

System delivery timeframe in weeks



100%

Pin coverage for parallel stimulus testing

V&V Test System Costs vs. Project

