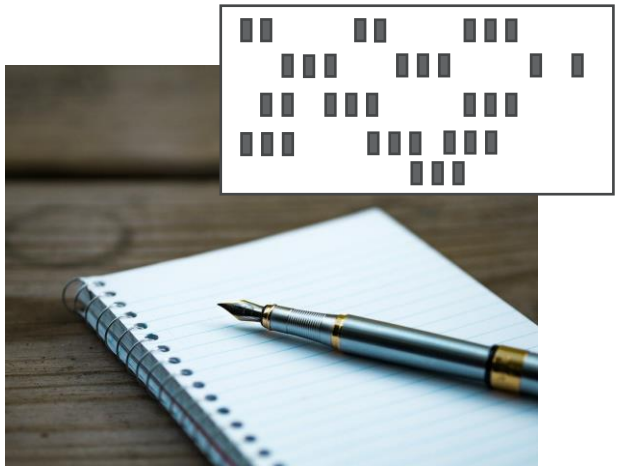
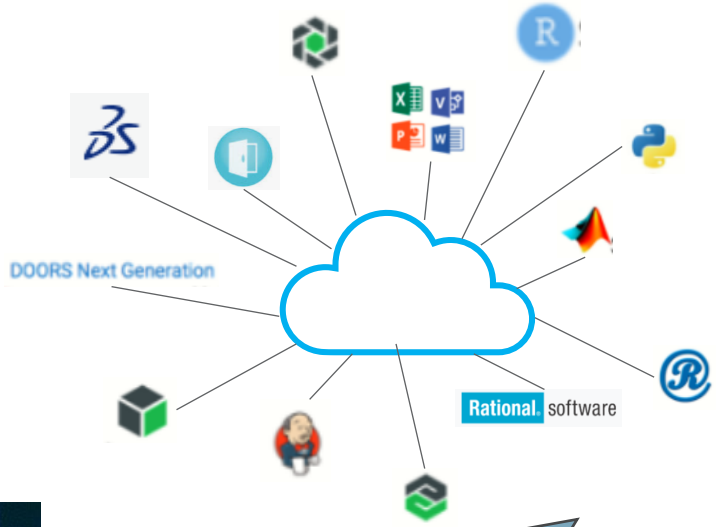
System Test Verification: The Digital Thread Lynchpin Between Systems Engineering Requirements Development and Software Deployment

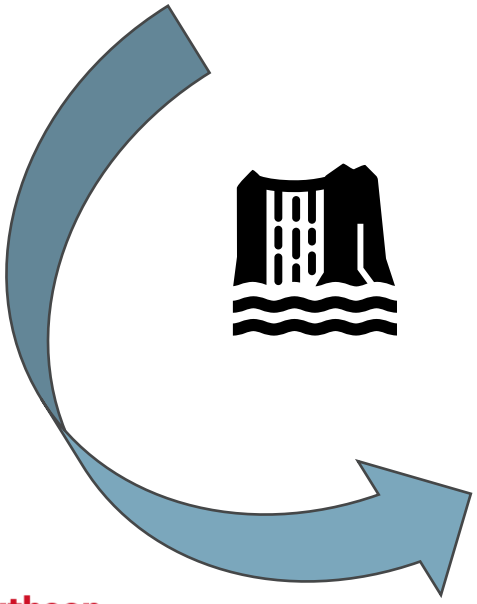
Raytheon Technologies
Yvonne Mok Green

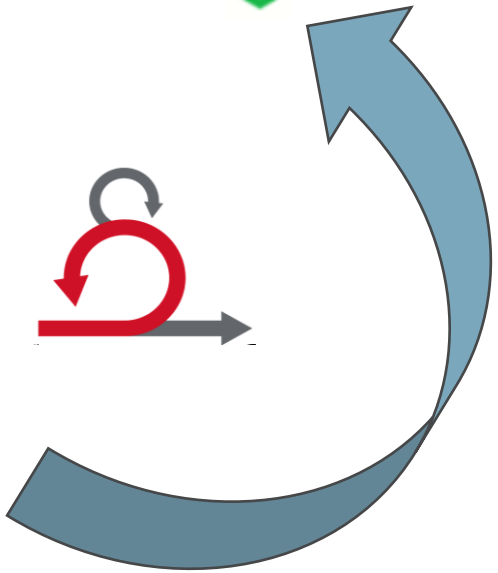
November 2022

Examining our Digital Development Evolution





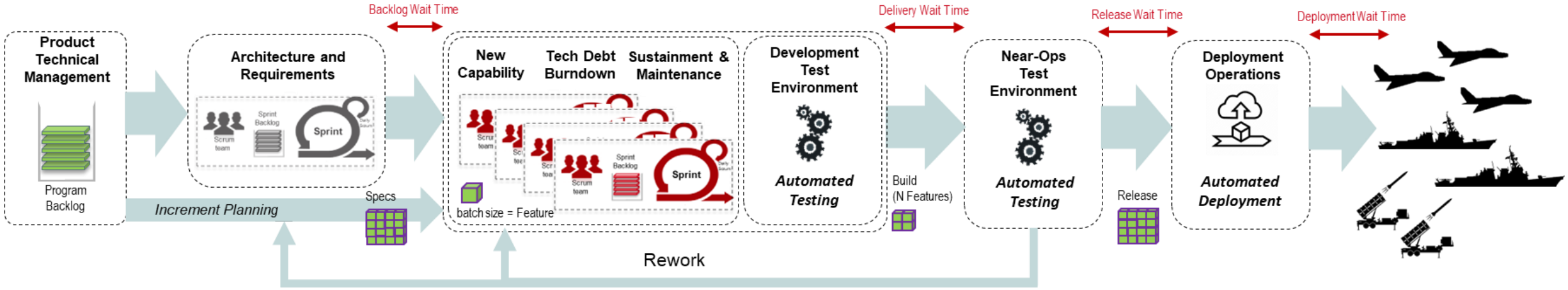




Overview

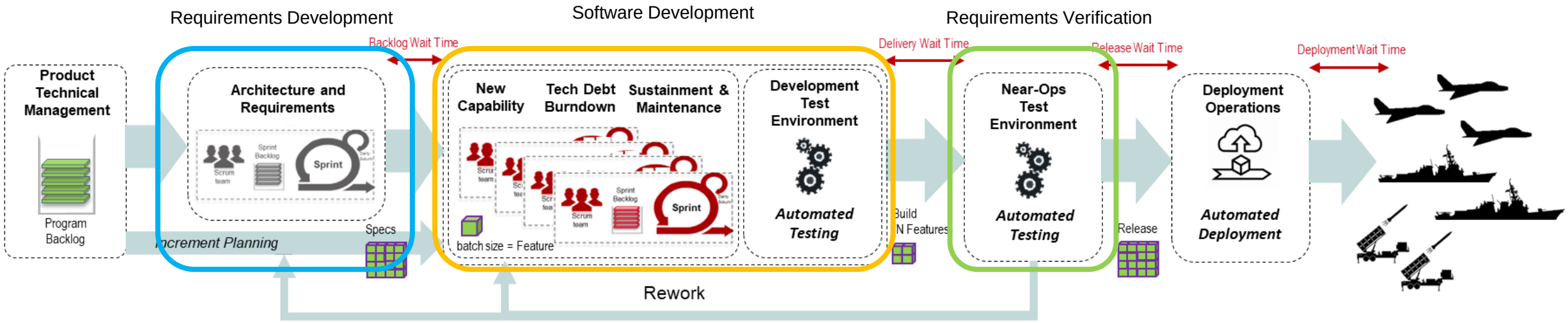
- Development Flow
- Systems Engineering Digital Environment
- Software Engineering Digital Environment
- The Challenge
- Proposed System Test Interaction
- Current Gaps

Development Flow



System Test Interaction has traditionally been the end activity

Development Flow



Water Scrum Fall at play

Digital Environments

Systems Engineering Digital Thread Use Cases focus on:

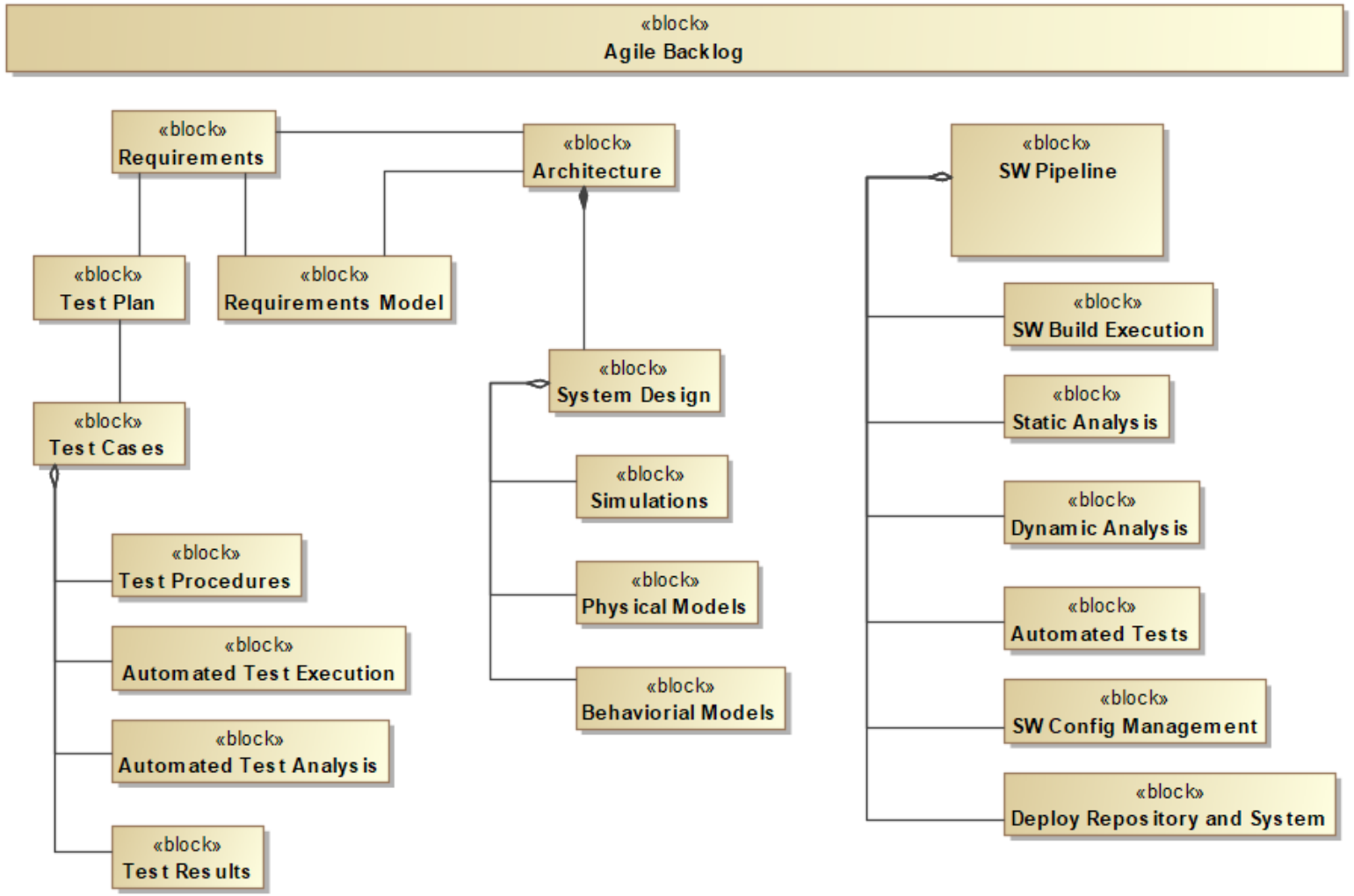
- Architecture
- Requirements Development
- System Design Capture
- Modeling & Simulation
- System Verification
- Reports/Compliance Evidence

Software Engineering Digital Thread Use Cases focus on:

- Compilation & Builds
- Pipelines
- Automation of historically manual processes
- SW Architecture and Design
- Code Analysis & Scans
- Tests
  - Unit, SWIT, Component, Formal Verification
- Software CM
- Software Documentation (e.g., version documents, design documents)

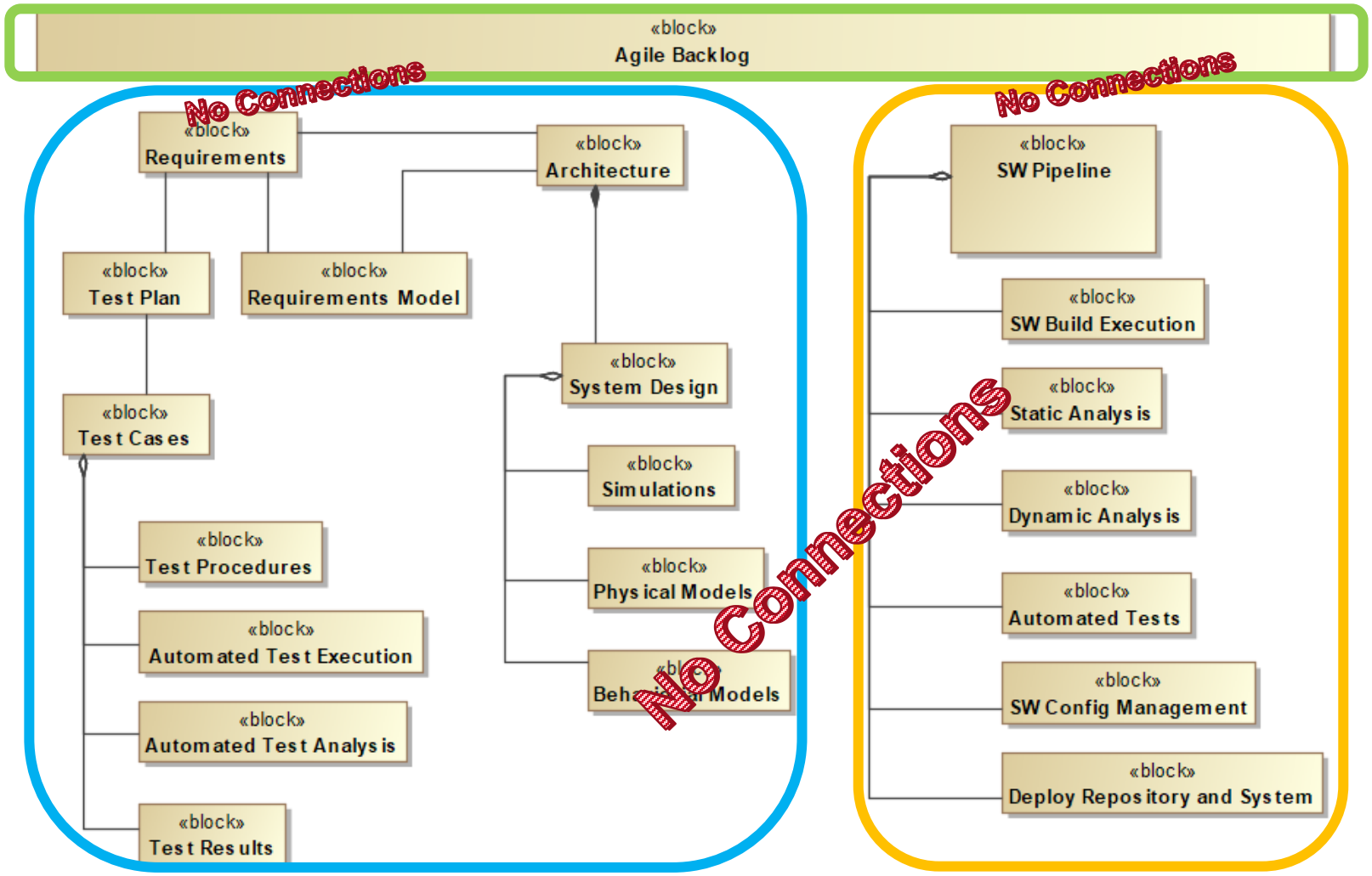
Systems Engineering Digital Threads Connect without Embracing the Software/Firmware Pipeline

The Challenge



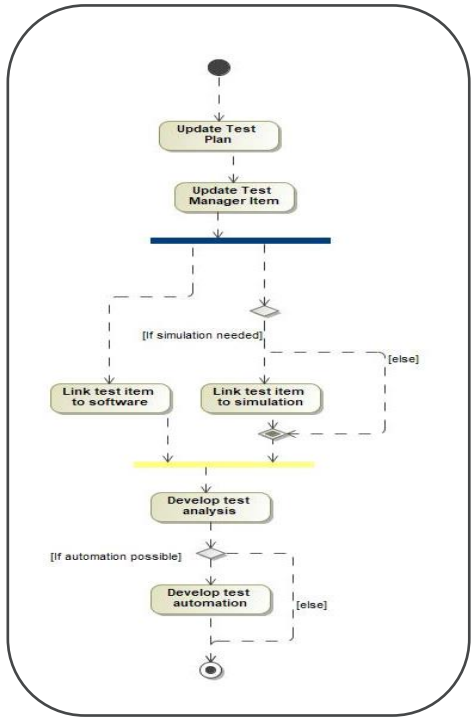
Connections between Systems Engineering Products and SW Factory Are Minimal

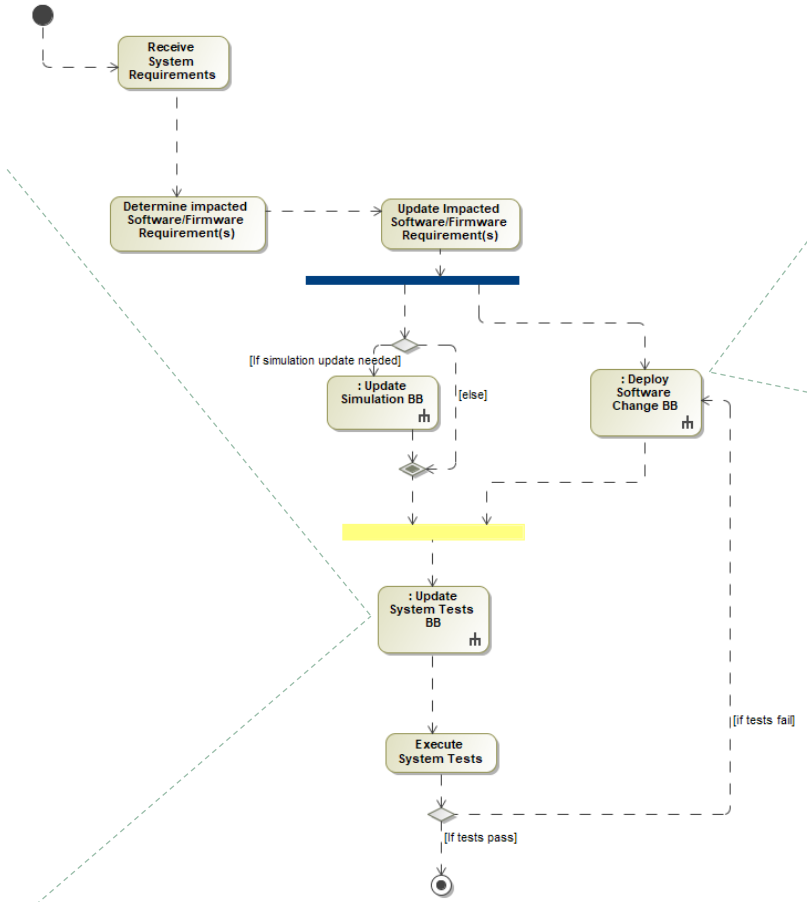
The Challenge

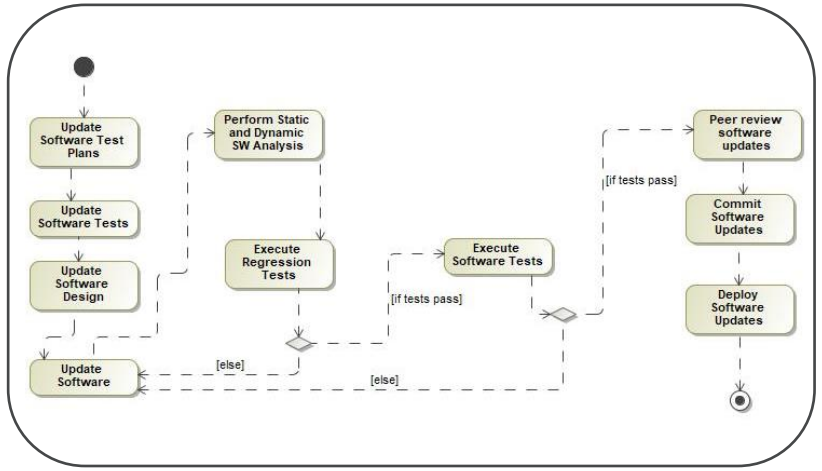


Digital Connections between Systems Engineering Products and SW Factory Are Minimal

Current Workflow



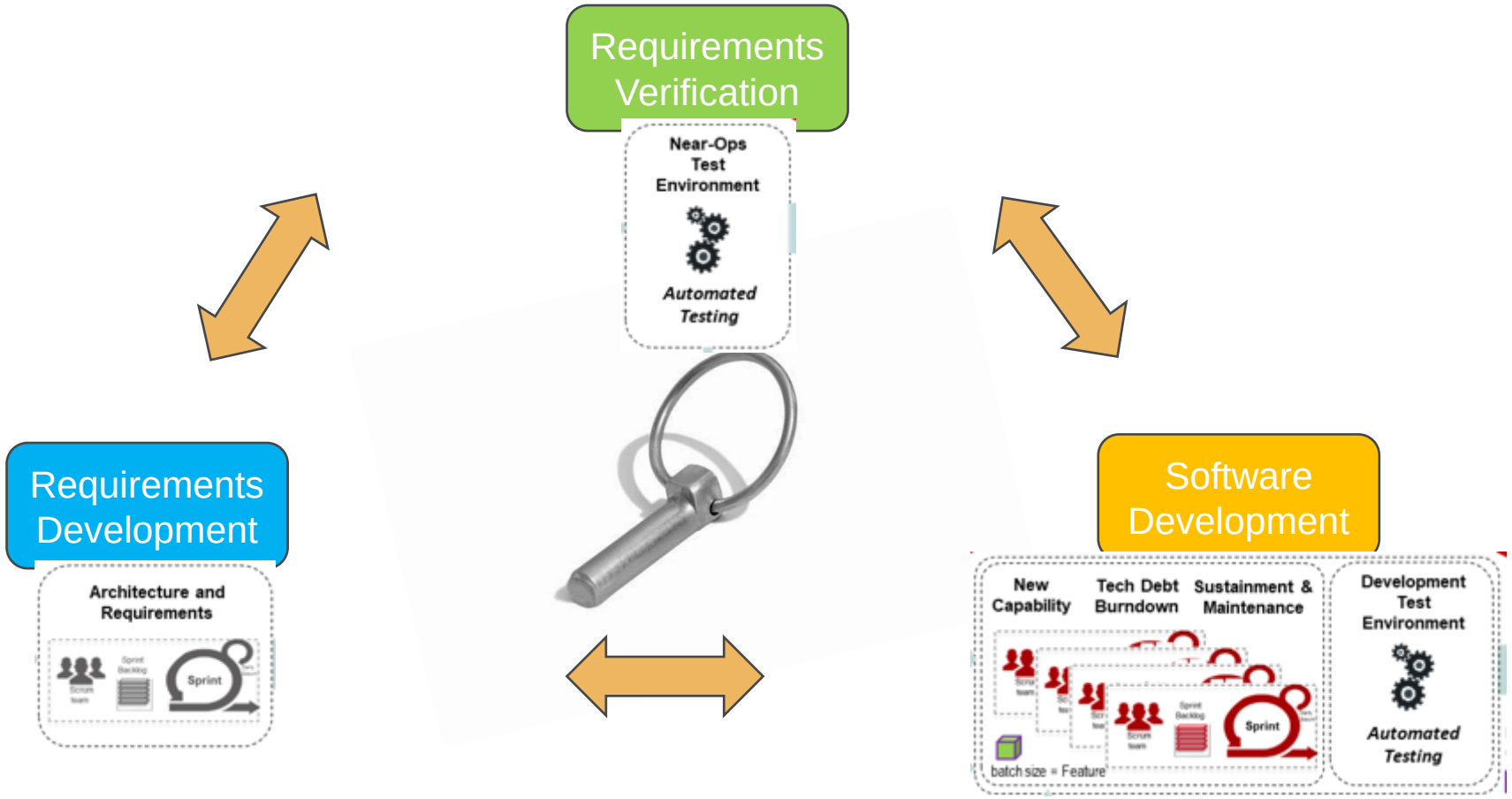




- Independent efforts kick-off for each digital environment without interaction
- Design and Modeling (not shown) may also be performed in parallel with software implementation and test development

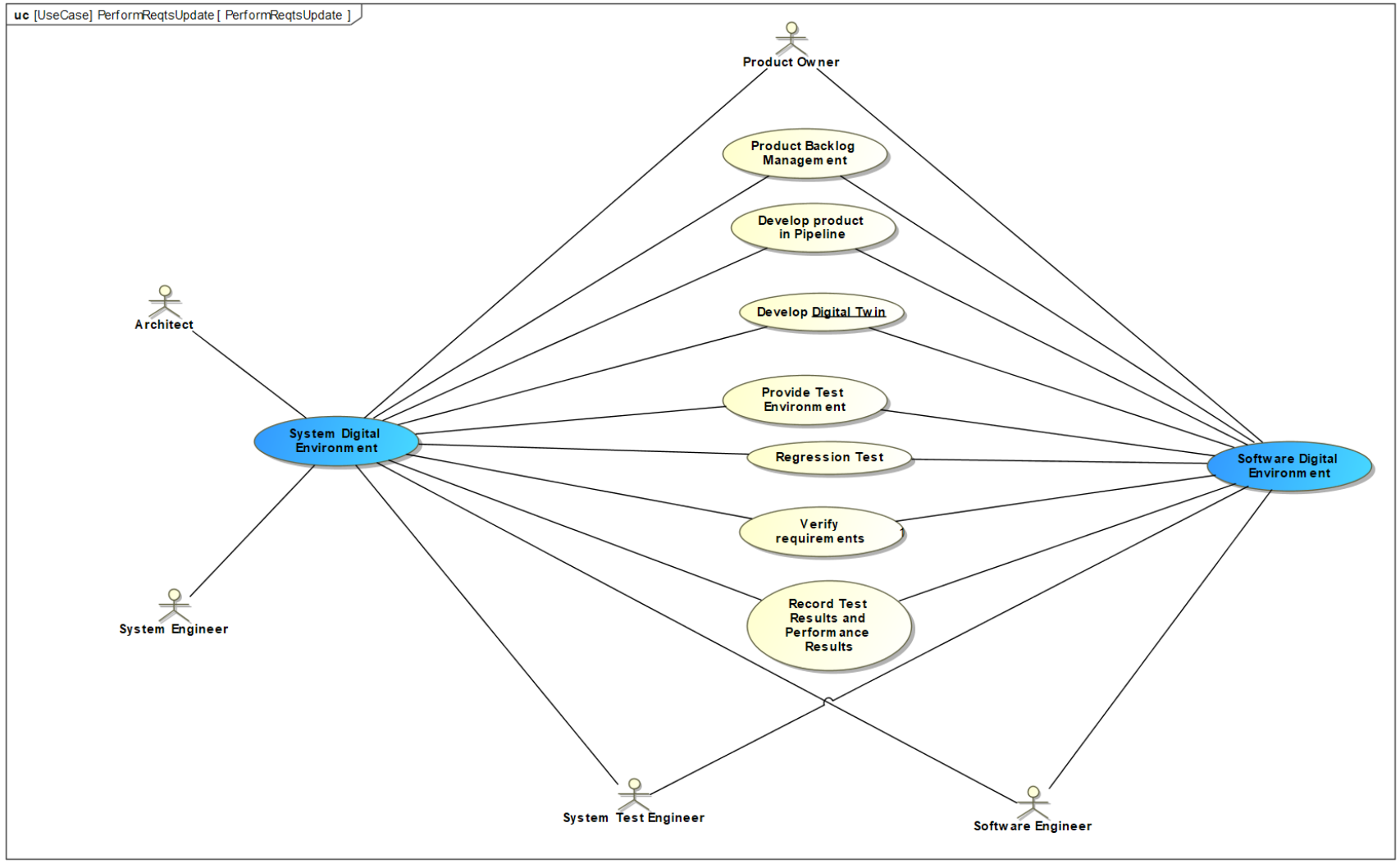
Silo'd by function approach to end-to-end product development

Proposed System Test Interaction



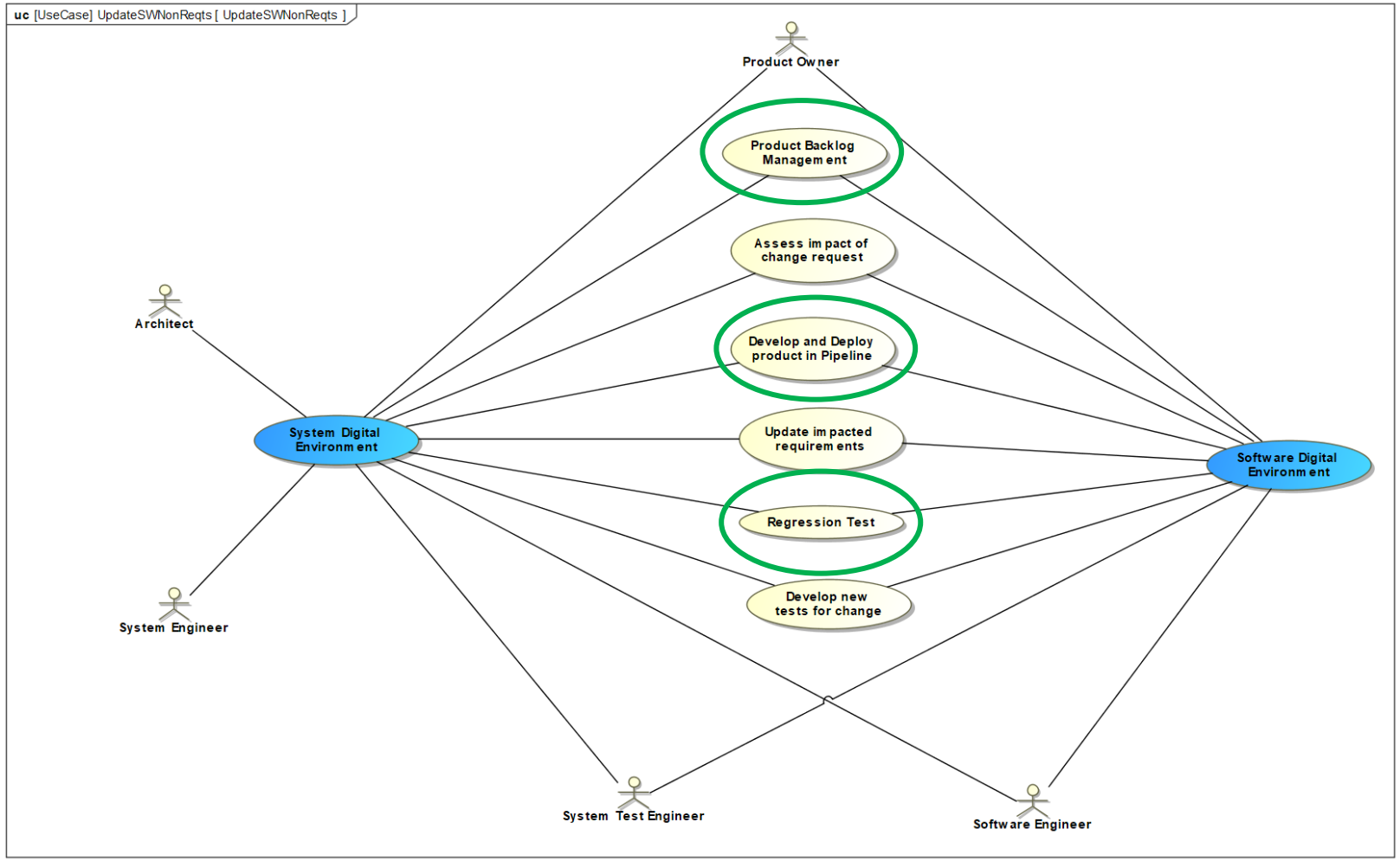
System Test is targeted as an upfront activity with continuous interactions with Requirements and Software development activities

Coordination Across Digital Environments



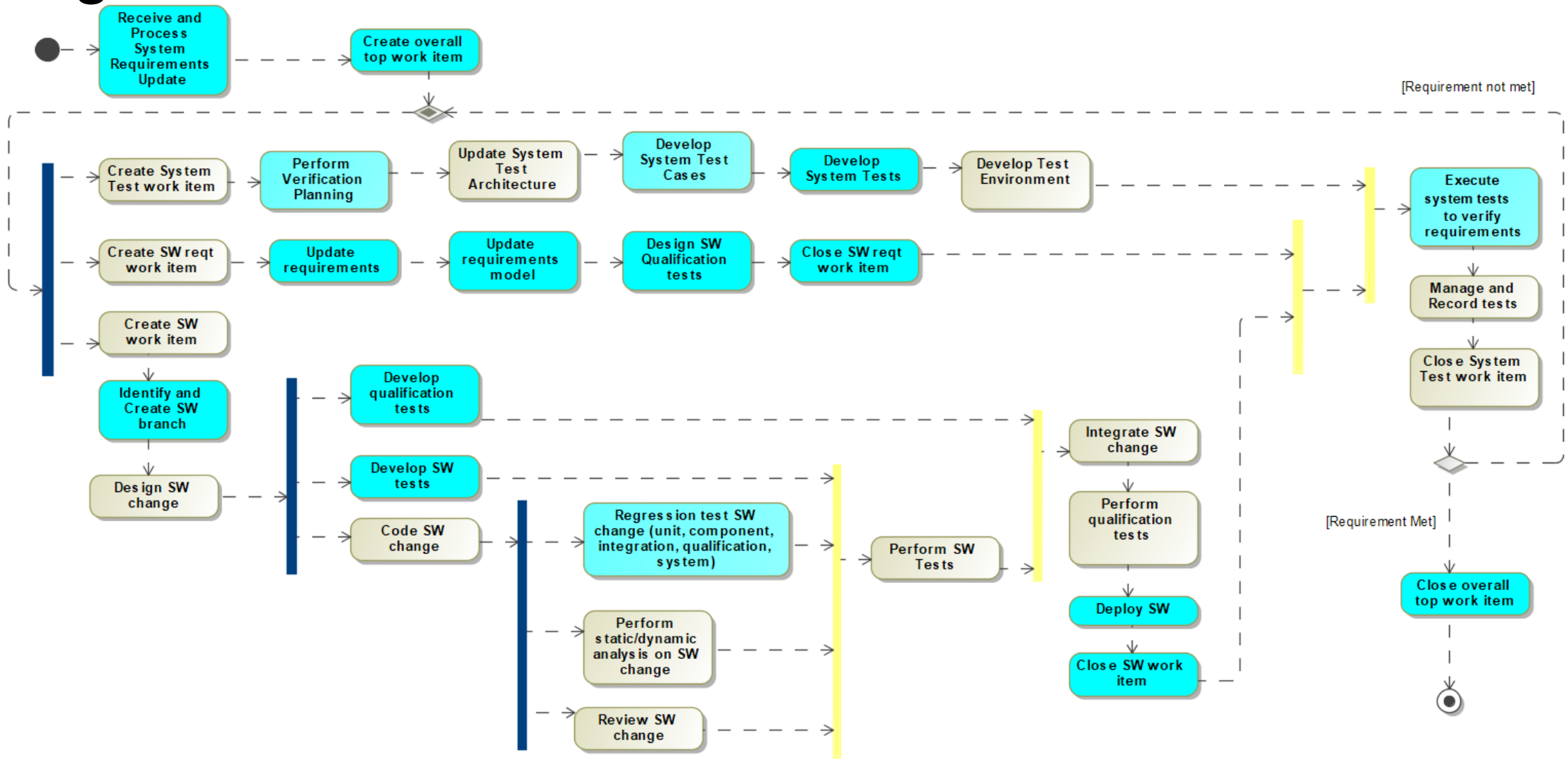
Integrating Digital Efforts Supports Rapid Integration, Product Line Development, and Improved Reuse

Coordination Across Digital Environments

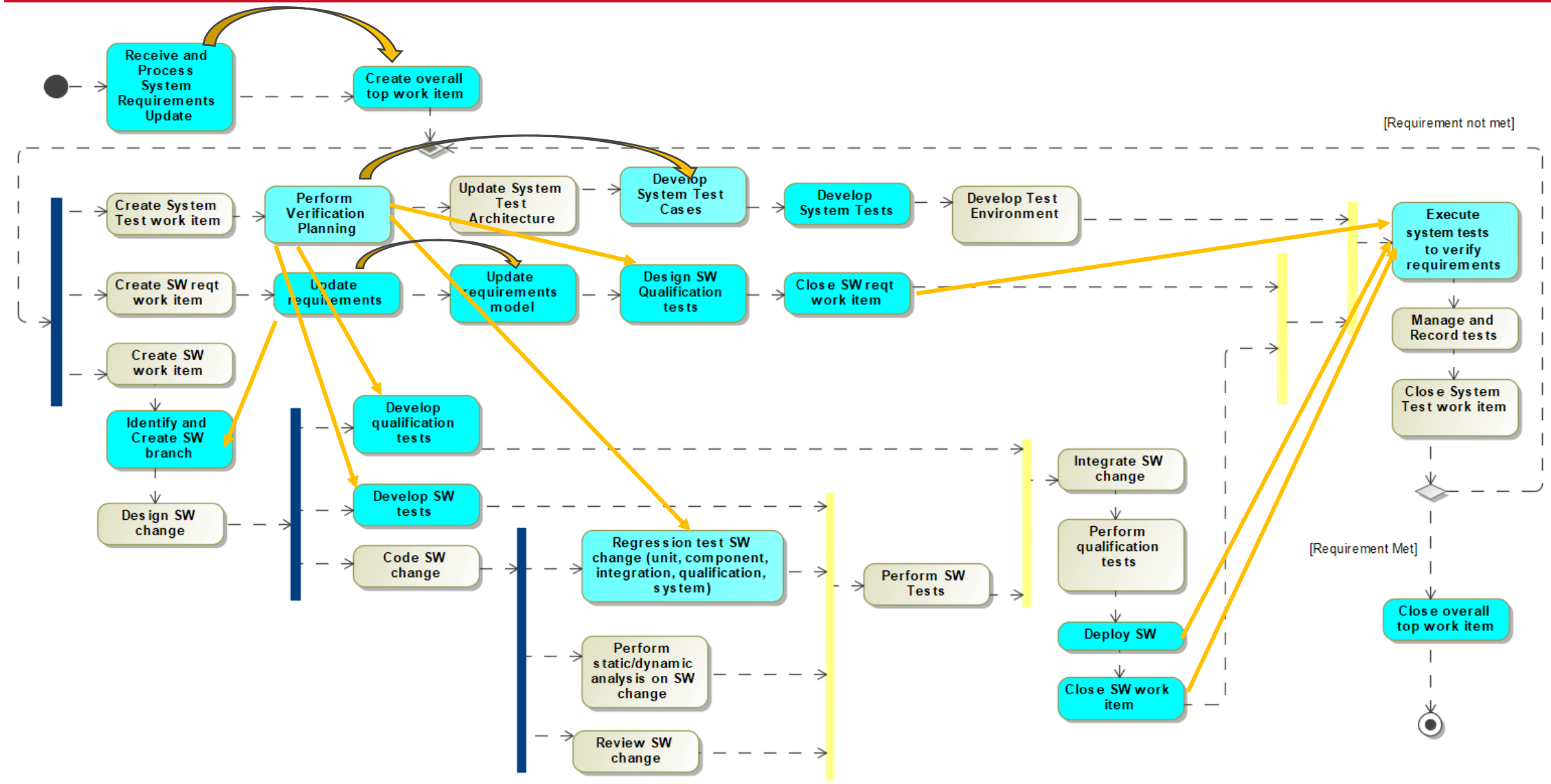


Integrating Digital Efforts Supports Rapid Integration, Product Line Development, and Improved Reuse

Target Workflow



Design the System Tests before deployment of the product



Tool Data Connections for a Tool Digital Thread

Current Gaps

- Many tools are not directly linked to other tools.
  - Some are due to being in the same family of tool suite.
- Hub tools exist to be explored (e.g., SBEVision, eQube, Syndeia)
  - Some use link protocols.
  - Some use data cloning.
- Not all data connections are needed.
  - Strategic connections need to be identified with associated value.
- Some processes can involve multiple tools. Some processes have multiple tools as options.
  - Choose wisely: Identify tool feature criteria.

More investigations still needed

Thank you.

Yvonne Mok Green

- Yvonne Mok Green is a Raytheon Technologies Senior Manager in Software Engineering. She graduated from Worcester Polytechnic Institute with a Bachelor of Science and Master of Science in Computer Science. She is a Registered Scrum Inc Product Owner and Scrum Master, and a Registered Scrum Inc Trainer and Agile Coach. Yvonne has 17+ years of experience in Sensors software development on radar programs, internal research and development projects and corporate initiative programs within the Raytheon Missile Defense business unit. Currently, Yvonne is contributing to the RMD Digital Transformation (DTx) Digital Product Development (DPD) Architecture and is Raytheon Certified Architect Program trained.

Abstract

As customers embrace and demand Dev*Ops execution, the habits of waterfall silos between Systems Engineering requirements development and Software Engineering product deployment have begun to change. There is recognition that the throw-over-the-wall approach is ineffective and inefficient. The movement towards an iterative coordination with immediate feedback involved is accelerating both with the customer and as a part of execution across Raytheon Technologies.

At the same time, the digital thread of how products are delivered including the workflow of requirements development through software deployment is gaining increased focus. While the processes of Systems Engineering and Software Engineering collaboration have evolved, some aspects remain manual, especially when code generation from models are not in use.

Our customers expect verification of the System Requirements. The System Test verification process acts as one lynchpin to connecting the digital thread from System Engineering requirements development to the Software Factory product delivery. This area has not been leveraged significantly but may be the most powerful leverage point.

In this presentation, we will discuss why the digital thread connection is important and how System Test verification is a major player in the thread, even though waterfall has pushed off its up-front pipeline relevance for too long. We will discuss how the digital thread connections can be made and how those connections can be leveraged to improve both the Digital Engineering Environment and Software Pipeline. While tools are important to make the connections easier, this presentation is not focusing on tools recommendations, but rather key characteristics that tools can provide to make development easier.

Abstract (abridged)

As customers embrace and demand Dev*Ops execution, the digital thread of how products are delivered including the workflow of requirements development through software deployment is gaining increased focus. The System Test verification process acts as one lynchpin to connecting the digital thread from System Engineering requirements development to the Software Factory product deployment. I will discuss why the digital thread connection is important and how System Test verification is a major player in the thread, even though waterfall has pushed off its up-front pipeline relevance for too long.