Adapting Systems Engineering from Waterfall to Agile

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Enlightened Integrated Program Management

Agenda

- Background – Set the Context
- Issue Description
  - Historical Systems Engineering Practices Are Bulky
  - Is SE obsolete in today's rapidly changing environment?
- What are we doing ab out it?
  - Working with the National Defense Industry Association (NDIA) and the US DoD to document a potential migration path to a true Agile mindset.
  - Move from predictive planning to empirical planning
  - Adapting systems engineering life cycle on iterative and incremental development

Background

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- Technology Enabled Market
- Commercial Need
  - Competitiveness (First to Market, Adapt to User desires, real time sustainabili
  - Applications
    - Cell Phone, Video Streaming, Business collaboration, Enterprise business systems
    - Supply Change Management.
- Government Need
  - Stay ahead of the adversaries (Real time threat adaptation)
  - Applications
    - SW Intel, Enterprise systems, Command and Control, …
    - Integrated Hardware and Software Systems.

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Traditional vs Typical Agile Process

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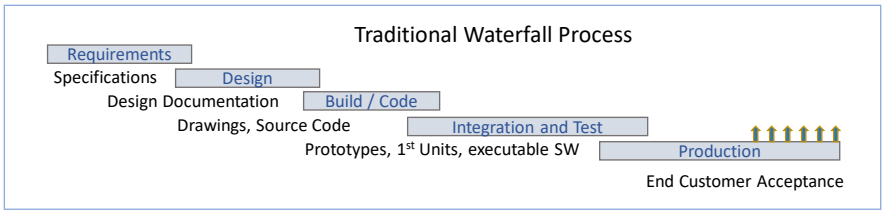
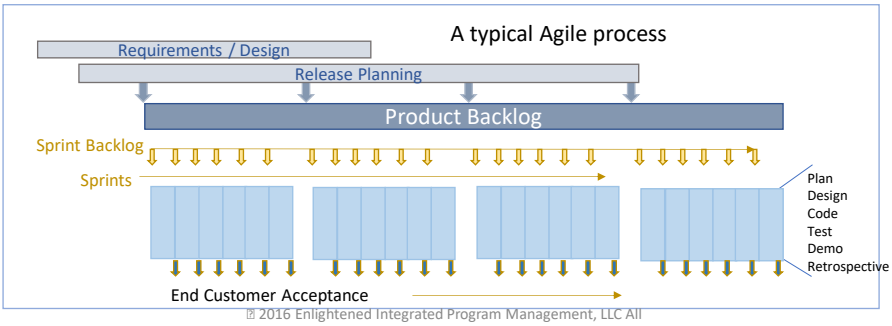
Predictive Planning



Empirical Planning



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IEEE Std 15288.2-2014
IEEE Standard for Technical Reviews and Audits on Defense Programs

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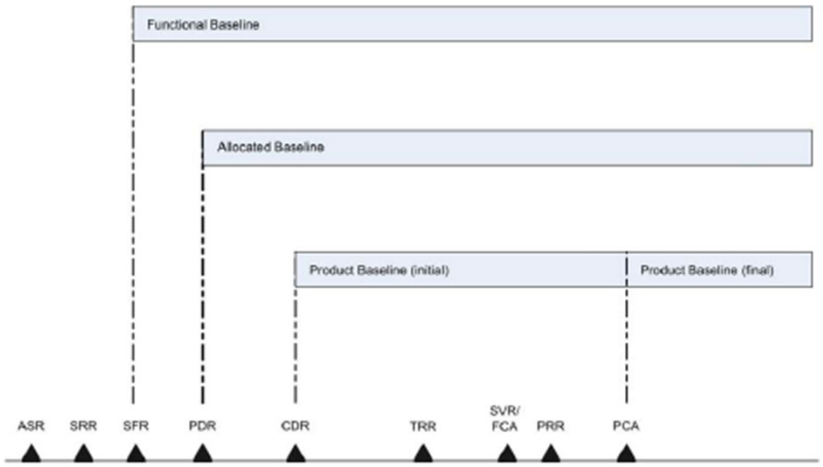

Figure 1— Relationship between technical reviews and audits and the technical baselines across the acquisition life cycle

Traditional Systems Engineering Life Cycle

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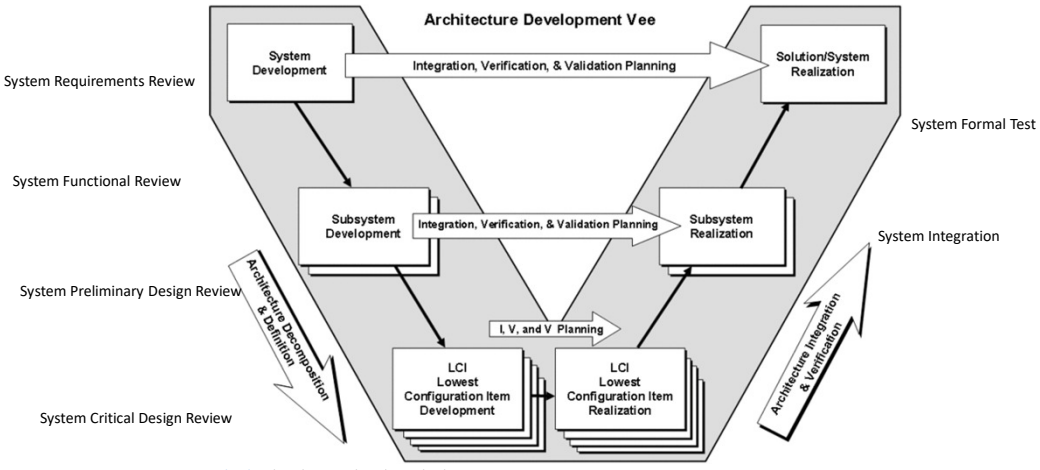

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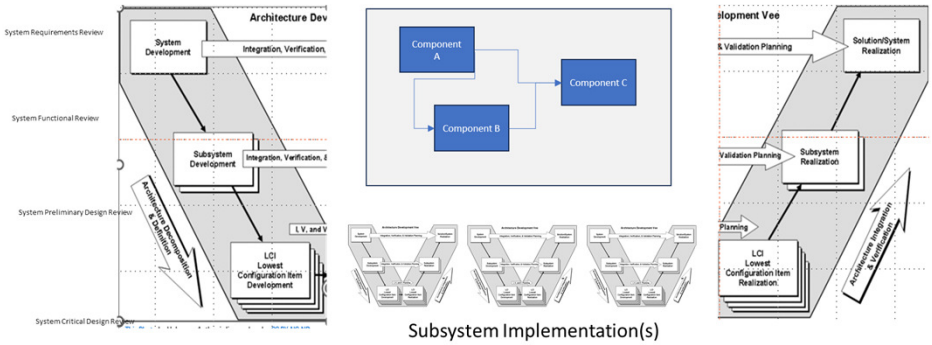
Traditional Development Abstraction



Subsystem Implementation(s)
(Build, Integration, Test)

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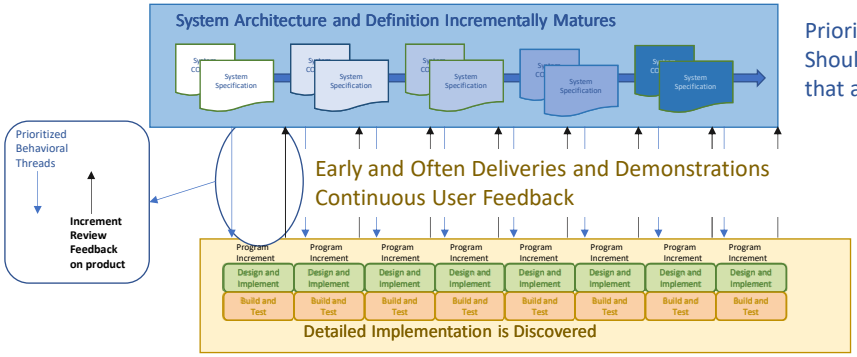
Agile Development Lifecycle

Architectural runway: What documentation is required/desired? How do you maintain? How related to Detailed Product Backlog?



Prioritized Behavioral Threads: Should represent end user behaviors that are not variable?

How the behaviors are implemented is what changes based on user feedback against the behavioral threads.

Design and Development Documentation Generated Incrementally
What is this documentation? Functional and Product Specifications? Development and Maintenance Documentation?

Issue

- Systems Engineering Processes steeped is predictive in nature
  - System Designs and documentation done before anything is built
  - Stems from long lasting culture documented in Industry and Defense Standards
- Changes in need are too rapid to benefit from lengthy processes
- New philosophy is to deliver at the “speed of need”
- Current Agile implementations often jump to quickly into implementation
- Early technical planning and documentation still necessary but not being done.

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DoD and National Defense Industrial Association (NDIA) Collaboration

NDIA

Integrated Program Management Division

An Industry Practice Guide for Agile on Earned Value Management Programs May 26, 2019

Department of Defense Agile and EVM: A Program Manager's Desk Guide - Nov 2020

Early planning Agile Working Group

Systems Engineering Division

Agile Delivery for Agencies, Programs, & Teams (ADAPT) Working Group

Facilitate Industry-Government interaction across policy, acquisition/contractual, product engineering, solutioning, and delivery by continuously improving the implementation of Agile practices to meet business outcomes.

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What is the Future State - Leverage

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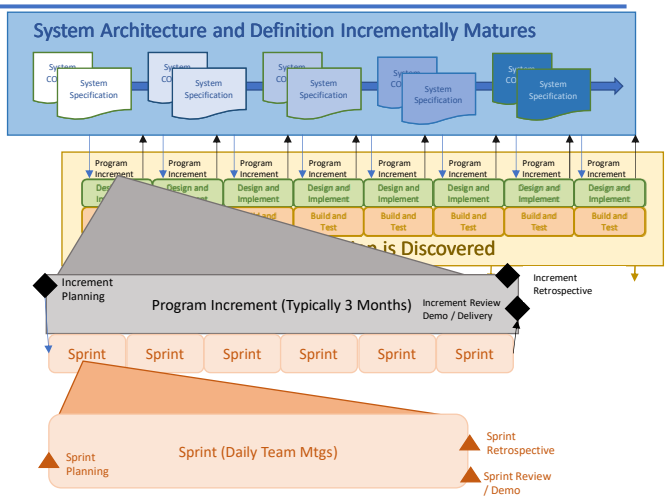
Agile methods drive a continuous planning, execution, and progress measurement process.

- Risks, User Need / Feedback, Technical Scope incrementally reviewed and planned.
- **Product Roadmap** provides big picture overview
- **Increment**
  - Increment planning
  - Increment Review
  - Demo
  - Retrospective
- **Sprints**
  - Sprint Planning
  - Daily Status Updates
  - Sprint Review
  - Demo
  - Sprint Retrospective



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Systems Engineering Life Cycle

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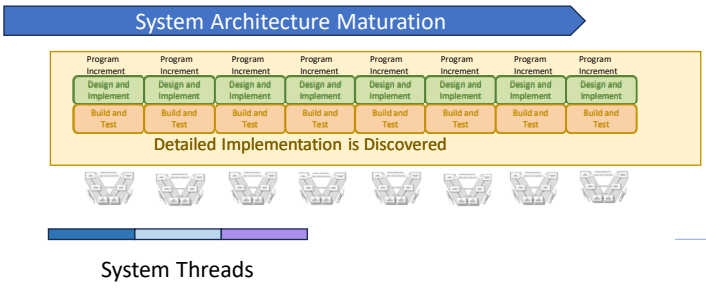
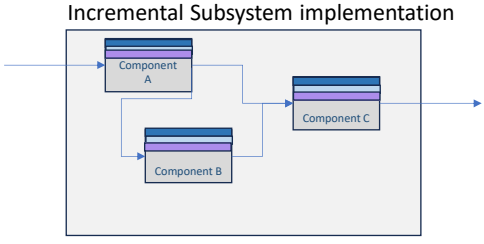


System / Sub-system Implementation
Each Increment implements an end-to-end system behavioral thread

Incremental Subsystem implementation



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Steps to Consider for Migration

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1. Establish a shared technical vision.
2. Define Key Events and decision points.
3. Perform Essential Capabilities Decomposition.
4. Develop a Product Roadmap.
5. Define the approach for incremental system verification.
6. Establish a collaboration environment.
7. Rolling Wave Planning - Move from predictive to empirical planning.
8. Define the program's organizational structure.

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Considerations for Migration to Agile

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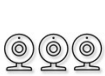
- Shared Technical Vision
  - Document Mission Objectives and Critical System Behaviors –Non-Fungible
  - The mission objectives and these key events will be used to gauge the progress of the system implementation.

Objectives:
- Launch and Recovery UAV
- Identify, Locate, and Adversary Activity
- Evaluate and identify potential threat
- Provide real-time warning of potential threat

Set of COTS UAVs
- Competitive bid against a set of technical specifications.
- Modified to host variety of modular sensors, developed by other subcontractors.
  - Air Vehicle Contractor selected and paid to modify payload interface to common modular payload Interface
  - Range
  - Speed
  - Rel Avail Maintain requirements



Develop, Build, Test, and Deliver Modular Sensors
Sensors: includes sensor and interface to UAV downlink
Full HD Resolution
Ability to Zoom
Technical Trades: Weight, range, chem sensor sensitivity.

Portable Ground Control Station
- Develop, Build, Test, and Deliver Portable GCS.
- Ruggedized computer
- SW application to control all UAVs
- SW application to gather and interpret sensor data
- Environmental Requirements
- Two Man Lift
- Dimensions
- Reliability Availability Maintain Requirements

Define key events and decision points

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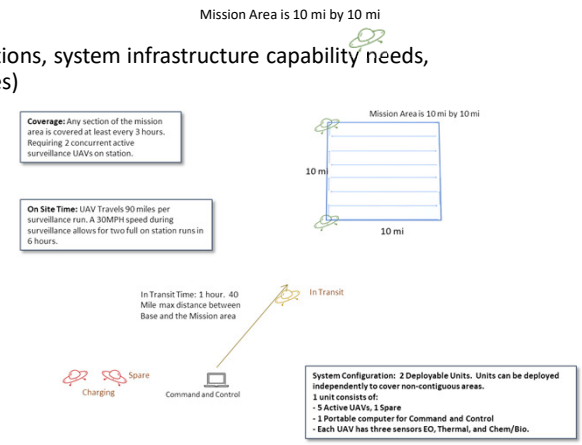
- Hardware and Software integration points, demonstrations, system infrastructure capability needs, Integration with external systems, and system deliveries)
- Used to define implementation priorities
- Examples
  - UAV First Flight
  - Command and Control Communications Demonstration
  - Support Joint Operational Live Demonstration
  - Graphic representation of sensor correlation
  - Initial Operational Capability Delivery



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Perform Essential Capabilities Decomposition

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- Objectives:
  - Identify and Locate, Adversary Activity
    - Electro-optical surveillance – Daytime identification and location of adversary activity
    - Thermal IR surveillance – Night-time identification and location of adversary activity
  - Evaluate and identify potential threat
    - Identify potential chem / bio threat – User awareness of potential threat
    - Classify type of threat – User understands avoidance techniques
  - Provide real-time warning of potential threat
    - Provide notification to user of specific threat – User takes evasive action

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Considerations for Migration to Agile

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4. Develop Product Roadmap
   - Map Capabilities to Product Roadmap (More detail (features) in near term).
   - Key events and decision points help establish implementation priorities
   - MVP and Next VPs established and shown on roadmap

Considerations for Migration to Agile

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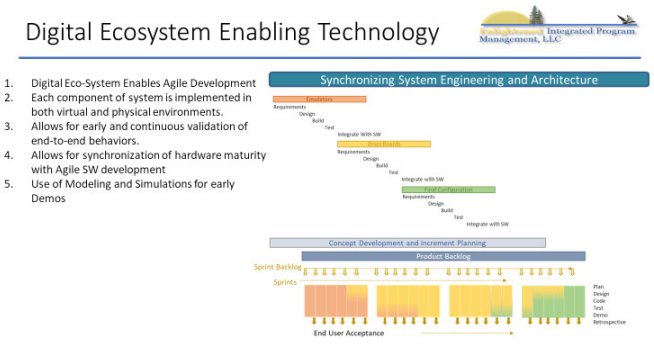
5. Incremental and early system verification process
   - Digital Eco System used for system verification
   - Early and often user feedback and acceptance
   - Clear process must be established Up front

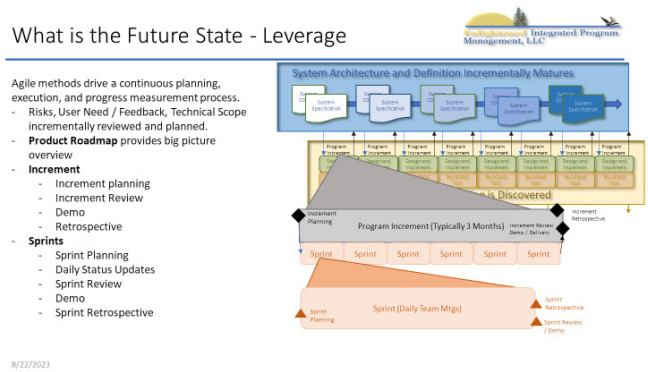


Considerations for Migration to Agile

5. Collaboration Environment
   - Not a new concept – However PMO and User(s) participation in environment likely is
   - Required to keep Agile teams in sync
   - Process for continuous update must be defined

Iterative and Incremental Planning Process

- Agile processes demand a continuous planning and review process
  - Sprint Planning and Review
  - Increment Planning and Review
  - Release Planning and Review
- Monthly reporting must be tailored to leverage Agile best practices.



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Considerations for Migration to Agile

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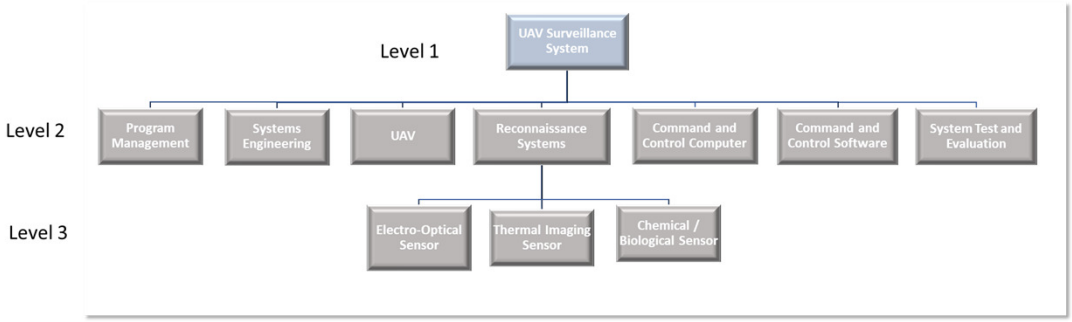
8. Agile organization
   - Current programs tend to be Product oriented with supporting SE, PM, Test



Considerations for Migration to Agile

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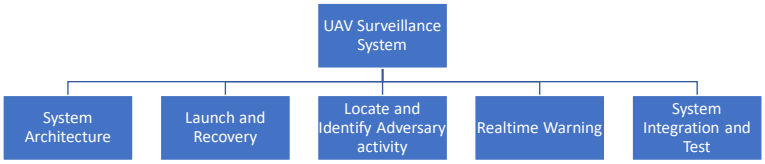
8. Agile organization
   - Consider organizing around value streams (operational behavioral threads)



Summary

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- System Engineering is required as part of the Agile life-cycle
  - Provide the technical vision, priority, and big picture direction of the program
  - Maintain and update the technical architecture as the system implementation is discovered
  - Establish and set up collaboration environment.
- Traditional SE methods must be transformed
  - Definition and decomposition of end-to-end behavioral threads
- Take – Away – Not only is Systems engineering still required it is even more important in an Agile environment

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