

Digital Disruption: New Business Models that Leverage Technology

Disruption is Happening in OUR Industries!



- Aerospace & Defense
 - Commercial competition
 - Consolidation
- Automotive
 - Electric, hybrid and autonomous vehicles
- Medical Device
 - Much more software/firmware content
- Government
 - Demanding more for less... with agility
 - Focus on getting capabilities to our war fighters



Fact...

The waterfall/phase gate approach no longer serves the engineering industry!



Hardware Inclusive Agile & DevOps

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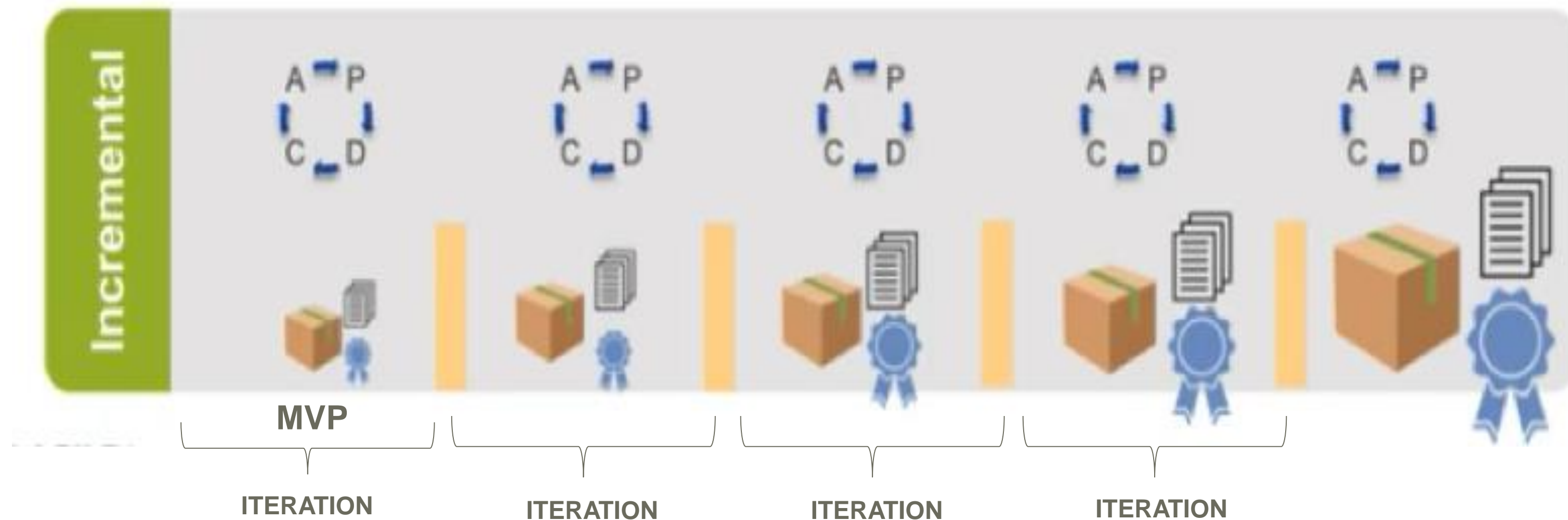
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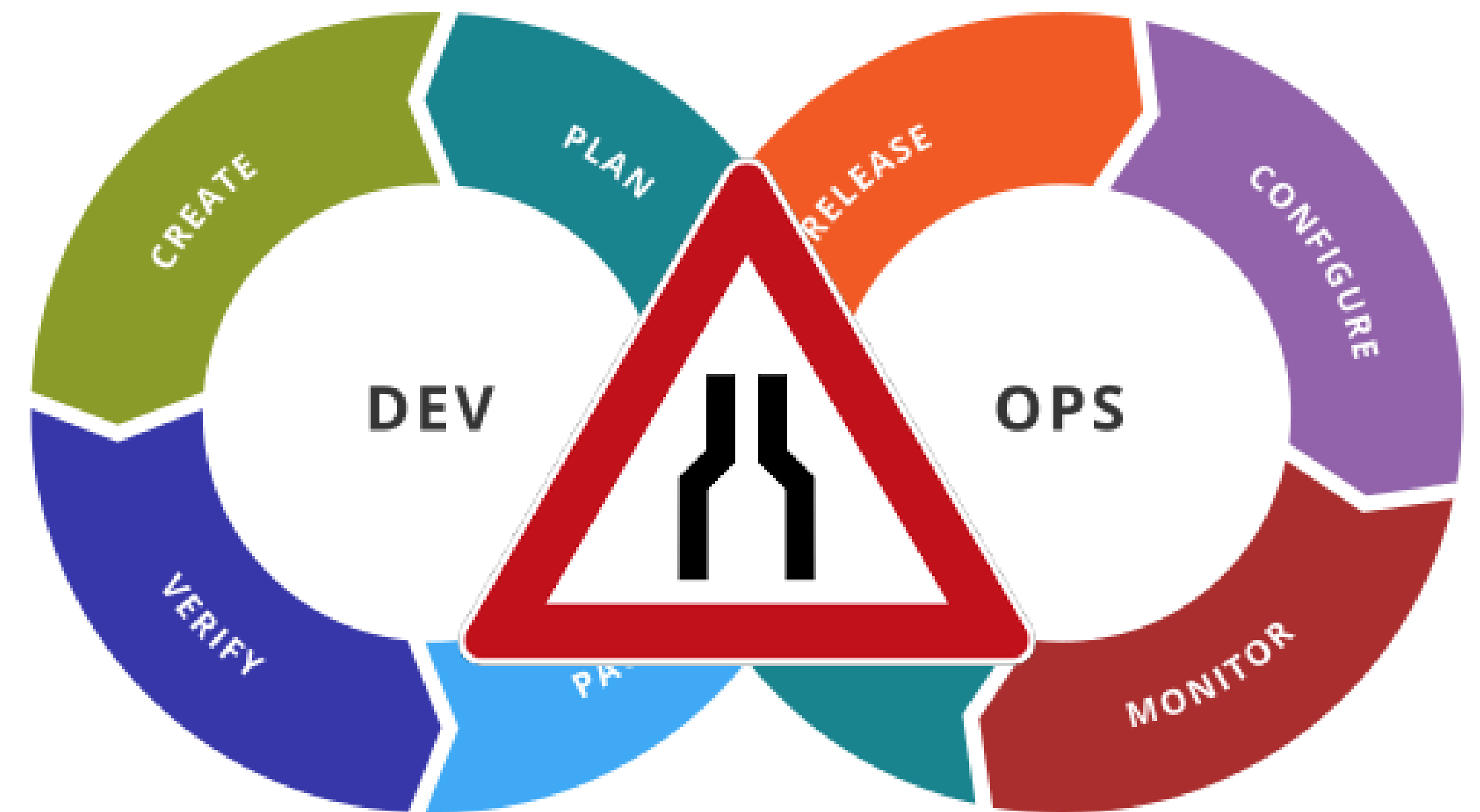
Agile Concepts – A Refresher

- Focus on fixed-length timeboxes where cross-functional teams deliver incremental value in the form of working, tested software
- Smaller batch sizes and reduced cycle times improve flow and quality
- Significantly accelerates the delivery of value



Agile Dev Created a Bottleneck: Op's

- Agile software development began to outpace traditional operations' capacity to put new code into production
- This led to the push to improve and automate the handoff from Dev to Ops... and DevOps was born !



Market Value Increasingly with Software



As agile and DevOps practices have proven themselves over the last decade, and as cyber-physical systems now require fuller integration between hardware, firmware and software:

the **natural extension of DevOps** is to deliver the same benefits to hardware-inclusive product development organizations

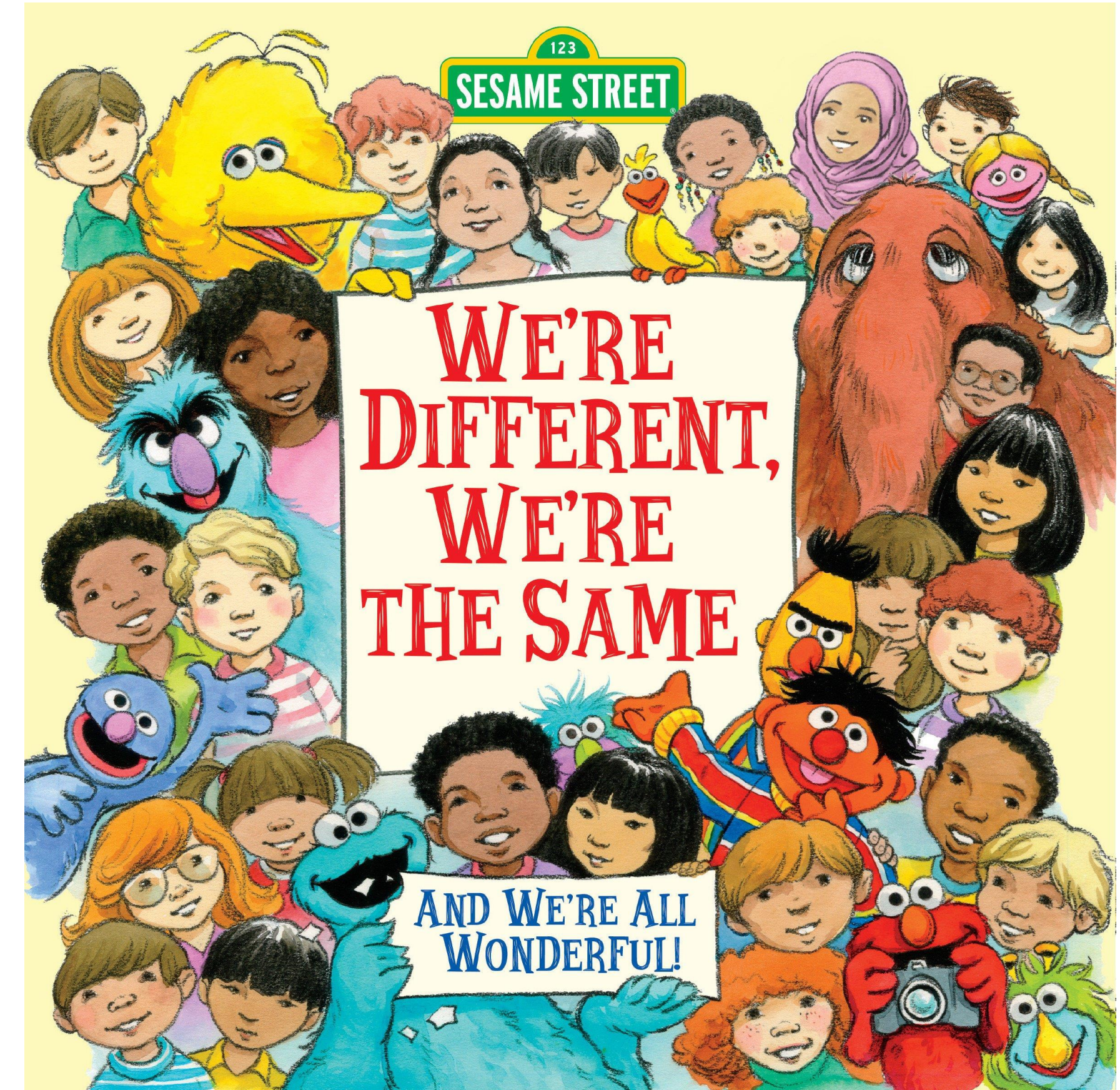
But Systems Engineering is... different !

Increments of value every 2 weeks?

Hardware 'requirements' take more time

HW design/devt & production require longer lead times

Is 'DevOps' even suited for hardware-inclusive systems...?



Debunking the



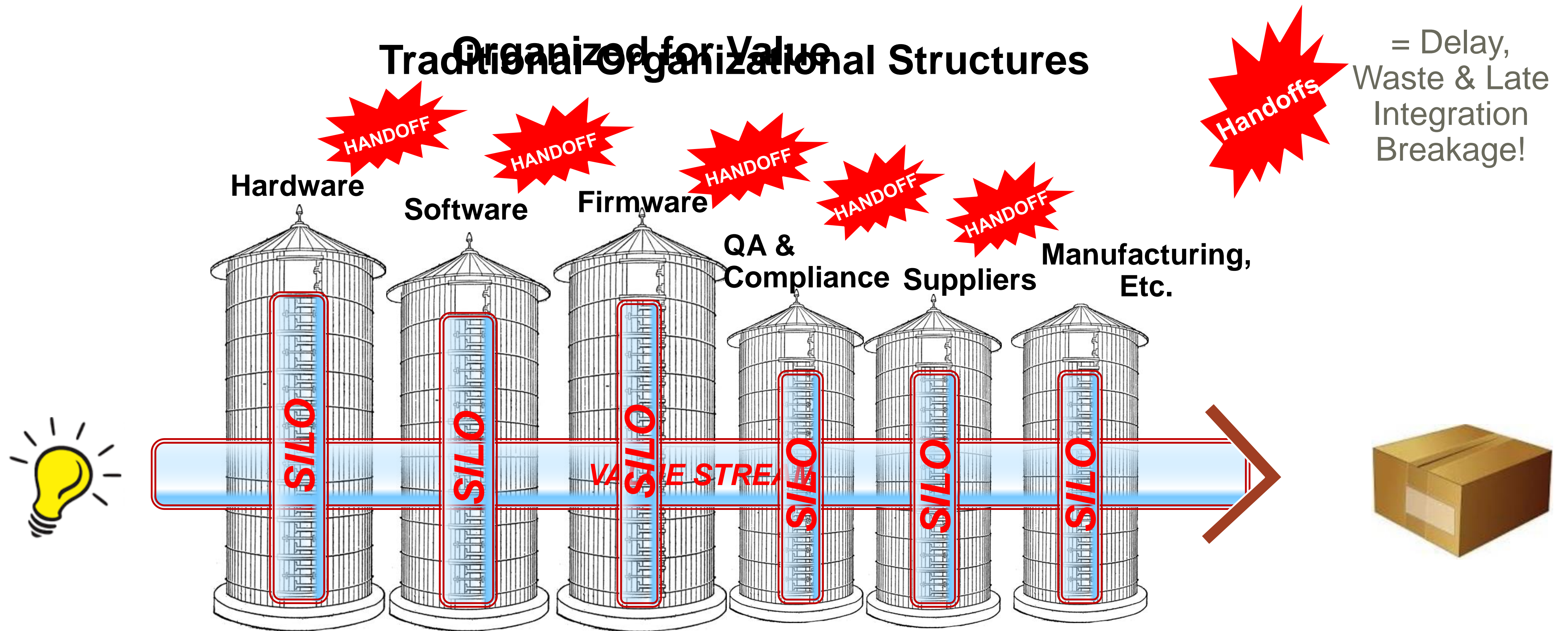
!

DevOps can be leveraged for hardware-inclusive systems:

- Some DevOps practices can be **applied directly** in development of cyber-physical systems
- Some DevOps practices can be **adapted** for hardware-inclusive systems
- Many of the contemporary / emerging engineering tools, techniques and practices are already *accelerating the inclusion* of hardware in DevOps programs, workflows, and cultures

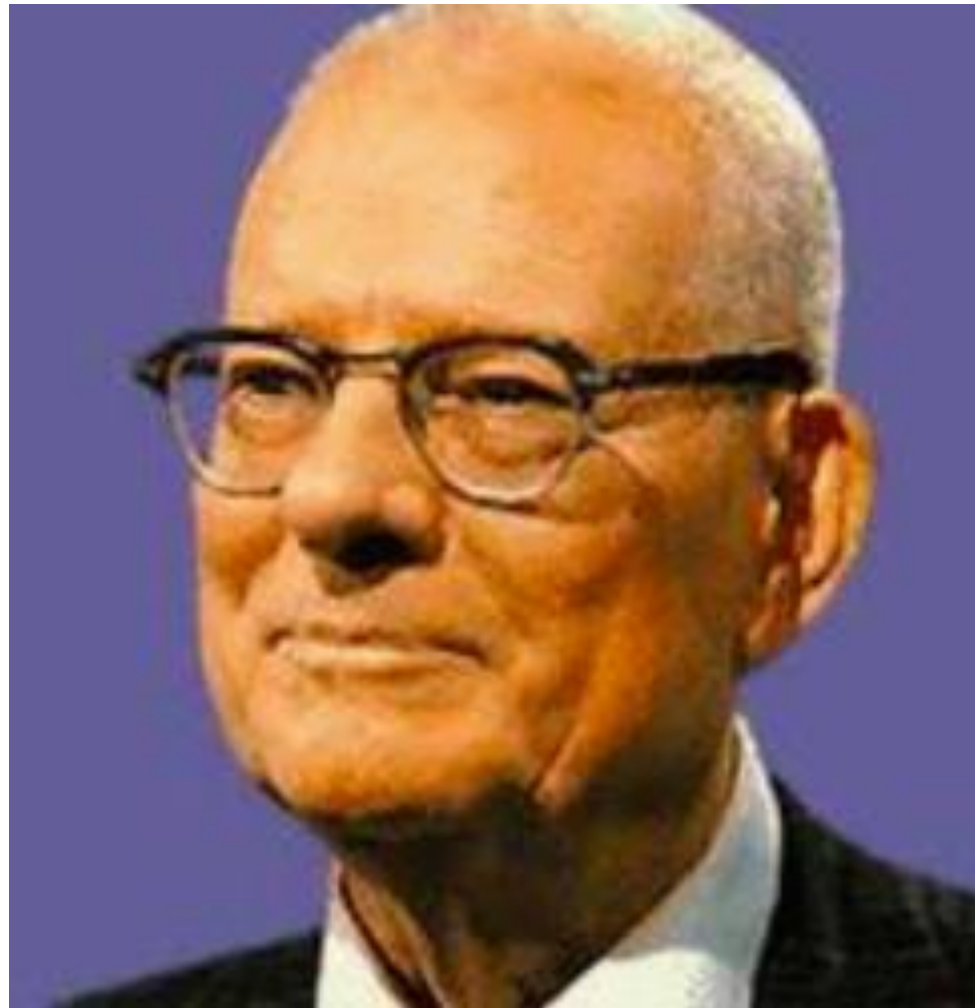
Step 1: Create a Value Stream

Organized for Value Traditional Organizational Structures



Systems Thinking

Optimizing the System- NOT functional Silos!

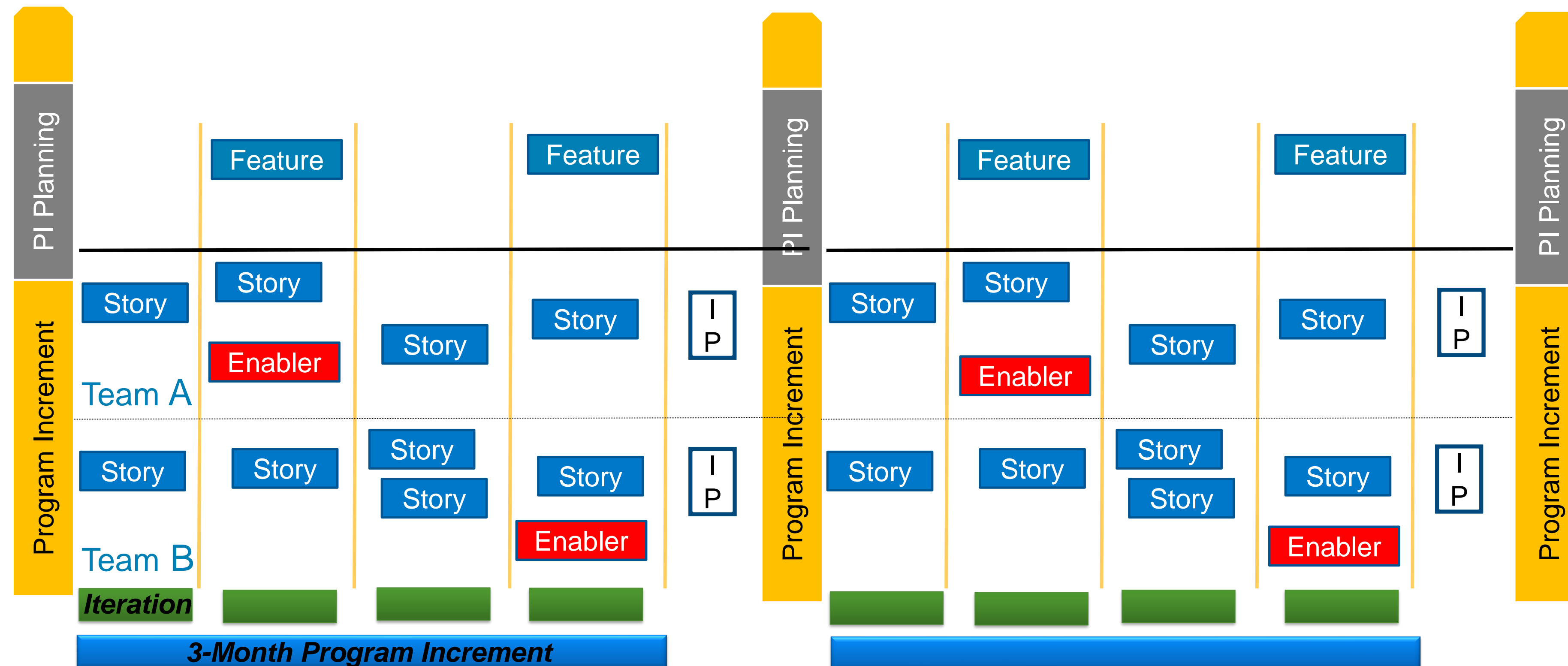


W. Edward Deming

‘A system must be managed. It will not manage itself. Left to themselves..., components become selfish, competitive. We cannot afford the destructive effect of competition.’

Step 2: Establish Cadence and Synchronization

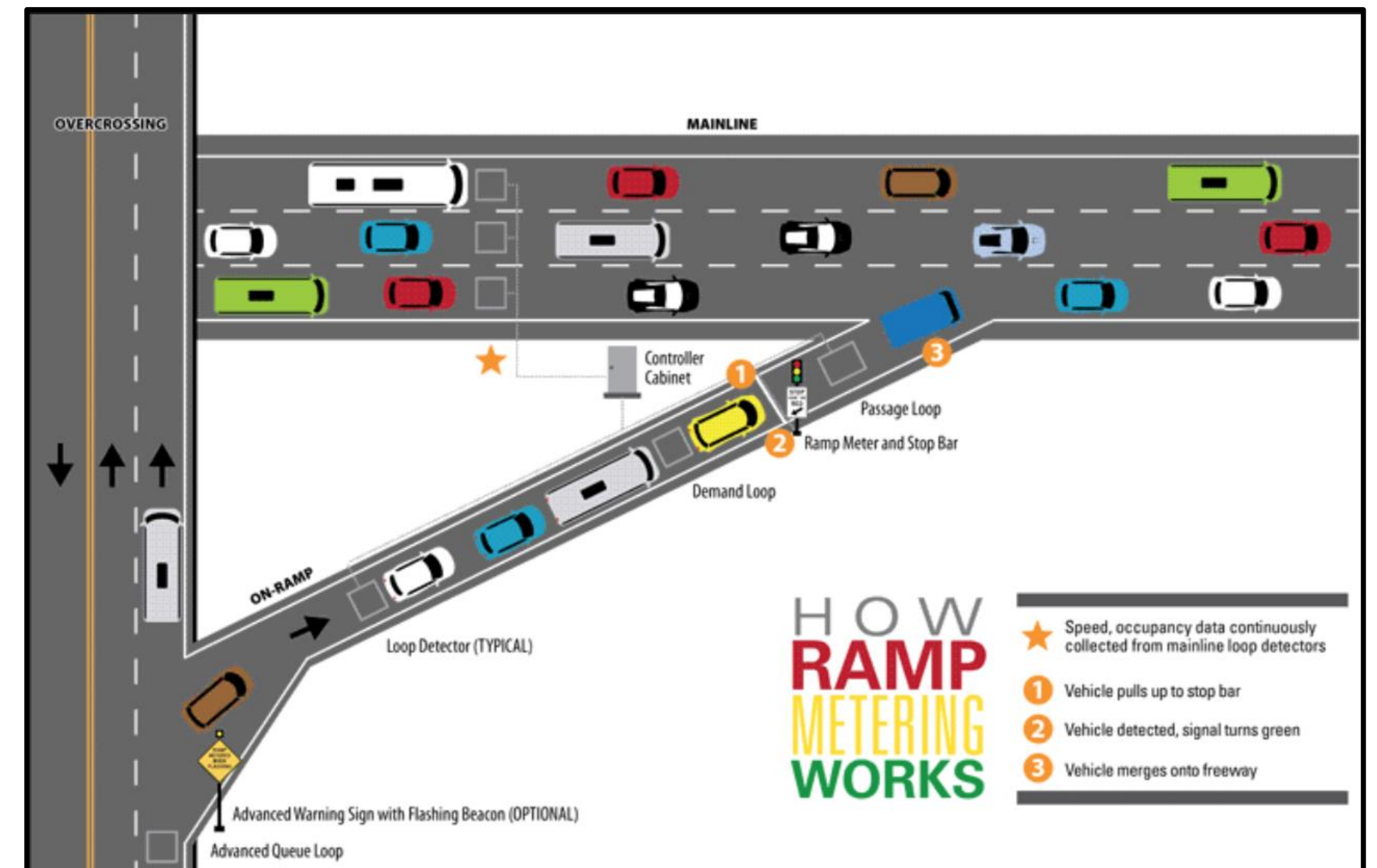
One Value Stream/Program...



Avoid too much WIP



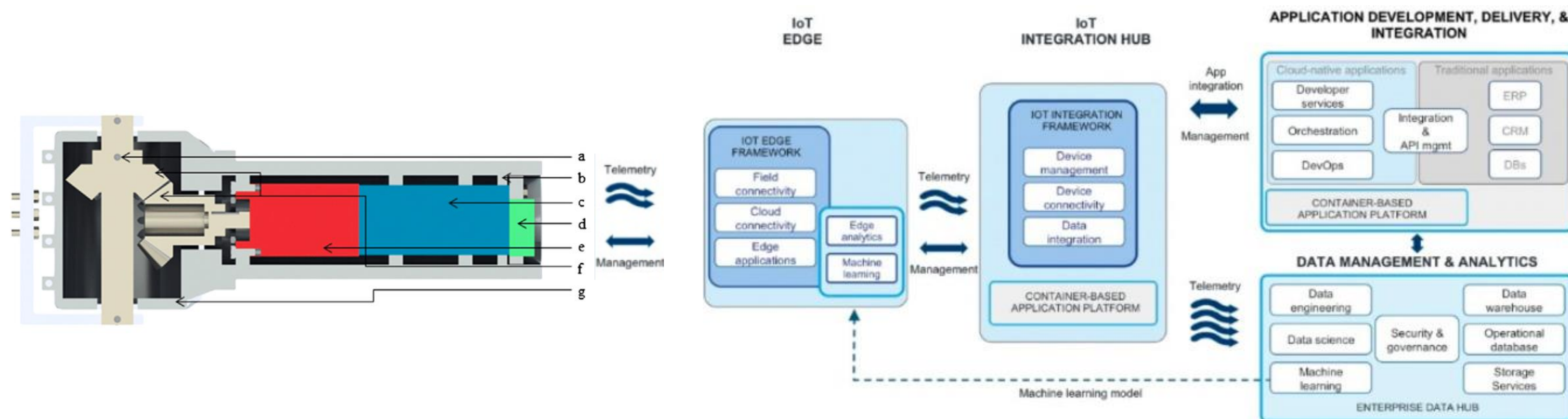
Be deliberate about the injection of work



Step 3: Architect for Modularity, Serviceability and Scale*

- Modularity: component decoupling and abstraction, enabling component-level replacement, upgrades and fixes
- API's and interfaces well-defined to highest technical standards
- Serviceability: reduce cost/time to deliver functionality (pre/post)

Fast feedback cycles, using prototypes/models/simulation allow us to defer/prove out architectural decisions!



*IT Revolution: Industrial DevOps

Step 4: Prototyping & Simulation

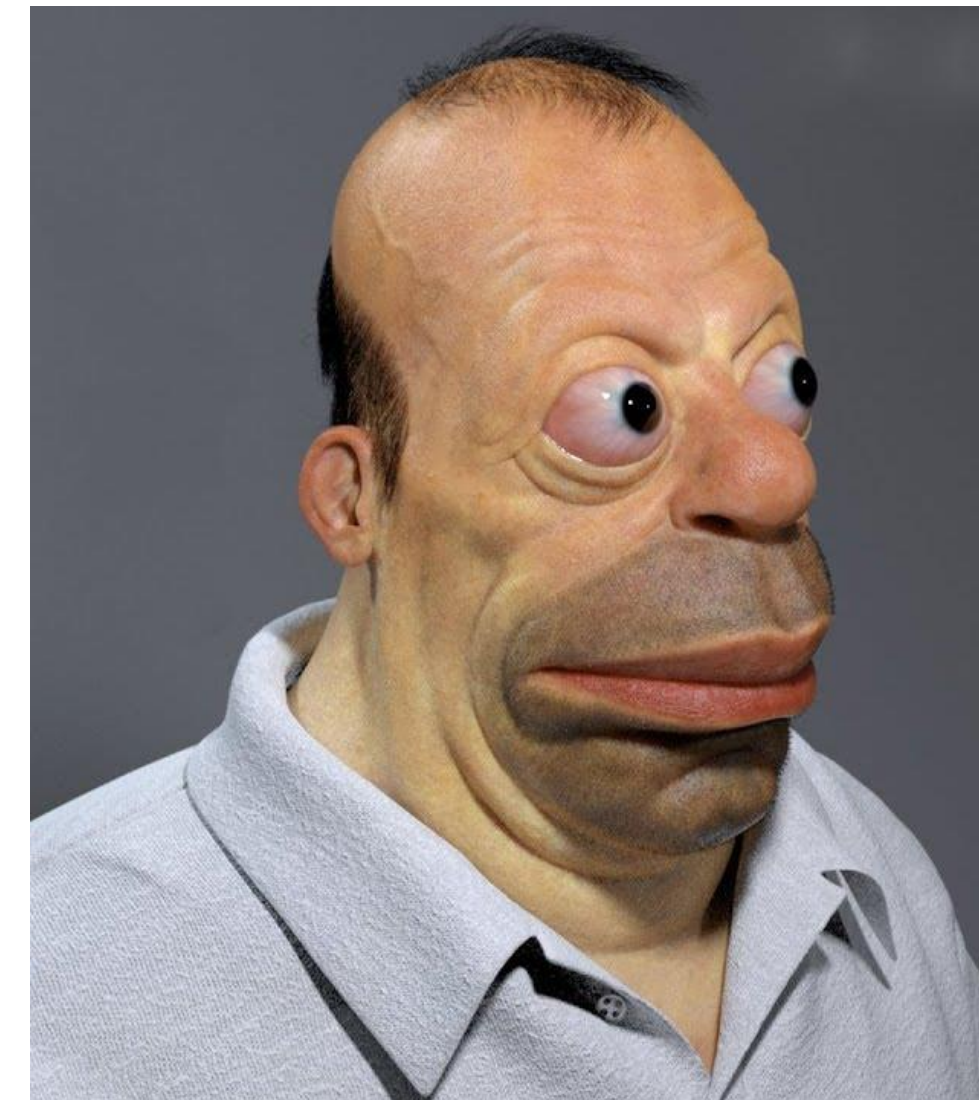
Create lower-cost **proxies** for components with longer lead times:

- Enables set-based vs. point-based design approach
- Reduces the cost of agile experimentation and learning
- Support earlier integration testing
- Enables earlier and more frequent testing of assumptions – when cost of change is lowest

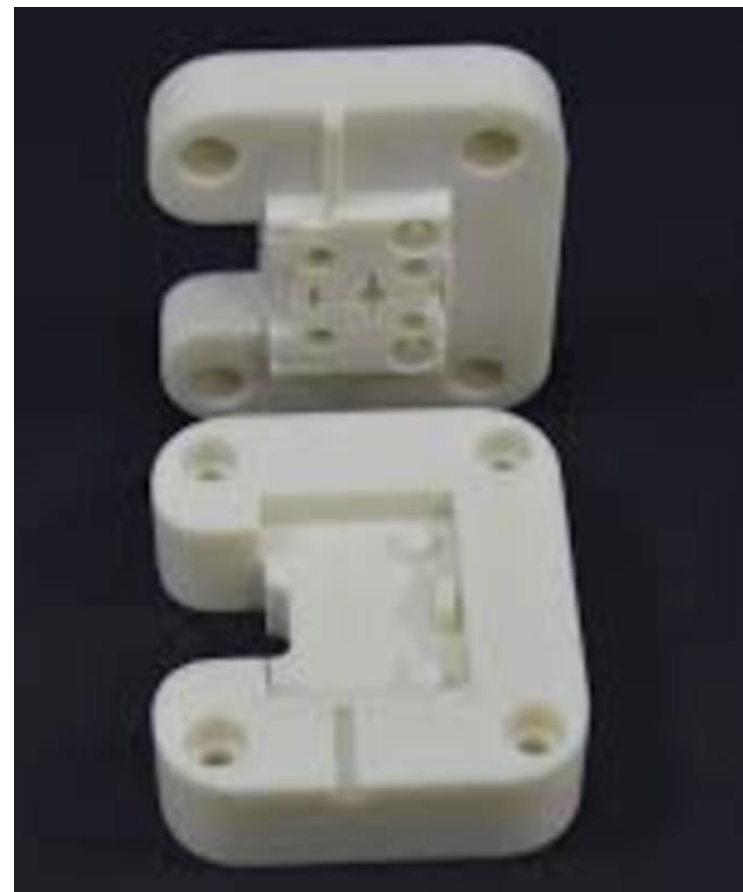
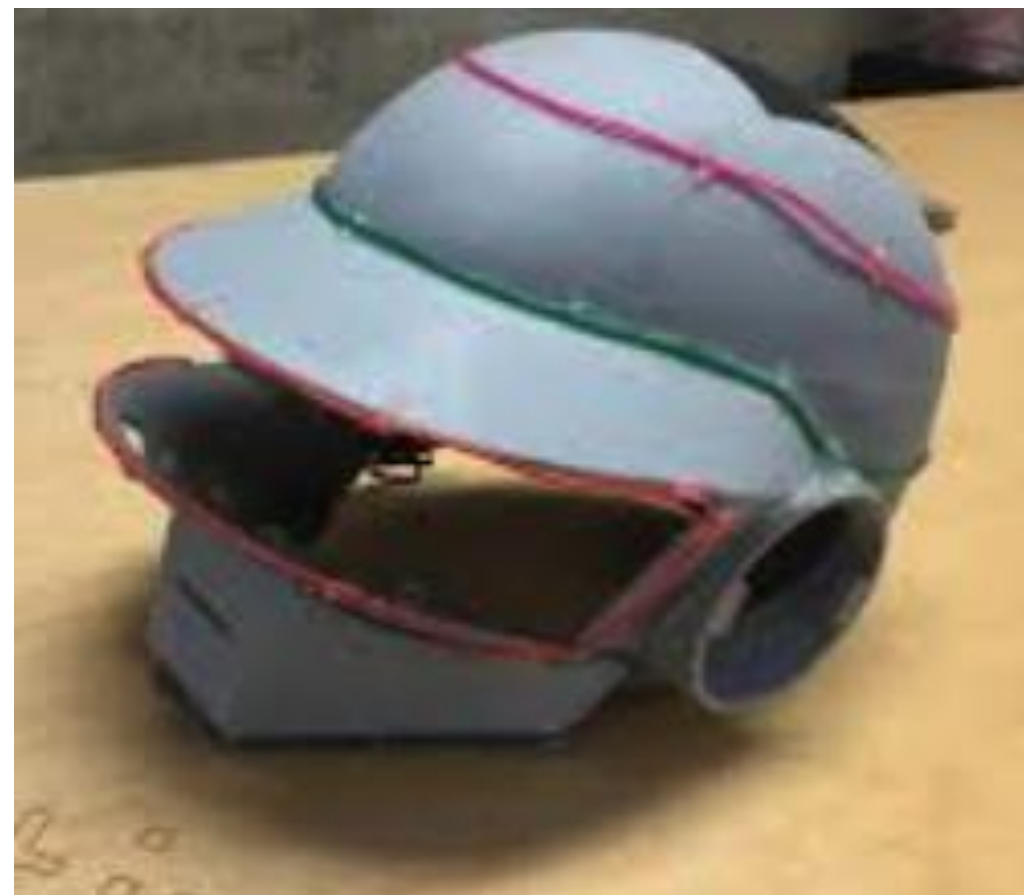
Let's look at some examples...

Look-Alike Prototypes

- Foam, Clay, Cardboard
- 3D printing technology
- Computer Numerical Control (CNC)



Look-Alike Prototypes



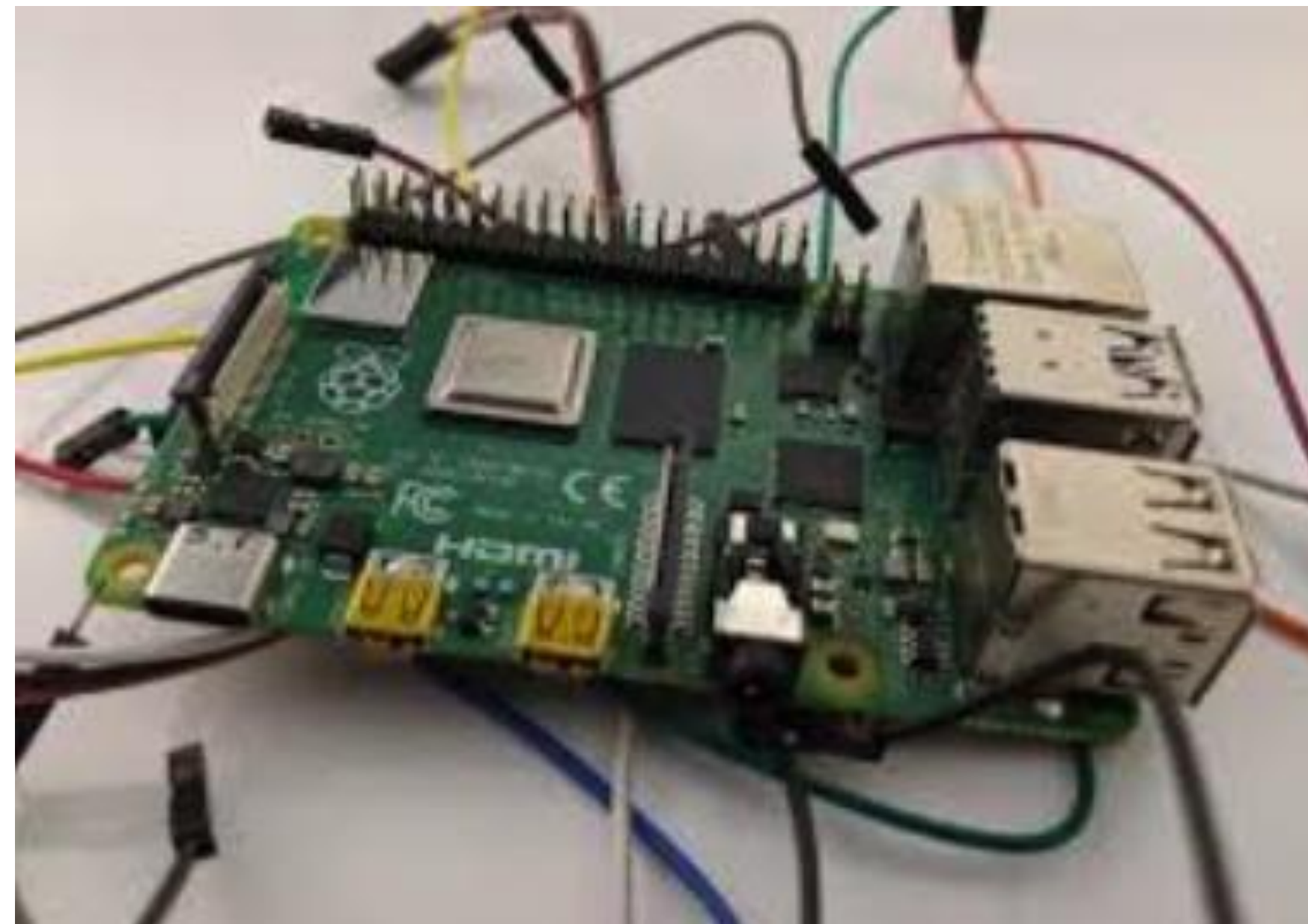
Acts-like Prototypes

**I NOTICE
EVERYTHING. I
JUST ACT LIKE I
DON'T.**

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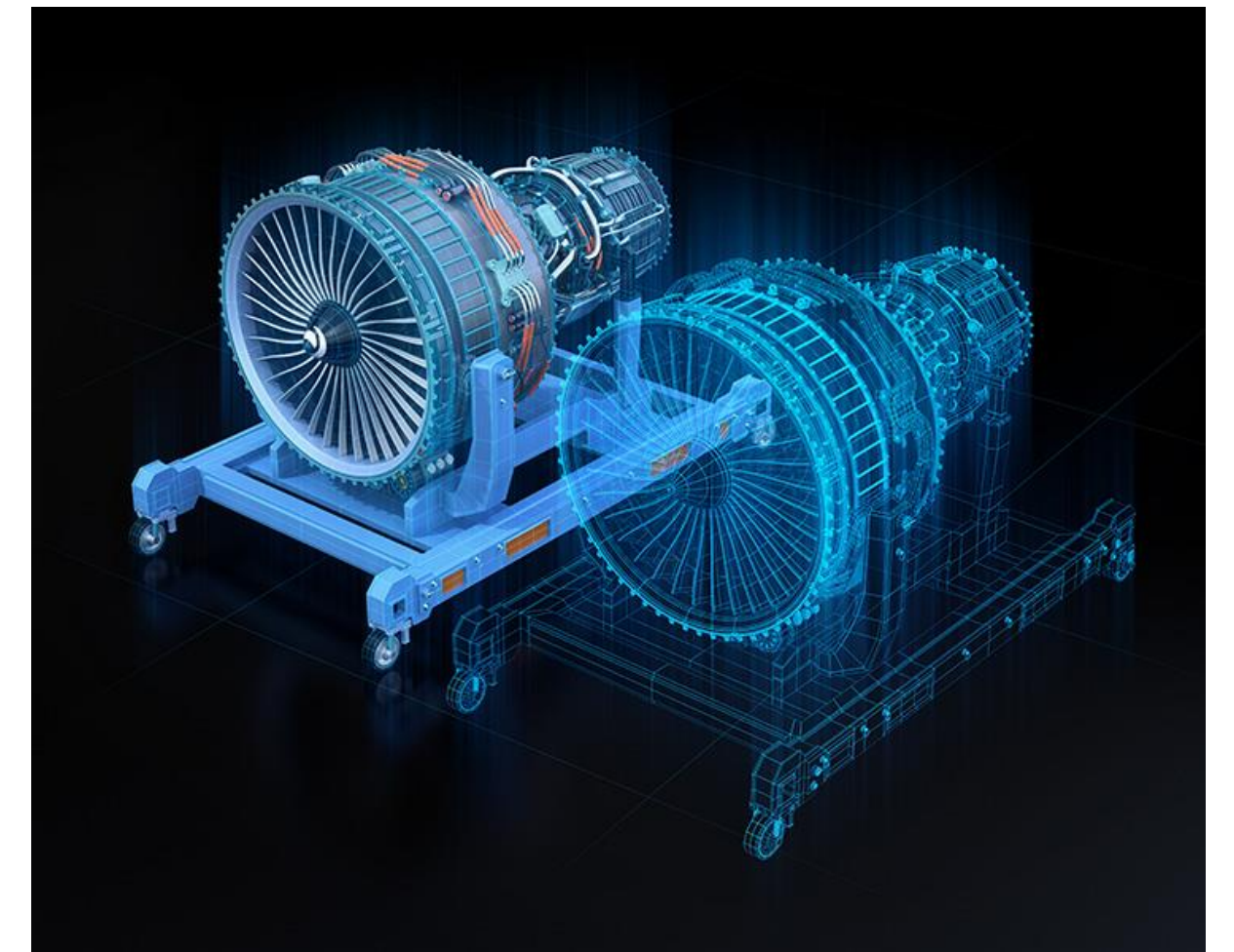
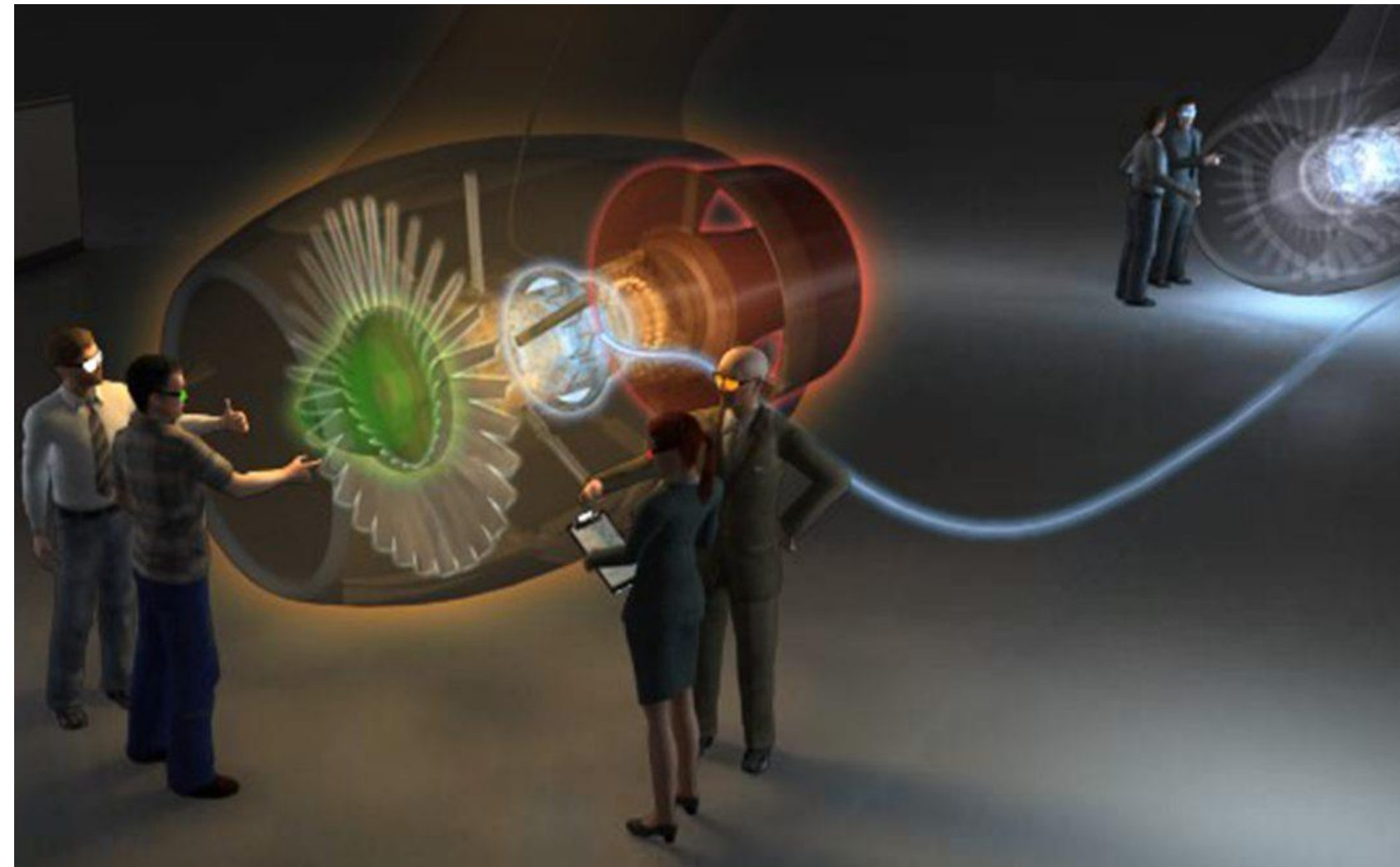
- Adding functional behaviors like internal electronics
- Leverage of off-the-shelf components & development kits
- Expand to custom Printed Circuit Boards (PCBs)

A Raspberry Pi computer board is shown housed within a clear acrylic case. The case is supported by four wooden legs, giving it a stand-like appearance. The board is populated with various components, including a large black heat sink, several white integrated circuits, and a white USB hub. The case is transparent, allowing the internal components to be clearly visible.



Digital Prototyping

MBSE
Digital Twins
Virtual reality



The Scaled Agile Framework (SAFe)

The world's leading framework for business agility

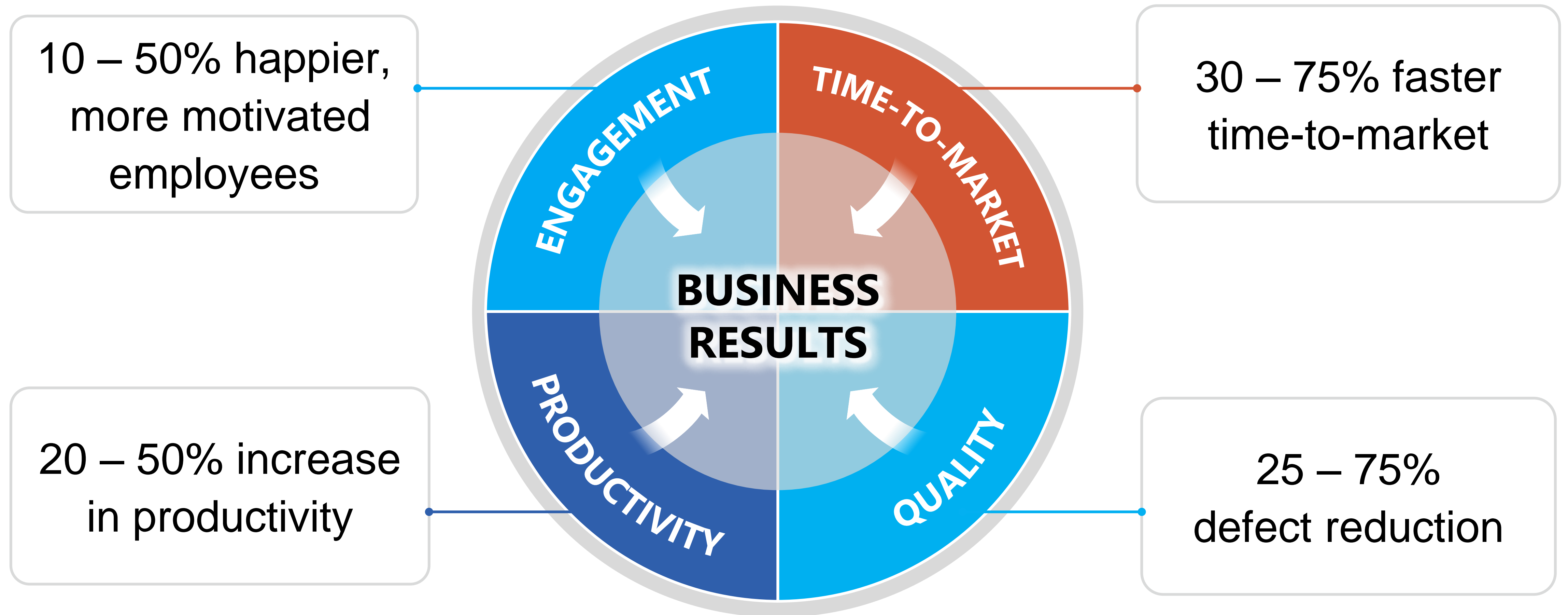
SAFe® for Lean Enterprises is a knowledge base of proven, integrated principles, practices, and competencies for achieving Business Agility by implementing Lean, Agile, and DevOps at scale.

www.scaledagileframework.com

Within enterprise and government



SAFe® - Business Results



See scaledagile.com/case-studies

Additional Resources

- 321 Gang.com: Scaled Agile Framework (SAFe) Resources
- IT Revolution: Industrial DevOps White Paper (Contributors: NGC & LMCO)
- SERC TALK: Can DevOps Practices Be Applied to Cyber-Physical Systems Development? (Dr. & SAFe Fellow Steve Mayner)
- F-22 SPO: Advanced Tactical Fighter and SAFe
- "The Principles of Product Development Flow: Second Generation Lean Product Development" (Reinertsen)
- "The Lean Machine: How Harley-Davidson Drove Top-Line Growth and Profitability with Revolutionary Lean Product Development" (Oosterwal)



Better together...

Systems thinking, iterative development, agile architecture, and greater leverage of prototyping and simulation can each deliver incremental benefits...



however, it is when these practices are deployed together that organizations can achieve the **most significant outcomes.**

Thank You!

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