321 Gang

The Continuous Engineering Experts

Agile at Scale: Incorporating Systems Engineering and Hardware Into the Mix

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Agenda

- Specify system for agile construction
- Organize around value
- Align on a common cadence
- Lower hardware batch sizes

Specify system for agile constructions

We need to change our system

Big batches

Lots of WIP

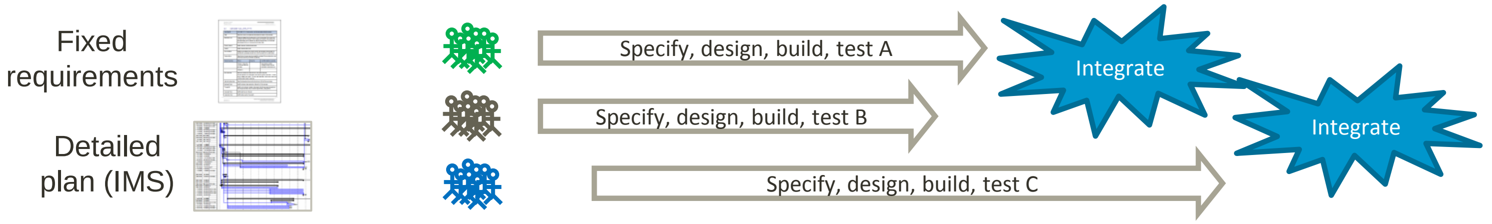
Commit early, without validating assumptions

Long feedback cycles on decisions

Hard to adapt to changes

Finger pointing

Emphasize meeting schedule & "productivity"



Fixed requirements
Detailed plan (IMS)
Specify, design, build, test A
Specify, design, build, test B
Specify, design, build, test C
Integrate
Integrate

Create focus and alignment

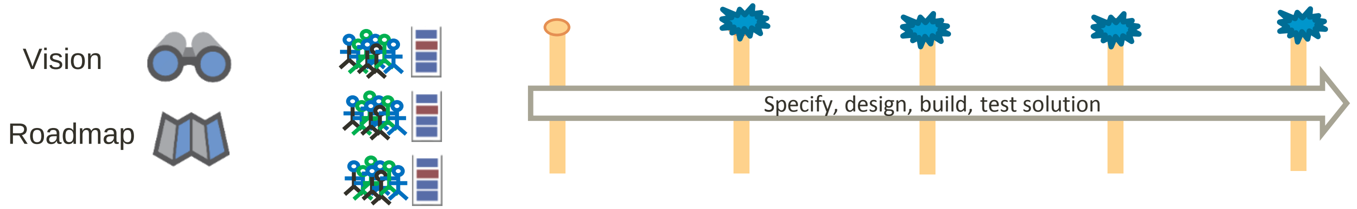
Small feedback cycles

Learning & adapting

Engaged, self-managed teams

Harmony & bliss ☺

Emphasize customer satisfaction



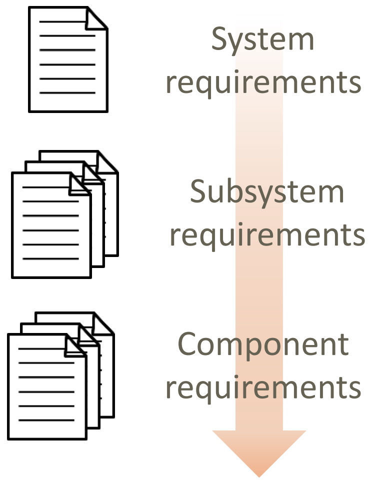
Use lean-agile approach to define and track requirements

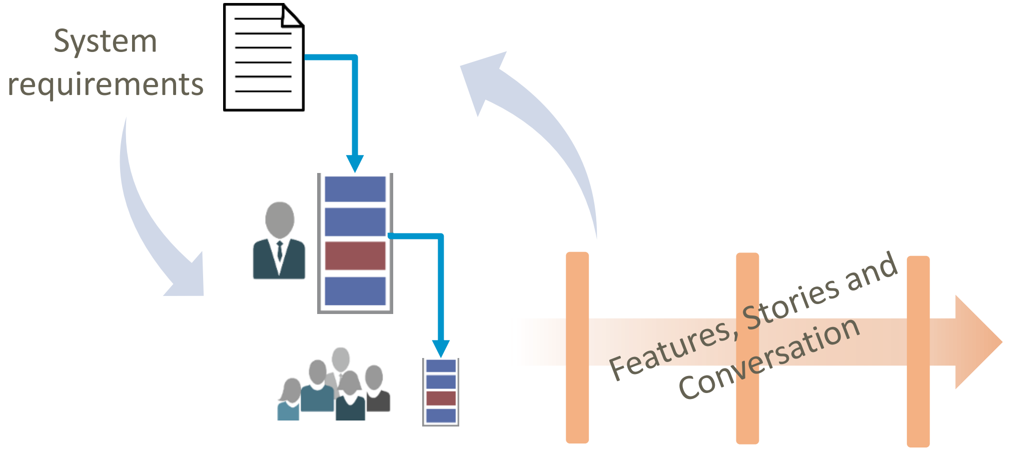
Traditional approach

- Specified and detailed early by “smart people”
- Communicated via documents
- No opportunity for feedback or learning
- Slow to adapt

Lean-agile approach

- Detailed at appropriate time, in backlogs, by producers
- Emphasis on face-to-face
- Short learning cycles all for fast feedback
- Quickly adapt to new knowledge





Workshops create alignment and shared understating

- Collaboratively create a shared understanding of system structure, behavior, and information
- Record decisions as a single source of truth using standard notation
- Use emergent specifications to drive the agile development process

Conceive

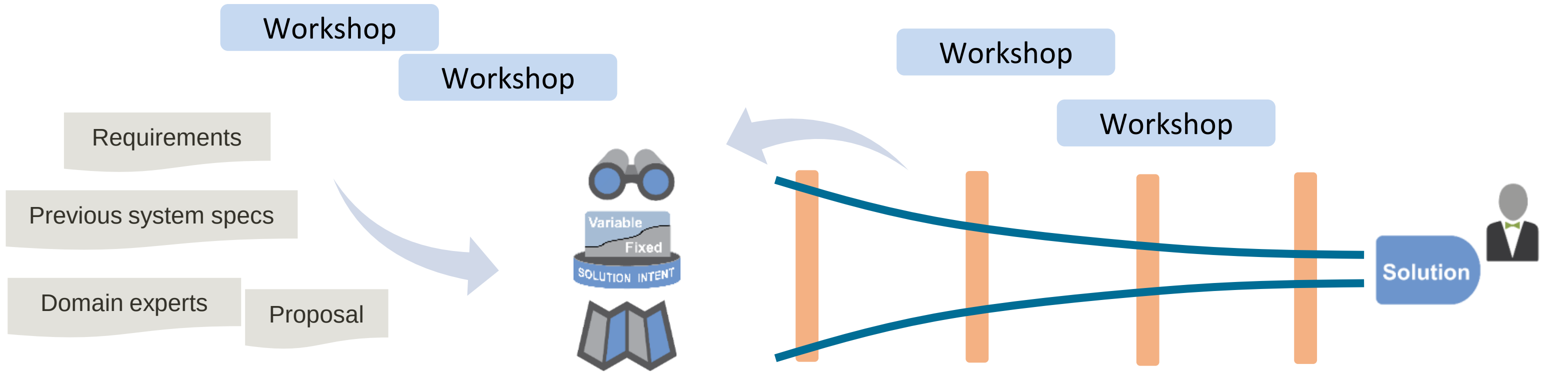
- Understand problem
- Postulate solution
- Create roadmap/plan to realize

Build

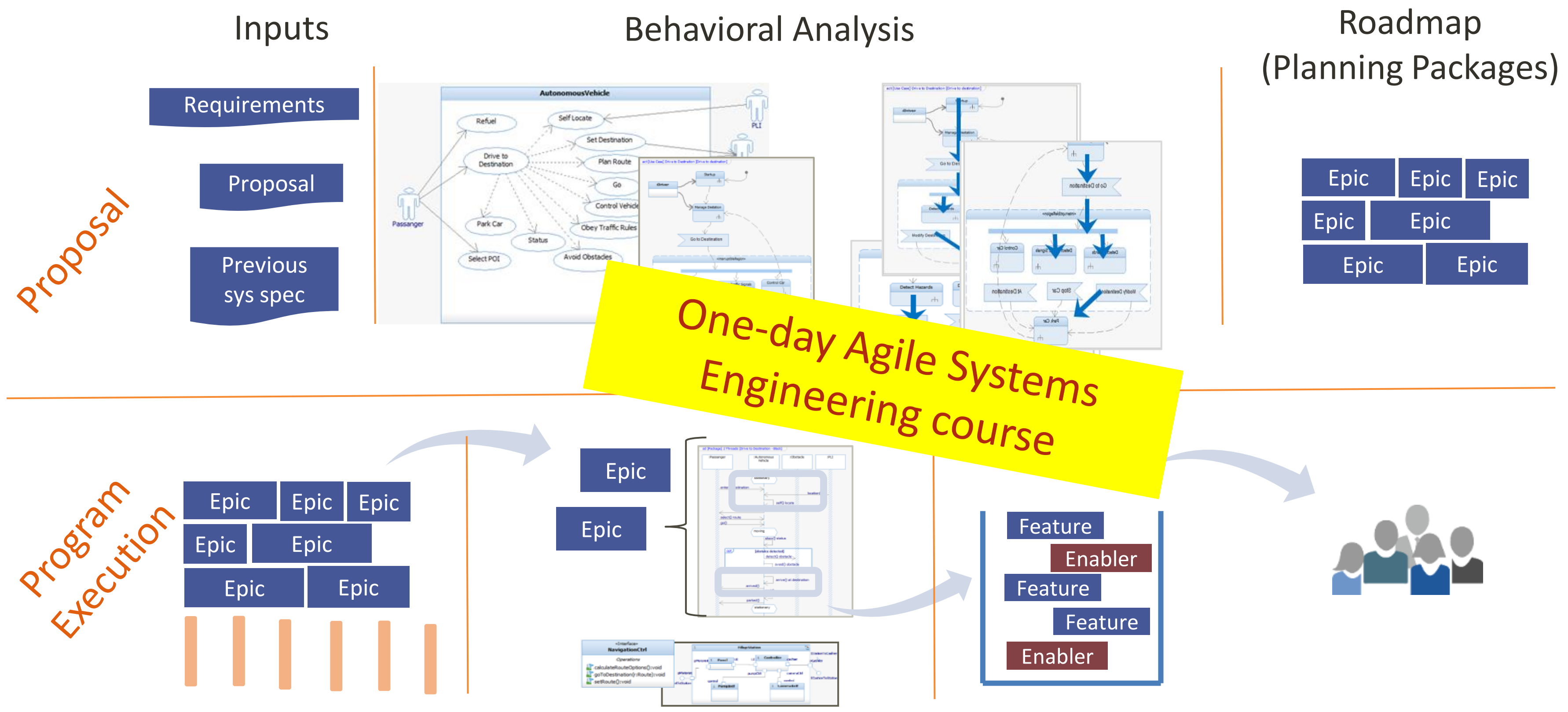
- Execute and adapt based on learning
- Continually refine solution and roadmap
- Regularly align teams and integrate solution

Validate

- Converge on optimal solution
- End users confirm solution
- Compliance approves fitness



Workshops use MBSE to evolve specifications

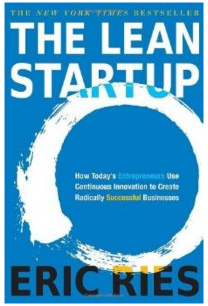


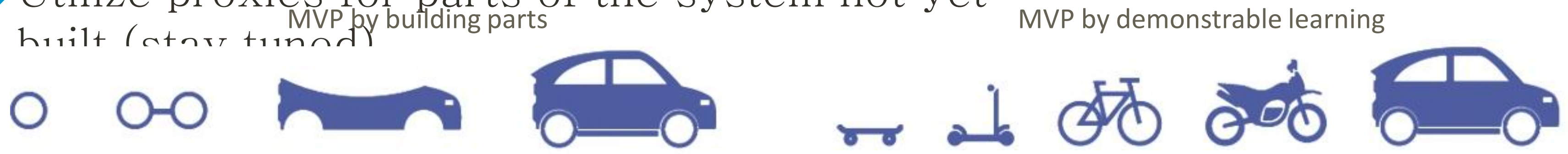
One-day Agile Systems Engineering course

Validate assumptions early

Build risk mitigation into the backlog, not a registry

- Select Epics that validate assumptions early
- Don't assume point solutions – explore alternatives through exploration activities to gain knowledge
- Strive for early, end-to-end behavior (Alpha Thread)
- Utilize proxies for parts of the system not yet built (stay tuned)


THE NEW YORK TIMES BESTSELLER
THE LEAN STARTUP
How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
ERIC RIES



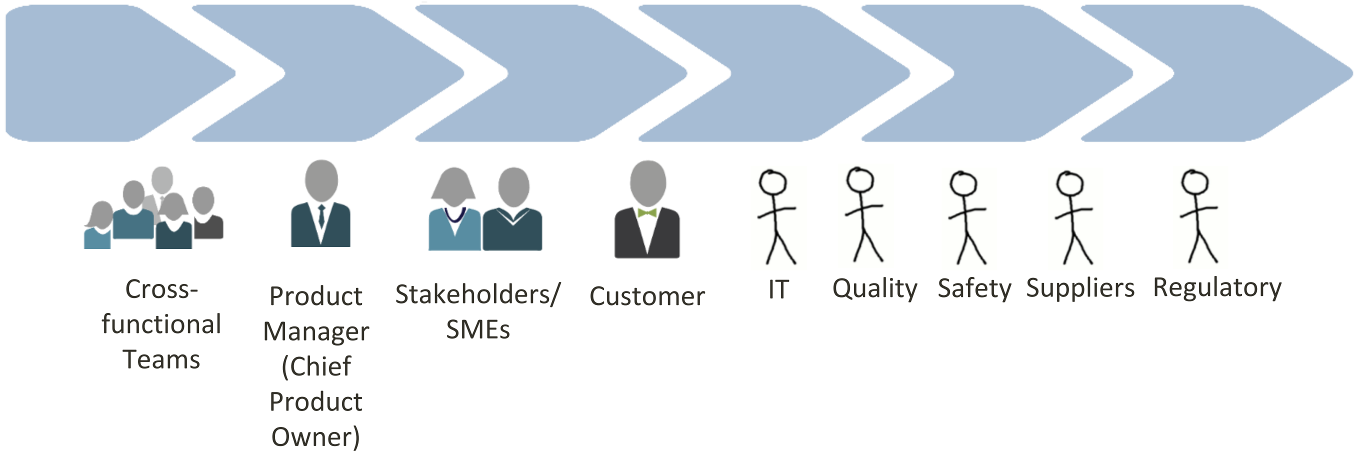
Organize around value

Myth

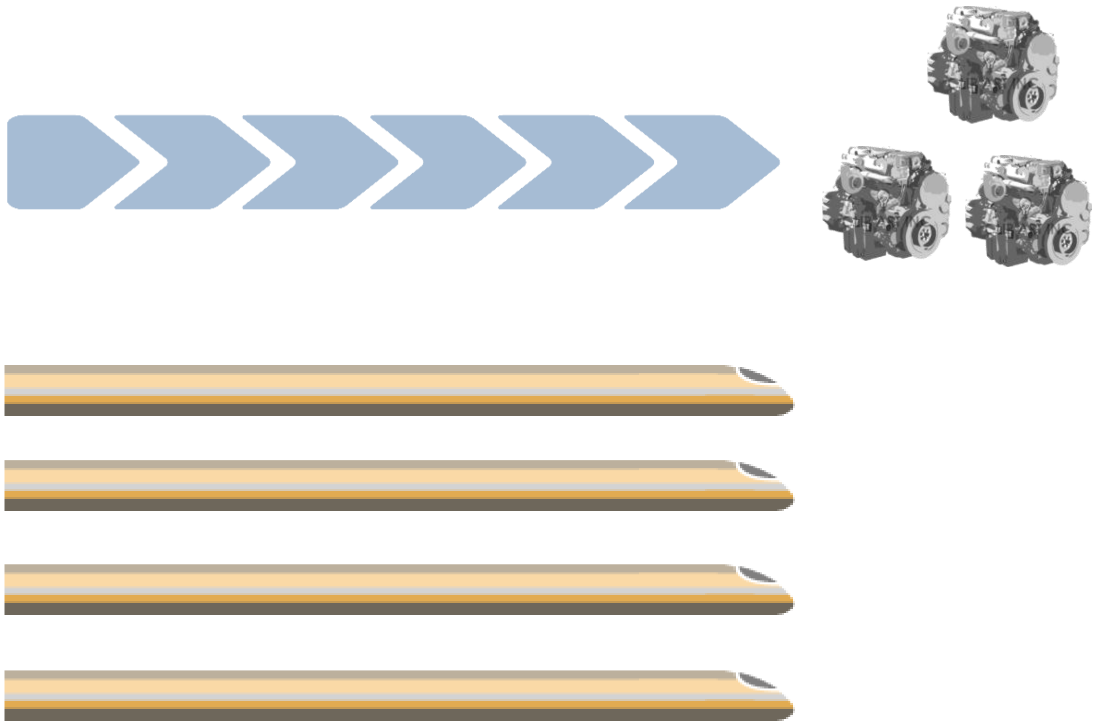
People from different engineering disciplines (Software, Firmware, Hardware, Mechanical, etc.) can’t work together

Ensure EVERYONE is on the value stream

- Reduce waste – waiting, delays, hand offs, batch sizes, WIP
- Create alignment on common goals
- Facilitate decentralized decisions and better engagement



Decompose value streams into ARTs (team-of-teams)



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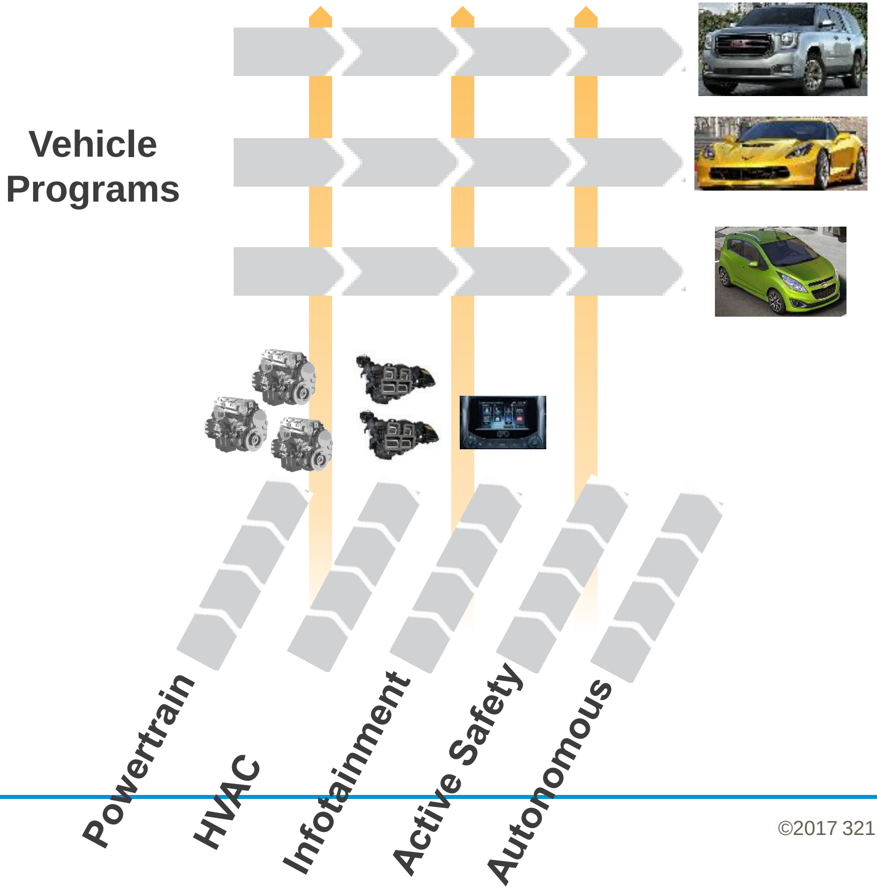
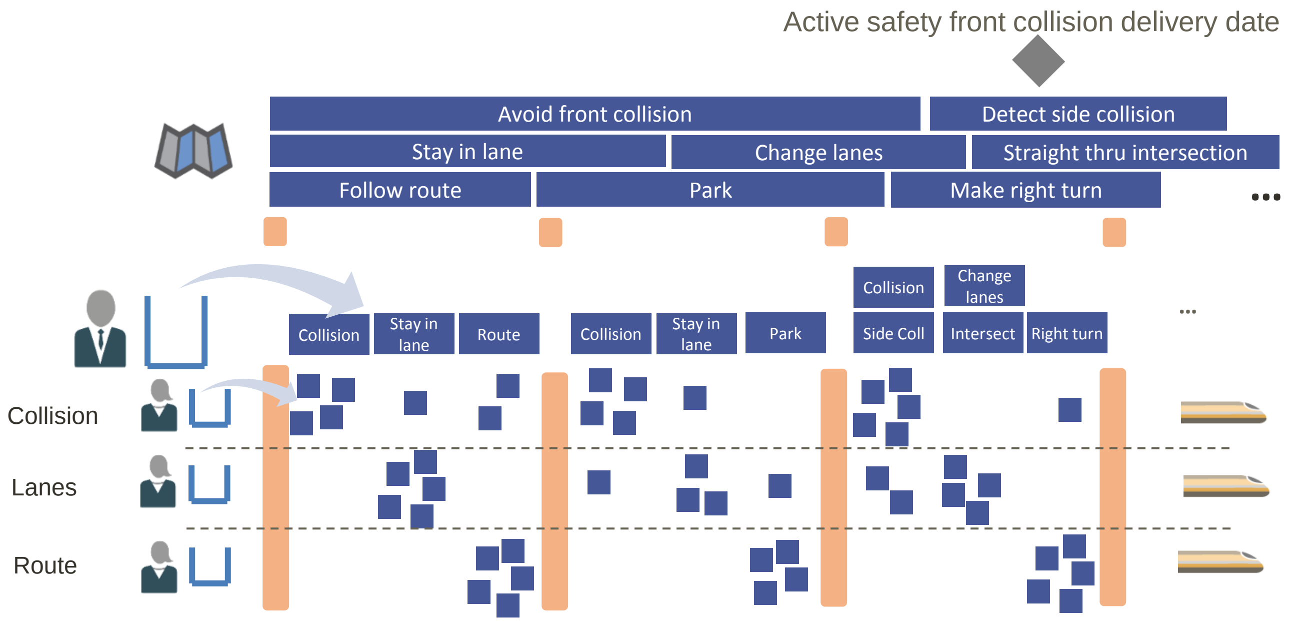
Value streams also scale up

The relationship is not always trivial “one-to-many”



Organize teams around delivering value

- Organize teams around implementing Epics
- Minimize simultaneous Epics to reduce program WIP and focus teams

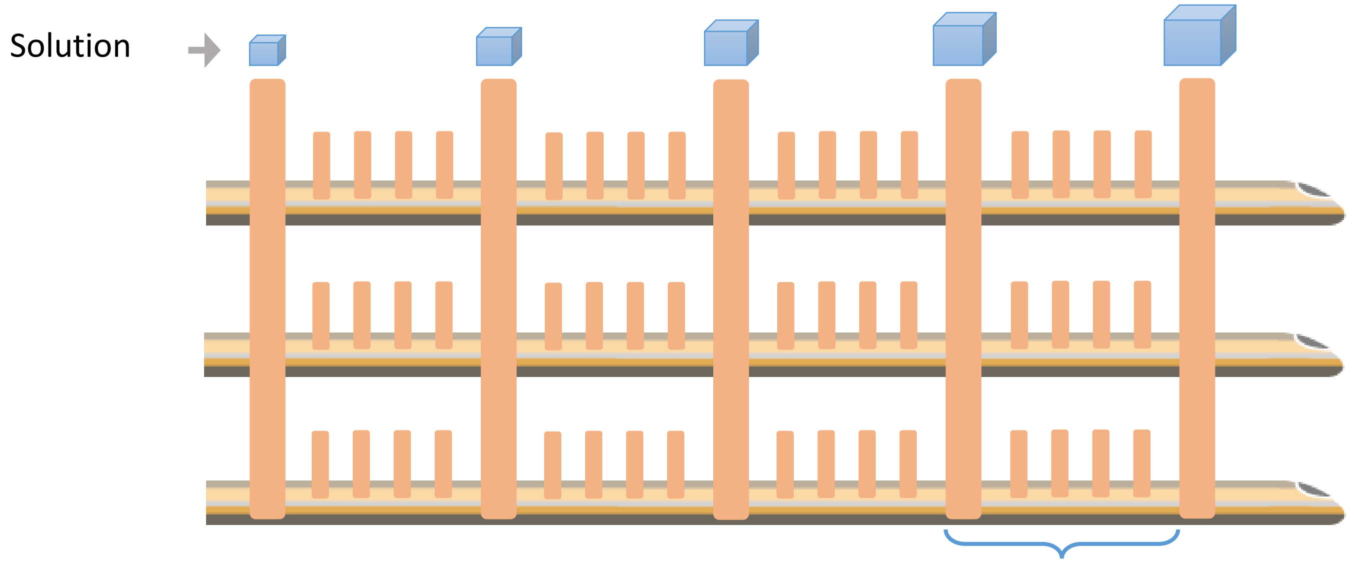


Align on a common cadence

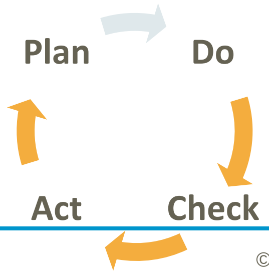
Myth

Hardware development cannot be Agile

Cadence creates the vital pace for the Value Stream

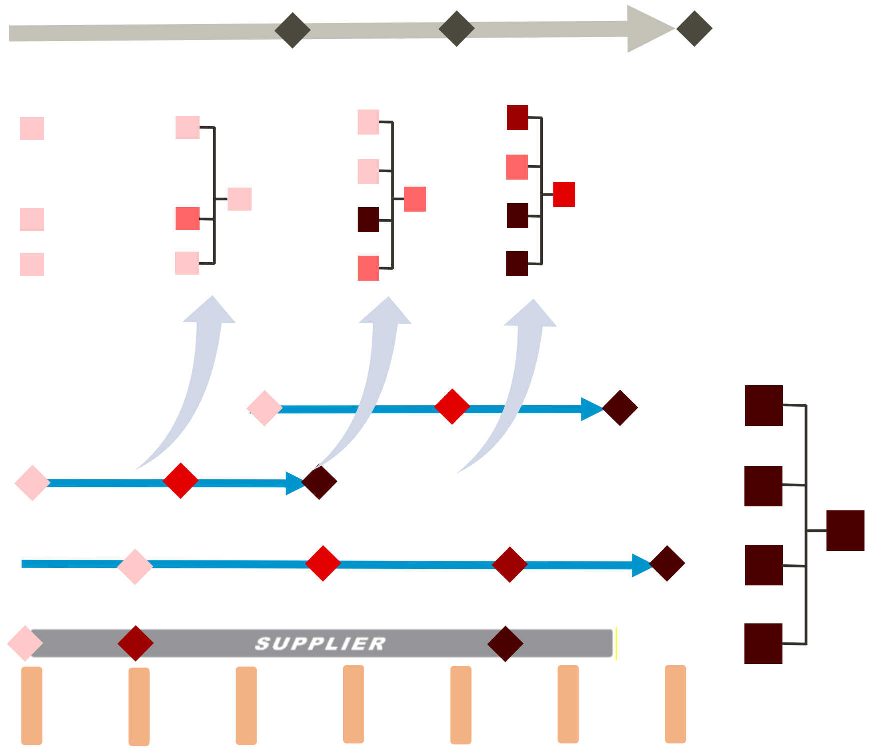


- Supports natural WIP limits
- Fosters learning cycles across the Value Stream



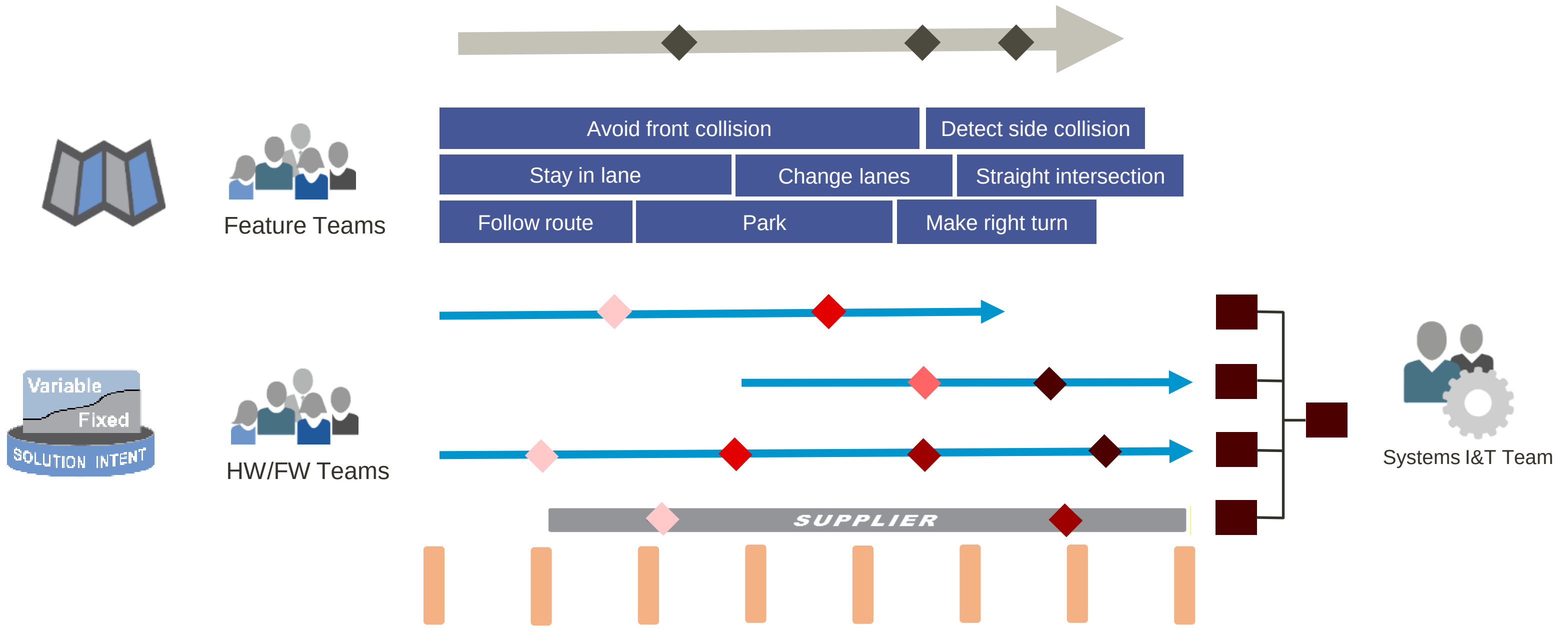
Use proxies to support early development

- Leverage proxies incremental solutions
- Strive for end-to-end solution early for faster validation feedback
- Bring production in early to validate manufacturability
- Make sufficient testing platforms available for teams to integrate and test their parts of the solution

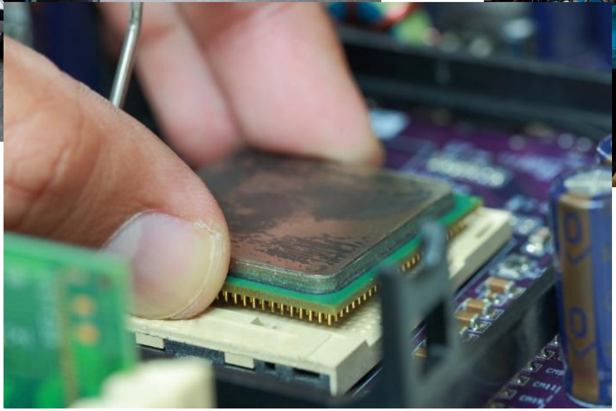


Align functional and physical roadmaps

- What physical assets and at what fidelity are required to validate assumptions early?



Design for flow



https://www.youtube.com/watch?v=IFyb-VBQfII

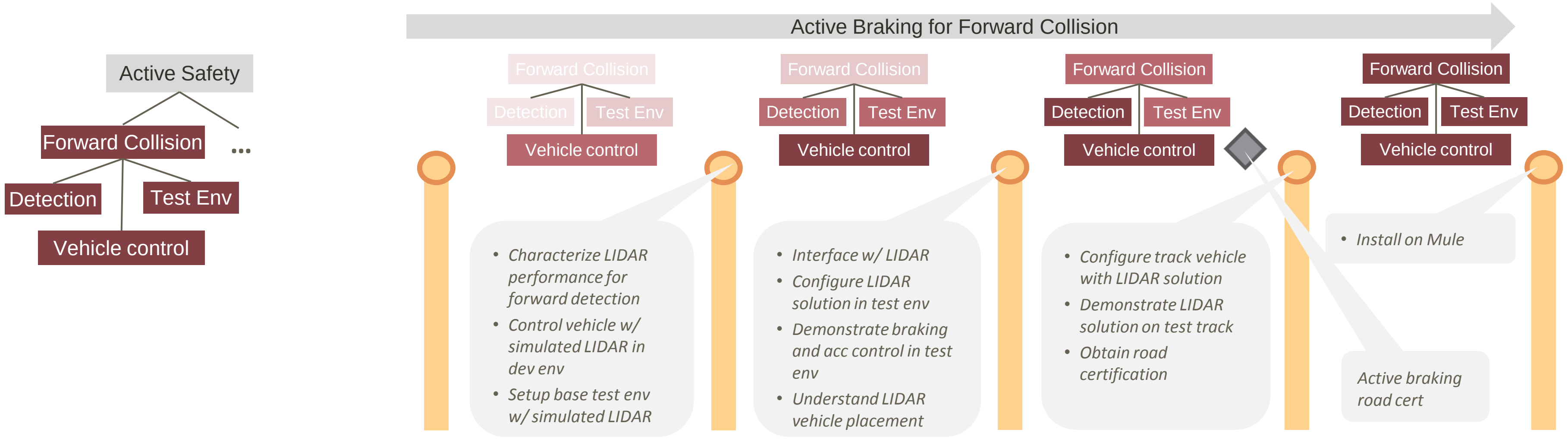
Lower hardware batch sizes

Myth

We can’t deliver new hardware every increment

Learn faster with small batches

- Grow key capabilities and initiatives over incremental milestones
- Each increment focuses on gaining knowledge and/or demonstrating parts of the solution
- Chief engineer set vision; teams determine detailed plans

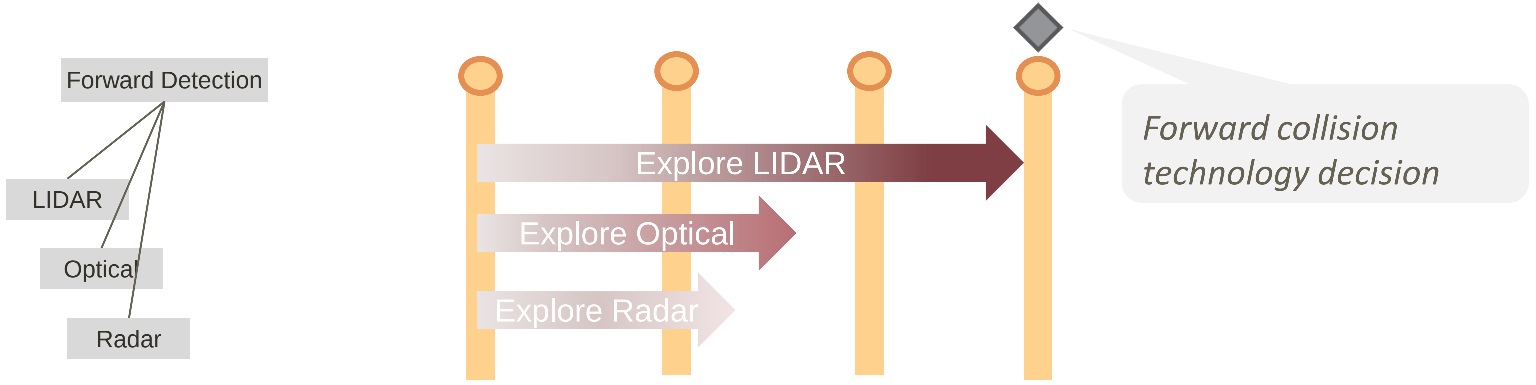


Active Braking for Forward Collision
Active Safety
Forward Collision
...
Detection
Test Env
Vehicle control
Forward Collision
Detection
Test Env
Vehicle control
• Characterize LIDAR performance for forward detection
• Control vehicle w/ simulated LIDAR in dev env
• Setup base test env w/ simulated LIDAR
Forward Collision
Detection
Test Env
Vehicle control
• Interface w/ LIDAR
• Configure LIDAR solution in test env
• Demonstrate braking and acc control in test env
• Understand LIDAR vehicle placement
Forward Collision
Detection
Test Env
Vehicle control
• Configure track vehicle with LIDAR solution
• Demonstrate LIDAR solution on test track
• Obtain road certification
Active braking road cert
Forward Collision
Detection
Test Env
Vehicle control
• Install on Mule

Enable late decision making with smaller batch sizes

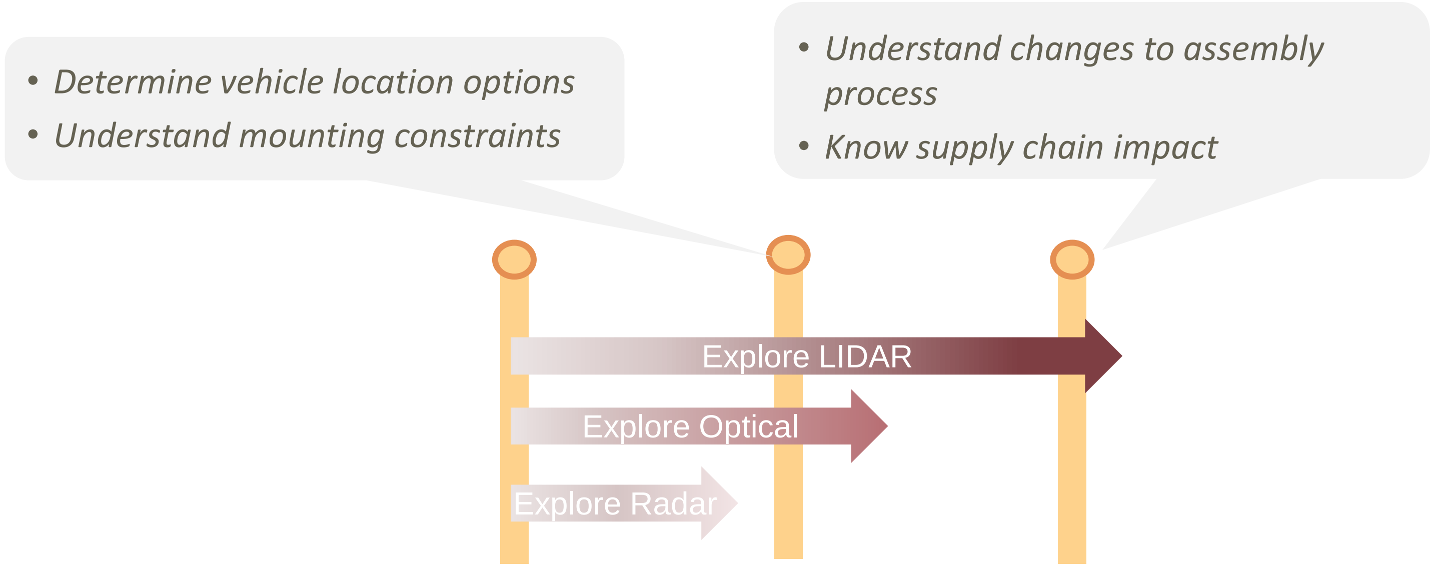
Aggressively evaluate alternatives. Converge specifications and solution set.
—Allen Ward, Lean Product and Process Development

- Fast PDCA cycles with small batches can quickly validate many assumptions
- Allows teams to simultaneously explore multiple options over longer period of time
- Suboptimal options dropped as they become inferior or no longer cost effective to pursue



Manufacturing/deployment are part of overall value stream

- Include manufacturing/deployment and their concerns in the development process
- Explore concerns each increment, in flow with rest of work
- HINT: apply same approach for other, “external” concerns (security, quality, safety, etc.)


• Determine vehicle location options
• Understand mounting constraints
• Understand changes to assembly process
• Know supply chain impact
Explore LIDAR
Explore Optical
Explore Radar

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