

Rapid Learning Cycles

Agile for Hardware

In Mid to Late Development

v. 7-0

February 2025

Prepared by Katherine Radeka

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Agile Hardware Development for the Middle Phase of Development

Katherine Radeka

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Welcome and Introduction

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In This Course



Before Wednesday

- Why Does Development Take So Long?
- What the RLC Framework Does Differently
- The Difference: Resilient Key Decisions
- Execution Cycles with Targeted RLCs
- Agile Release Trains
- Milestones - Deliverables - Work Packages
- Execution Cycle Event Structure

Post Kickoff Event As Needed

- Core Hypothesis
- NUDs, Uncertainties and Risks
- Key Decisions
- Knowledge Gaps
- Cadence and Flow
- Learning Cycles Plan
- Inside the Learning Cycle

Pework

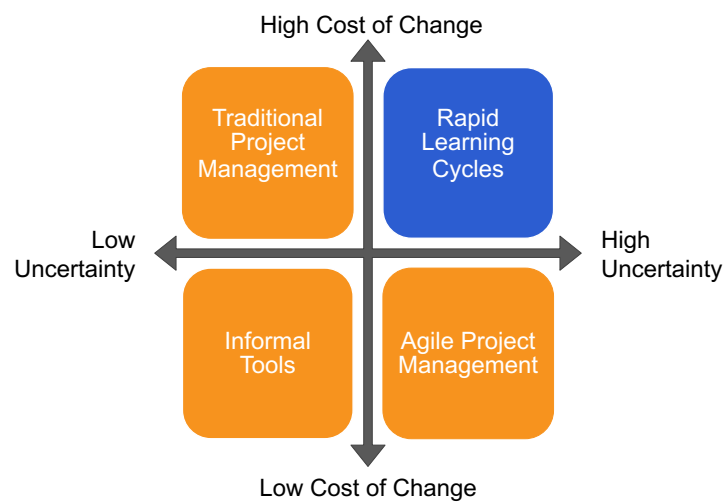


- Watch the videos.
- Think about these areas of your work on this project:
 - Where do you still have areas of outstanding technical risk?
 - Where do you have NUDs - New, Unique, Difficult areas of work?
 - What are the major deliverables you need to produce?
 - At a level of no less than two weeks, what do you need to get done to produce those deliverables?

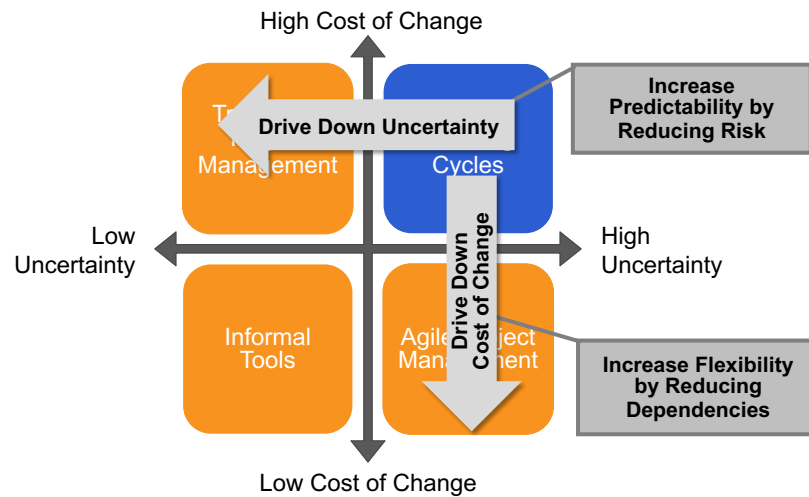


Execution Cycles with Targeted RLCs

RLCs Drive Down Uncertainty and/or Cost of Change



RLCs Drive Down Uncertainty and/or Cost of Change

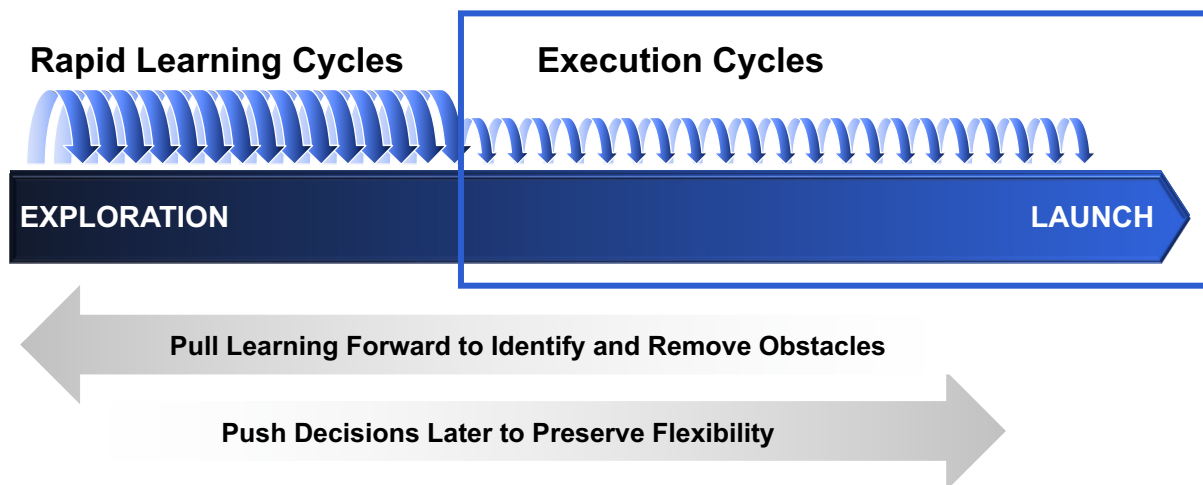


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Execution Cycles for Mid to Late Development



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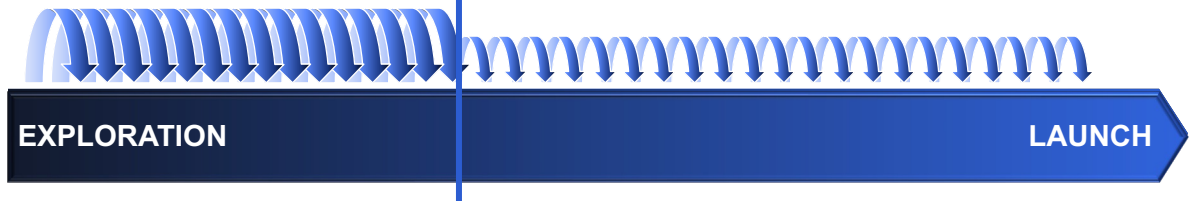
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Learning Continues Until Product Is Ready for Production

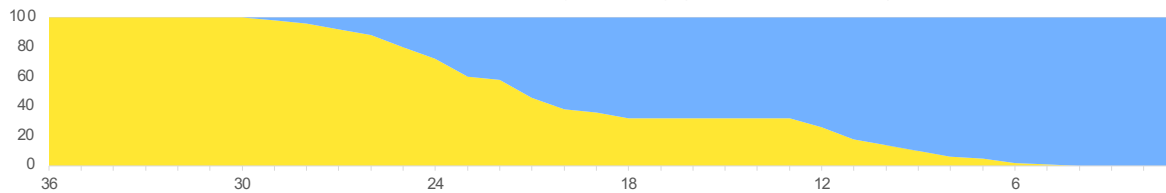


Rapid Learning Cycles

Execution Cycles



Transition from Learning to Doing (Months to Launch)



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Execution Cycles to Preserve Flexibility and Support Integration



Execution Cycle:

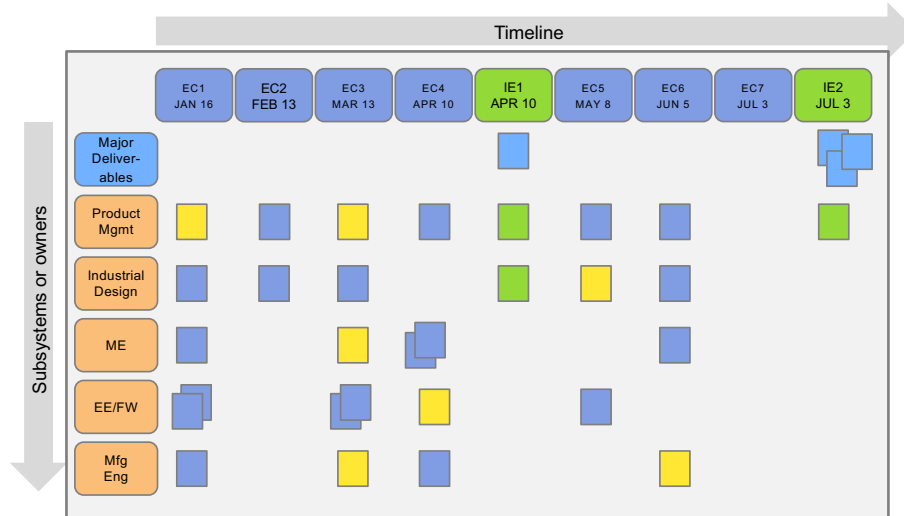
- Timebox: 4 - 8 weeks
- Produce deliverables
 - Final requirements, specifications, CAD models, quality management plans.
 - Prototype Builds / Technology Demonstrators / Test Units
 - Production process design / build
 - Supplier Selection and Initial Purchasing
- Make outstanding Key Decisions and capture knowledge in real time
 - Knowledge Gap Reports to summarize learnings
 - Key Decision Reports to synthesize learnings into recommendations

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The Execution Cycles Plan



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Agile Release Trains

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Agile Release Trains



- Run on a schedule aligned with Execution Cycles.
- One ART Slice per Train
- Train stops at station and all the system pieces needed for those slices board the train
 - Hardware prototypes
 - Software builds
 - Test harnesses
- Train stays on the tracks
 - Cannot add more slices or features once train has left!
 - If you miss the train, wait for the next one.
 - A train in motion can accept updated SW to fix problems.
- Goal: test all slices for this train and declare them done-done.

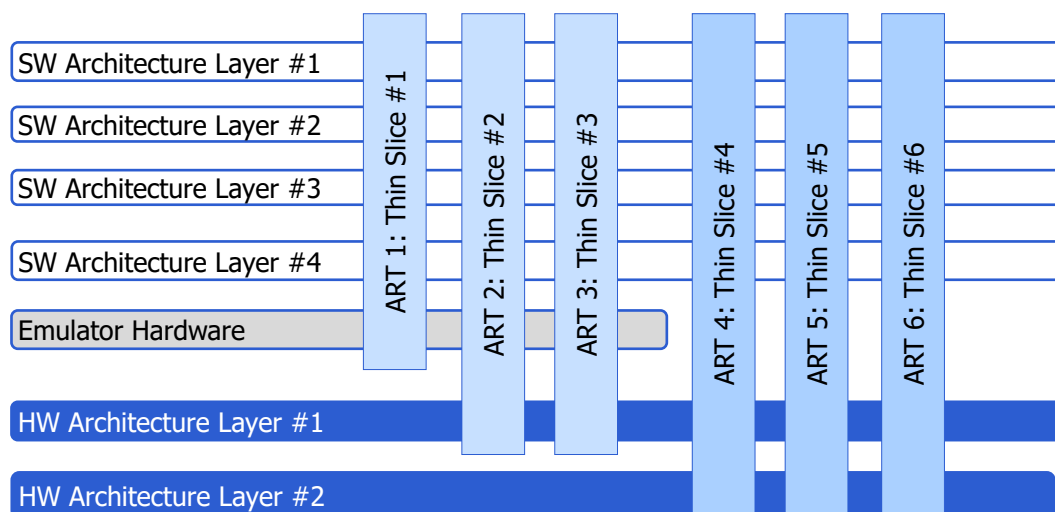


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Release Trains Deliver Thin Slices through the System



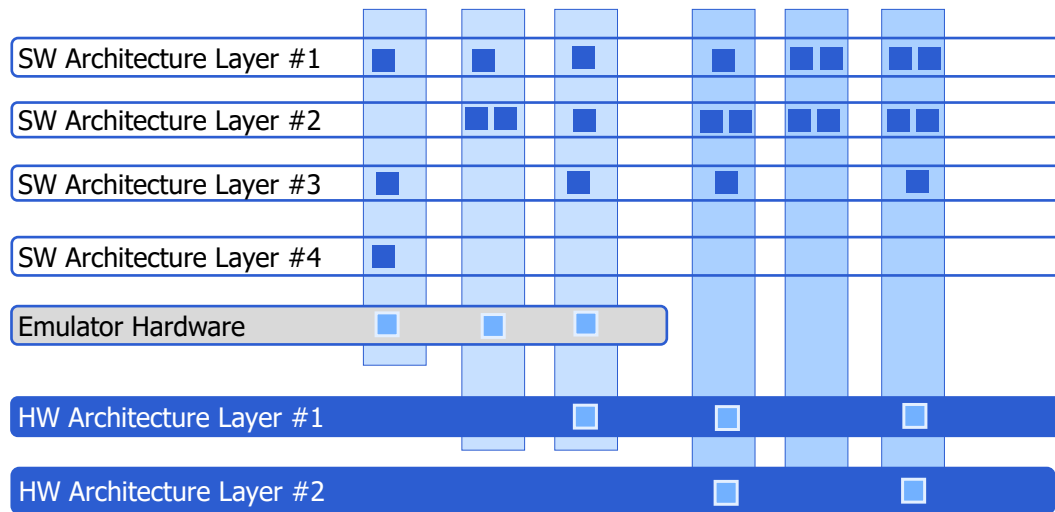
A Practical Approach to Large-Scale Agile Development by Gary Gruver, Mike Young, and Pat Fulghum

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Work Packages Map to an ART



A Practical Approach to Large-Scale Agile Development by Gary Gruver, Mike Young, and Pat Fulghum

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A Good Integration Slice ...



- Is a chunk of real functionality with business value
 - Takes the customer point of view
 - Tests the entire solution through all (available) layers
 - Has specific, measurable “pass” criteria
- } Agile
- Answers useful questions about the product for one or more teams
 - “Does it work?” is a useful question
 - Answers high-risk questions before low-risk questions
- } Rapid Learning Cycles

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Agile Release Train Plan



EXECUTION CYCLES	EC ending Feb 13	EC ending Mar 13	EC Ending Apr 10	EC Ending May 8
Proto Build:	Prototype 1		Prototype 2	
Hardware Deltas:	<none>	GRS board 4.2	Initial packaging	TBD – board 4.3 release?
Firmware:	Drop 0.2 4/02	Drop 0.3 4/22	Drop 0.4 - TBD	TBD
Mobile SW:	<none>	<none>	Release 1.13 4/20	Release 1.14
Slice Definitions:	- Print test page	- Print from PC - Rev 4.2 boards integrated	- Print from mobile app - Edge-to-edge photo printing	- Mfg alignment test works - Purchase more ink reminder
Tests Planned:	- Basic functionality - UX button response - Life test	- Print, all OS - Board regression - Life test, cont.	- End-to-end mobile printing - In-box durability	- Mfg verification of cartridge alignment - Low on ink - Deplete ink

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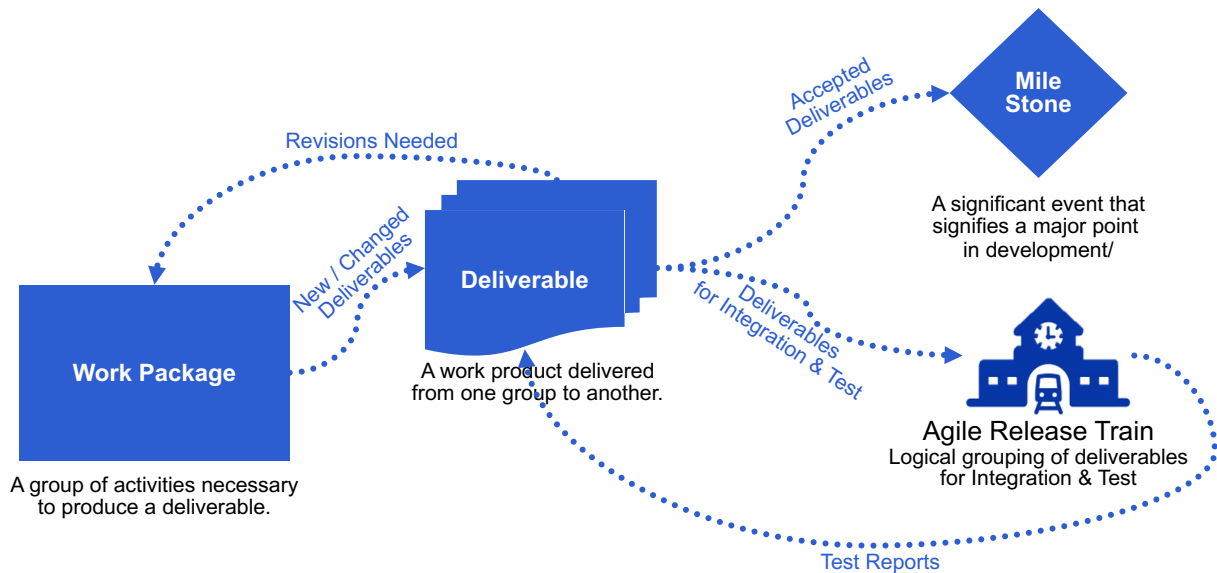
Milestones - Deliverables - Work Packages

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Work Packages → Deliverables → Milestones



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Major Milestones



- Visible on the plan one level up
- Requires deliverables to be produced and/or decisions to be made to pass
- Usually driven by external stakeholders
 - Phase gate PDP
 - Customer commitments
 - Significant full-system prototype builds



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Deliverables



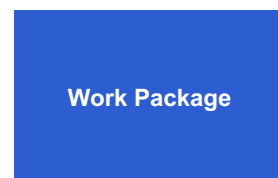
- Feed into Major Milestones and ARTs
- Acceptance Criteria Set by Recipients
- Document Bundles of Decisions
 - Key Decisions
 - Standards and Regulatory-Driven Decisions
 - Known Solutions
 - Easy-to-Change Decisions
- May be physical (prototype units), digital (documents, software pkgs) or something else (new hires, partner selection).



Work Packages



- Logical chunks of work to produce a deliverable
- Ideally fit within one Execution Cycle — but only if it makes sense
- May consist of a list of smaller activities



How to Define Work Packages



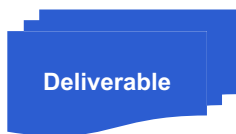
For a deliverable / set of related deliverables:

- Define the major pieces of work to be done and group into logical chunks, ideally that take up four weeks or less of time to complete.
 - A detailed activity breakdown is only necessary if you can't estimate time any other way.
- Give each Work Package a descriptive title and a Definition of Done that does not require anything outside your control.
 - If the deliverable requires review / approval / signoff / testing, the work package is done when the approver receives the work package (this is not an excuse to abdicate responsibility for chasing the next steps if needed).
- Give the Work Package a deadline that corresponds with the end of an Execution Cycle.
 - You can note major dependencies with other Work Packages if that's helpful, but not all dependencies need to be tracked or should be tracked.

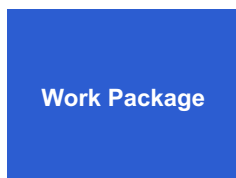
Example for a Components Supplier



First Customer Shipment: 100 Units



100 Fully Qualified Units
All Non-Commodity Parts Sourced
Automated Tooling for Full Production Released



Enter and validate Final BOM in ERP System
Qualify 2nd source for strategic component
Complete Engineering Change Requests to address vibration concerns
Explore ways to reduce cost of Subsystem A by 20% at full production



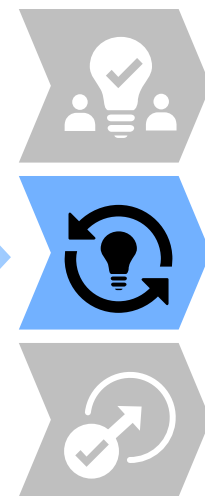
The Execution Cycle Event Structure

Execution Cycle Event: Deliverables

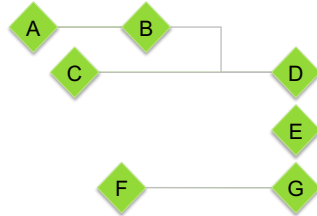
	LC1 4/7/16	LC2 4/28/16	LC3 5/19/16	IE1 5/19/16	LC4 6/9/16	LC5 6/30/16	LC6 7/21/16	IE2 7/21/16	IE3 9/1/16
Sensors									
Shell									
Control Panel									
Display									
Controls									

Execution Cycles – The Core Team

- Confirm delivery of work packages for each “station” of the train during this Execution Cycle.
- Review Knowledge Gaps closed during this cycle.
- Update the Execution Cycle Plan and the Agile Release Train plan if needed.



Integration Event: Key Decisions



Integration Event – The Team + Stakeholders

- Share recommendations for Key Decisions to be taken at this Event – **with Key Decision Reports**
- Take the Key Decisions
- Update the Release Train plan to reflect the decisions made.



Status Event: Activities



Status Event – The Team or a Department

- Ask Each Person Three Questions:
 - What got done?
 - What's going to get done?
 - What help do you need?
- Give Only One of Two Responses:
 - Thank you!
 - I can help with that!
- Take any other discussion offline.



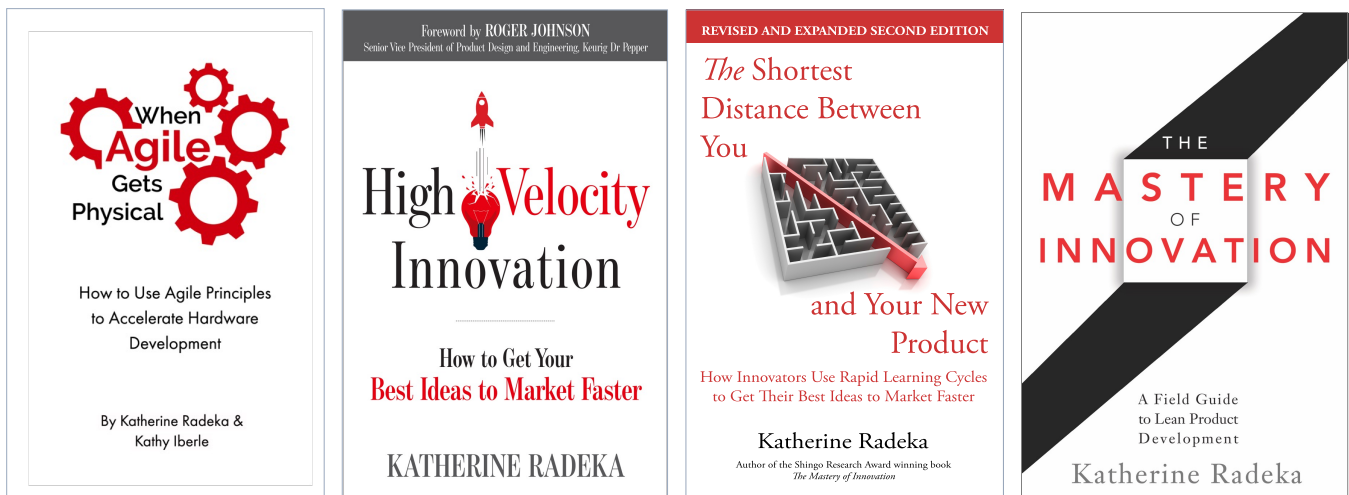


Author: Katherine Radeka

Katherine Radeka developed Rapid Learning Cycles to eliminate the root causes behind delays and disappointing results for innovation teams with physical products, so that they could accelerate the time from idea to launch.

She has shared the Rapid Learning Cycles framework with teams on every continent except Antarctica, working on products like medical devices, next-generation renewable energy, biotech, transportation, food production and consumer electronics.

Books by Katherine:



Available in eBook and softcover
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