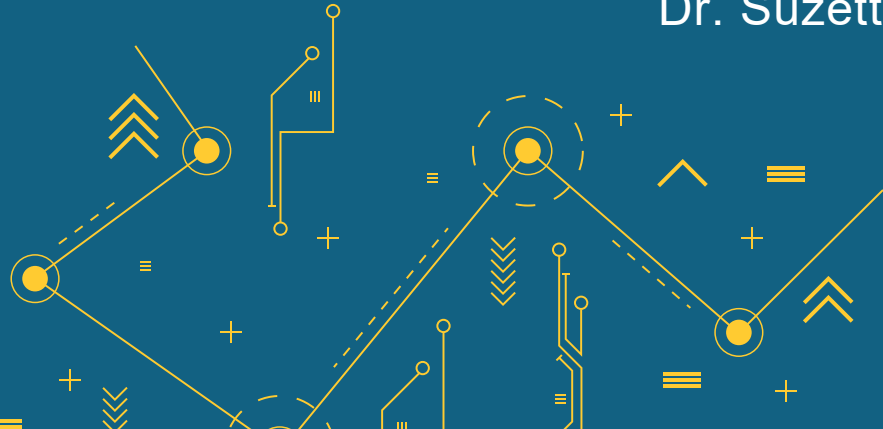# INDUSTRIAL DEVOPS

Accelerating Innovation

Dr. Suzette Johnson

Introduction

On a journey to improve the state of the practice in building large-scale safety-critical cyber-physical systems using Industrial DevOps principles

Dr. Suzette Johnson **NG Fellow, Lean Agile Digital**
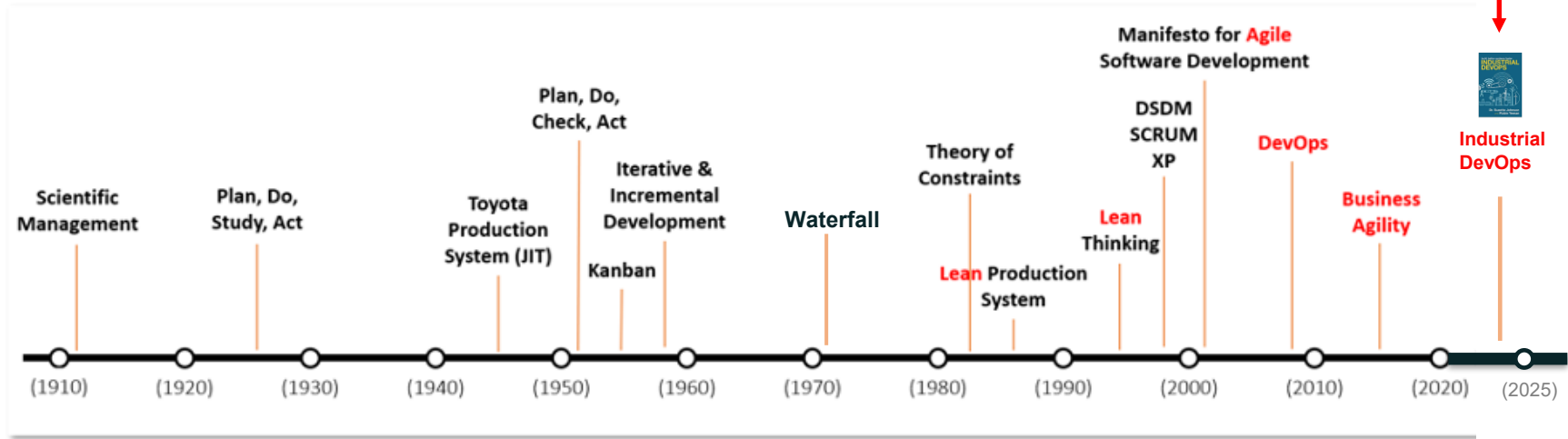
Power of Collaboration

Innovation and collaboration across all levels of the organization, are critical for a company's growth and survival in today's fast-paced working environments where new digital capabilities emerge every day

Continuous Evolution

Extending Principles and Practices to System Level

4

Cyber-Physical Systems

Cyber-physical systems include critical human-safety requirements

F-35


B-2

Setting the Stage

Challenges

- Lack of alignment: practices and tools
- Lack of transparency
- Large batch size
- Delays due to bureaucracy and outdated practices
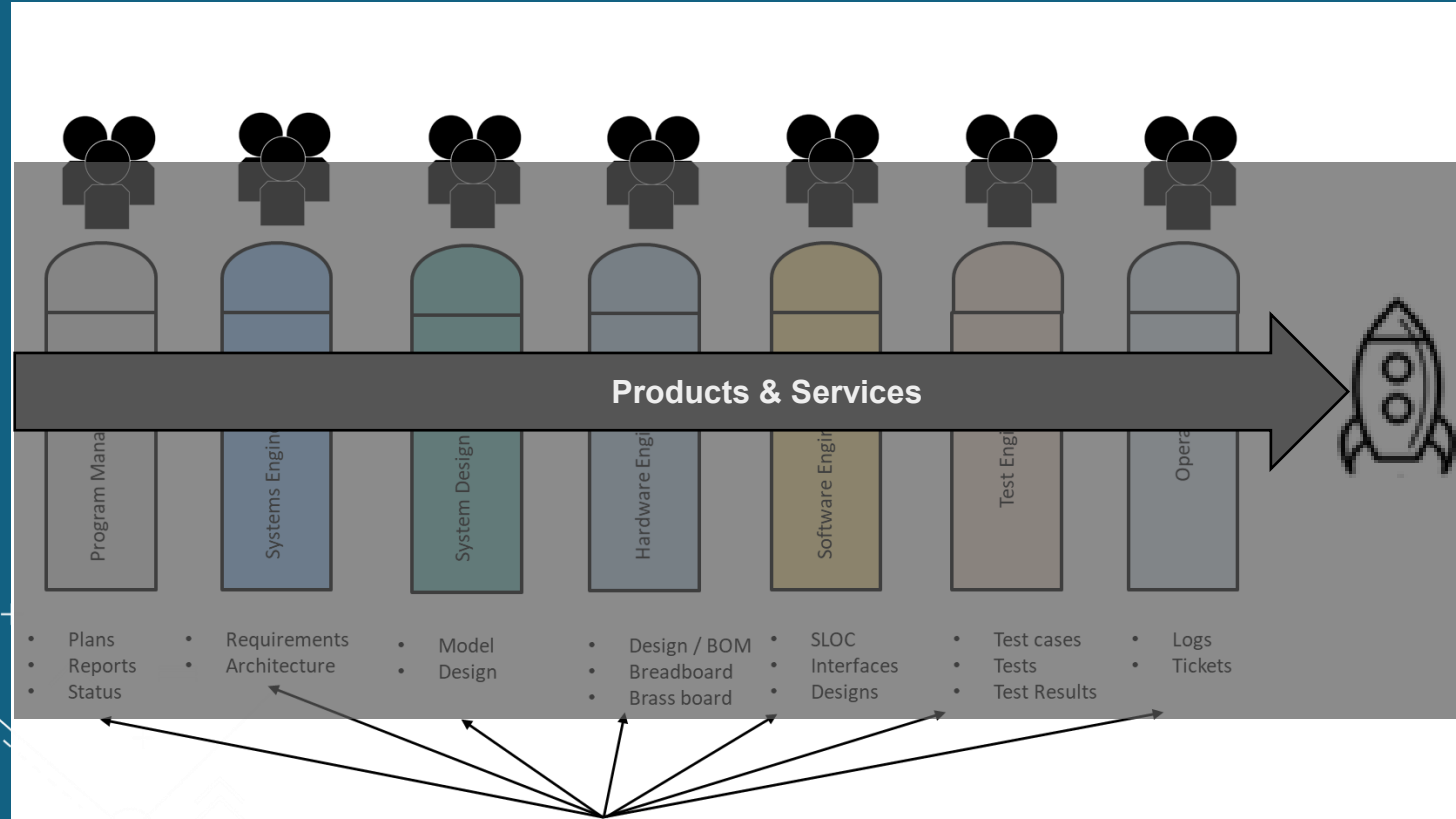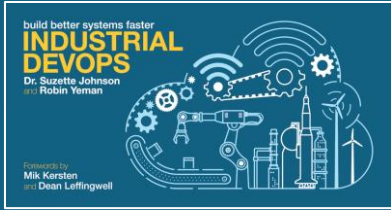- Long lead time for hardware procurement

Benefits

- Delivery of value in the shortest, sustainable lead time
- Improved collaboration and knowledge sharing across functional areas
- Build competitive advantage through rapid learning and experiments
- Improved quality
- Improved customer happiness
- Improve employee engagement

Industrial DevOps
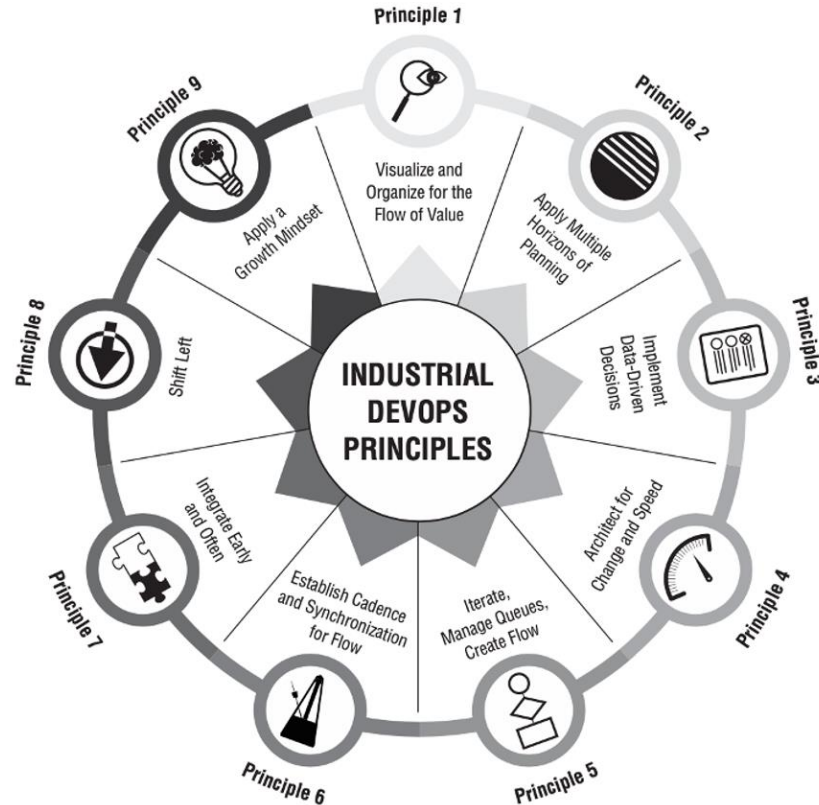
The application of Lean, Agile, and DevSecOps principles to the planning, development, manufacturing, deployment, and serviceability of significant cyber-physical systems.

(P1) Organize Around the Flow of Value

Program Manager — Plans, Reports, Status
Systems Engineering — Requirements, Architecture
System Design — Model, Design
Hardware Engineering — Design / BOM, Breadboard, Brass board
Software Engineering — SLOC, Interfaces, Designs
Test Engineering — Test cases, Tests, Test Results
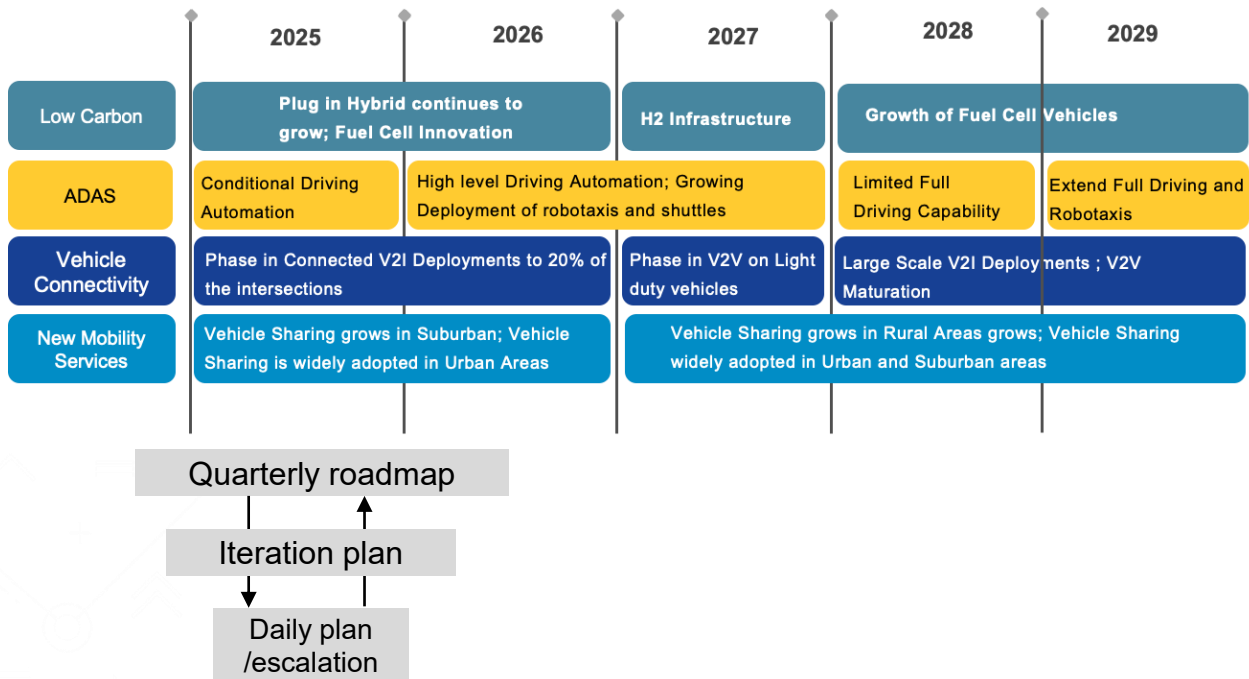Operations — Logs, Tickets

Products & Services

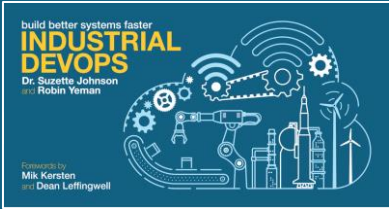# (P2) Multiple Horizons of planning

Moving from predictive planning to empirical planning requires multiple planning horizons that are regularly updated based on objective evidence.

To deliver big hairy Audacious goals….

	2025	2026	2027	2028	2029
Low Carbon	Plug in Hybrid continues to grow; Fuel Cell Innovation		H2 Infrastructure	Growth of Fuel Cell Vehicles	
ADAS	Conditional Driving Automation	High level Driving Automation; Growing Deployment of robotaxis and shuttles		Limited Full Driving Capability	Extend Full Driving and Robotaxis
Vehicle Connectivity	Phase in Connected V2I Deployments to 20% of the intersections		Phase in V2V on Light duty vehicles	Large Scale V2I Deployments ; V2V Maturation	
New Mobility Services	Vehicle Sharing grows in Suburban; Vehicle Sharing is widely adopted in Urban Areas		Vehicle Sharing grows in Rural Areas grows; Vehicle Sharing widely adopted in Urban and Suburban areas		

Quarterly roadmap

Iteration plan

Daily plan /escalation

(P3) Implement Data Driven Decisions

Continuously improve through demonstrated capabilities and real-time data

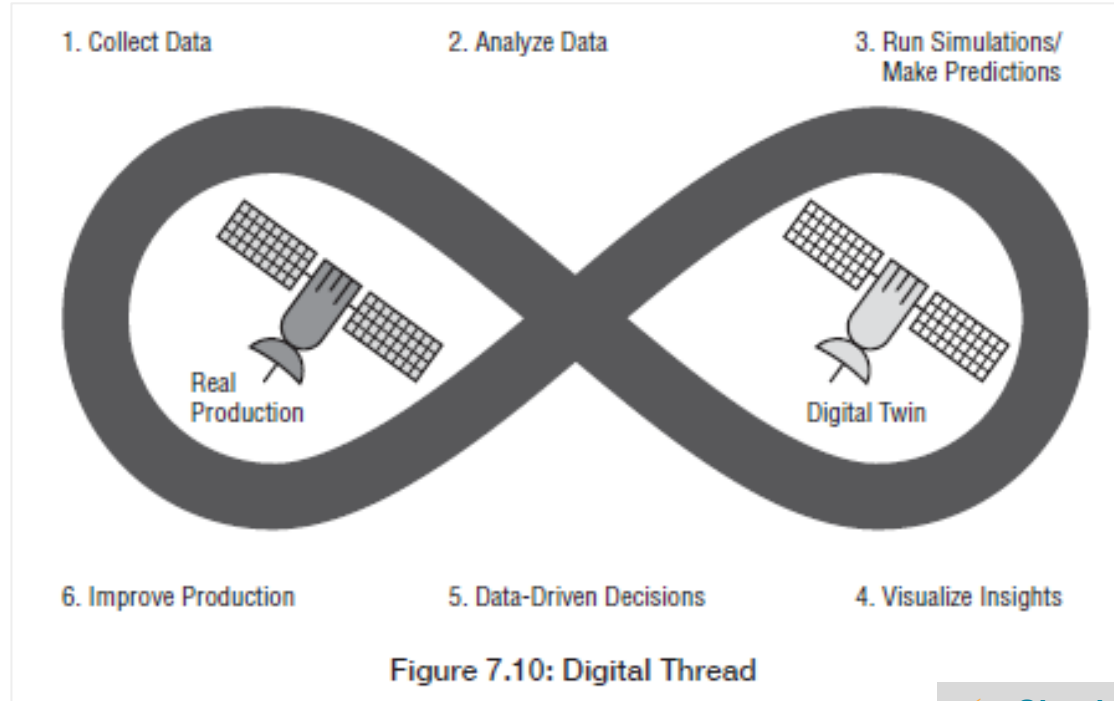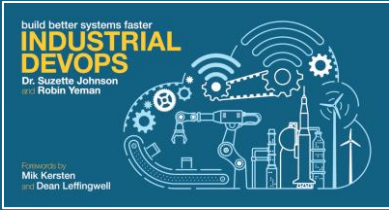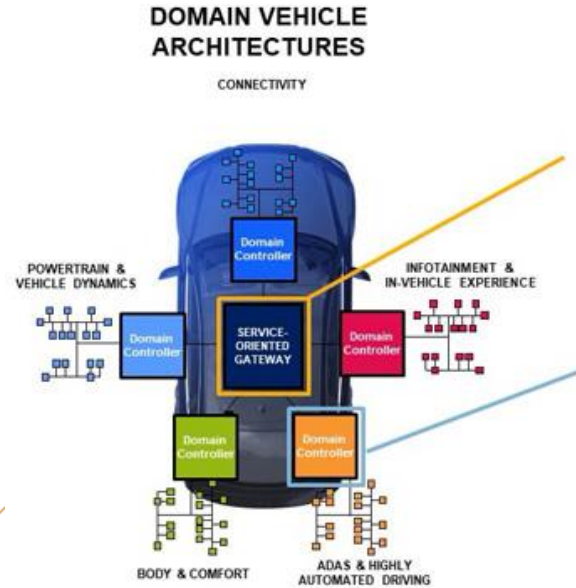
Figure 7.10: Digital Thread

- ✓ Simulator(s)
- ✓ Emulator(s)
- ✓ Digital Shadow(s)
- ✓ Digital Twin(s)
- ✓ 3D Printer(s)

(P4) Architect for change and speed

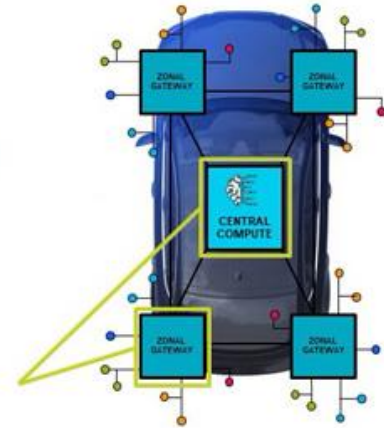Modularity enables continuous flow in software, hardware, and manufacturing

Practical Implementation

Joby Aviation

American aerospace company developing an electric vertical takeoff and landing aircraft for urban air mobility with plans to launch an air-taxi service.

Joby uses a modular architecture with standardized interfaces and a delivery pipeline that enables them to rapidly iterate on changes to the vehicle. They use agile practices and test-driven development of the entire vehicle to ensure quality is built in.

Johnson and Yeman. Industrial DevOps. 2023. IT Revolution.

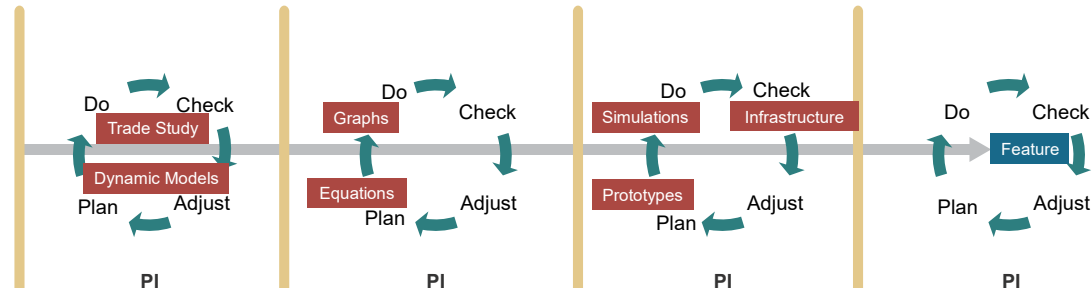Photo courtesy of Joby Aviation

(P5) Iterate and manage queues
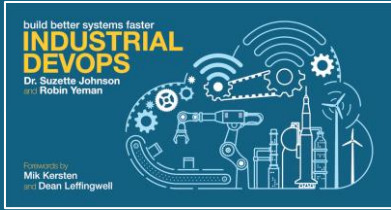
Early iterations of development may occur in virtual and simulated environments
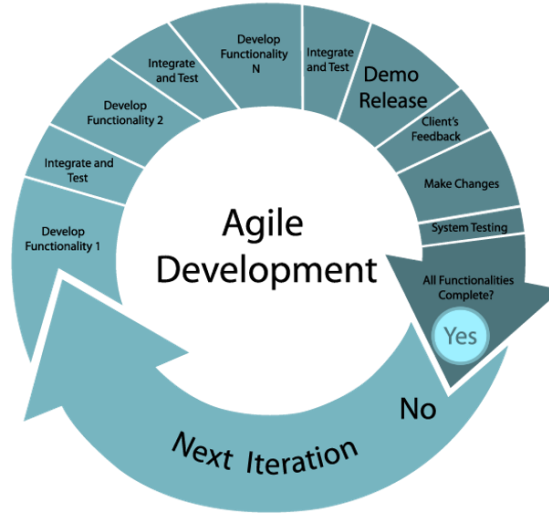
Tesla Model 3

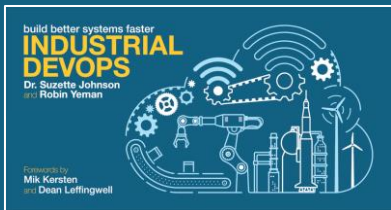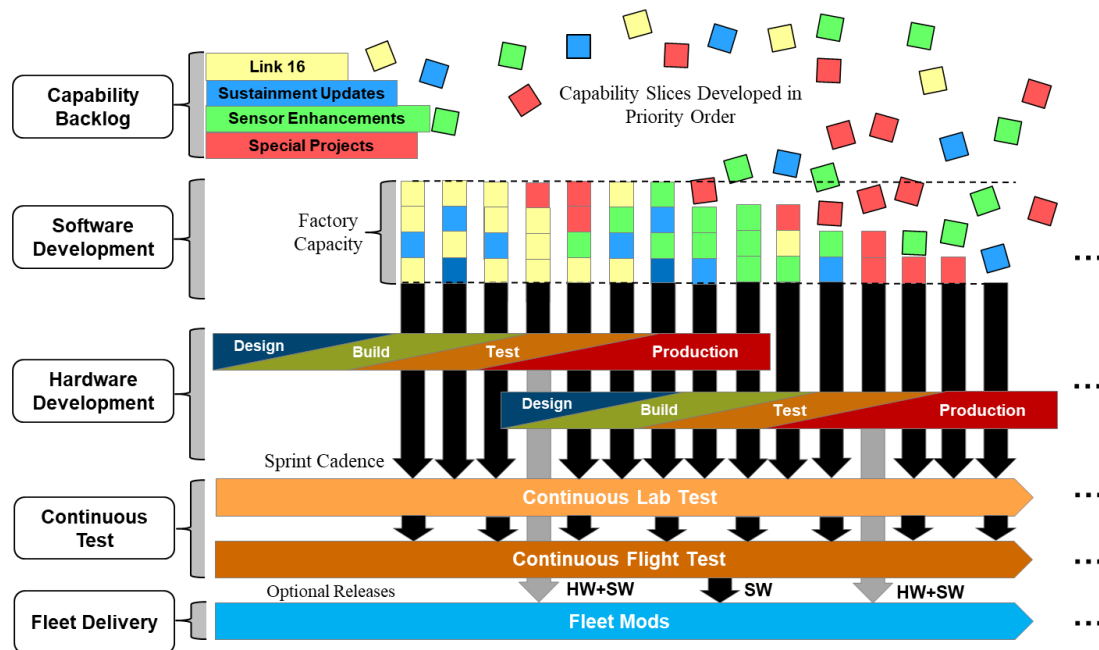Patti, A. (n.d.). *Tesla Model 3 agile car development framework*. Antonio Patti. https://www.antoniopatti.it/tesla-model-3-agile-car-development-framework-2/

(P6) Cadence and Synchronization

Regular synchronization occurs through demonstrations at the end of each iteration for fast feedback

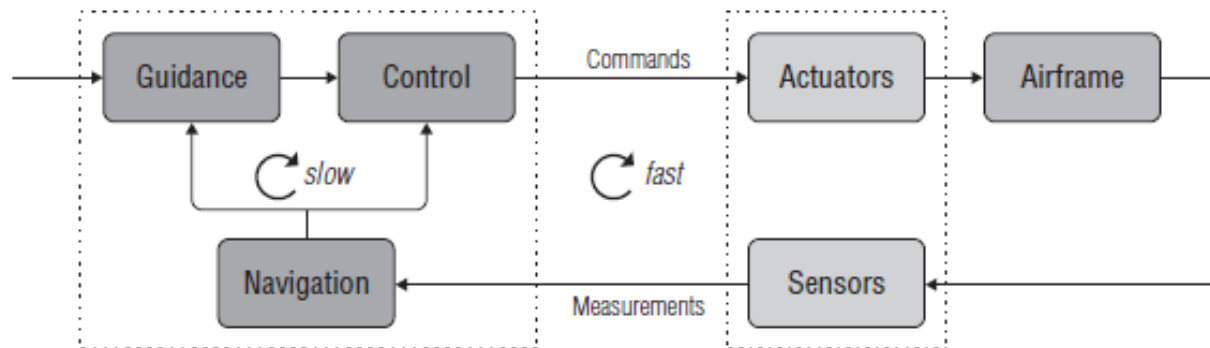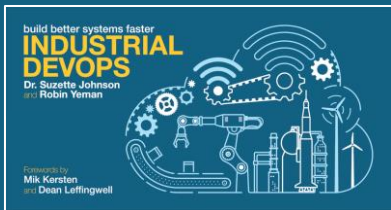# (P7) Integrate early and often

Figure 10.4: Cross-system Integration for Satellite

Scenario
You want to demonstrate how to use the satellite hardware to adjust the attitude using a software command.
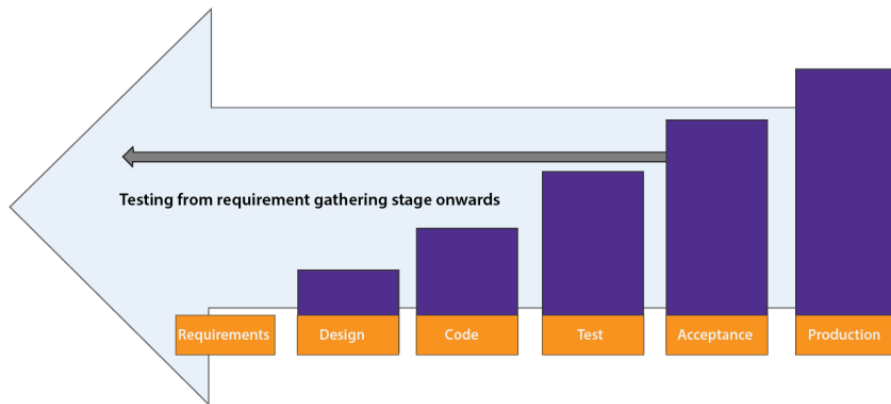
Practical Implementation

Planet Labs

American Private company with a mission to image all the Earth daily to identify temporal global changes. The imaging data allows them the ability to analyze agricultural, energy, forestry, maritime, and sustainability events and impacts.

Optimizing spacecraft design using success patterns of modularity, standardized interfaces, and open architecture along with Agile and DevOps practices.

Results: Faster time to delivery; ability to continuously optimize designs.

Johnson and Yeman. Industrial DevOps. 2023. IT Revolution.

Testing from requirement gathering stage onwards

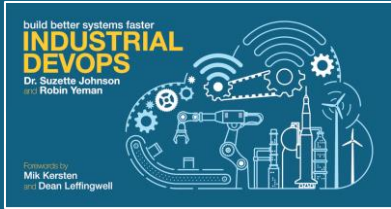| Requirements | Design | Code | Test | Acceptance | Production |

Shifting towards "LEFT"

McLaren commercial technology head Edward Green stressed the importance of maximizing digital twins to succeed under a budget cap.
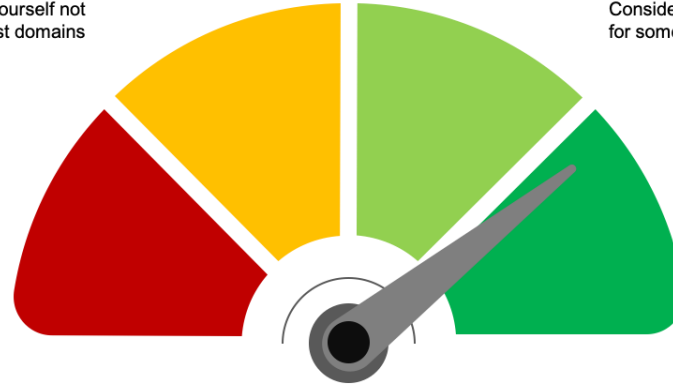
(P9) Growth Mindset

Low Growth
Consider yourself not capable for most domains

Mixed
Consider your self capable for some domains

Fixed Mindset
Matching the world to fit you

Growth Mindset
Matching you to fit the world

Any person who has never made a mistake never tried anything new
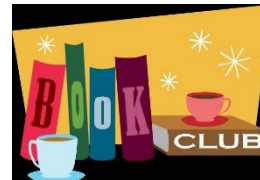*- Albert Einstein*

Continuous Learning

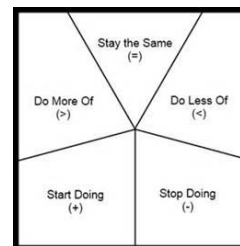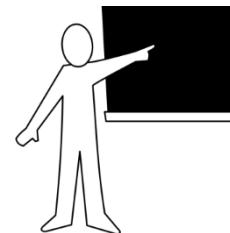| Communities of Practice	Webinars and Training	Book Clubs	Dojo Immersive Learning
Local Meetups	Gemba Go and See	Retrospectives Kaizen Events	Team Inside-Outs

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Leverage Your Tools

Follow the flow of value and leverage all of the tools in your toolbox

Begins with a need

- Planning
- Requirements And Discovery
- Virtual Reality
- Software Factory
- AI/ML
- Cyber
- Human Machine Interface
- Edge
- Digital Twin
- Data Aggregation
- Modeling
- 3D Printing
- Augmented Reality
- Data Visualization
- Immersive Education

Cyber Representation of Physical World Enabling Rapid Delivery

Value to the customer
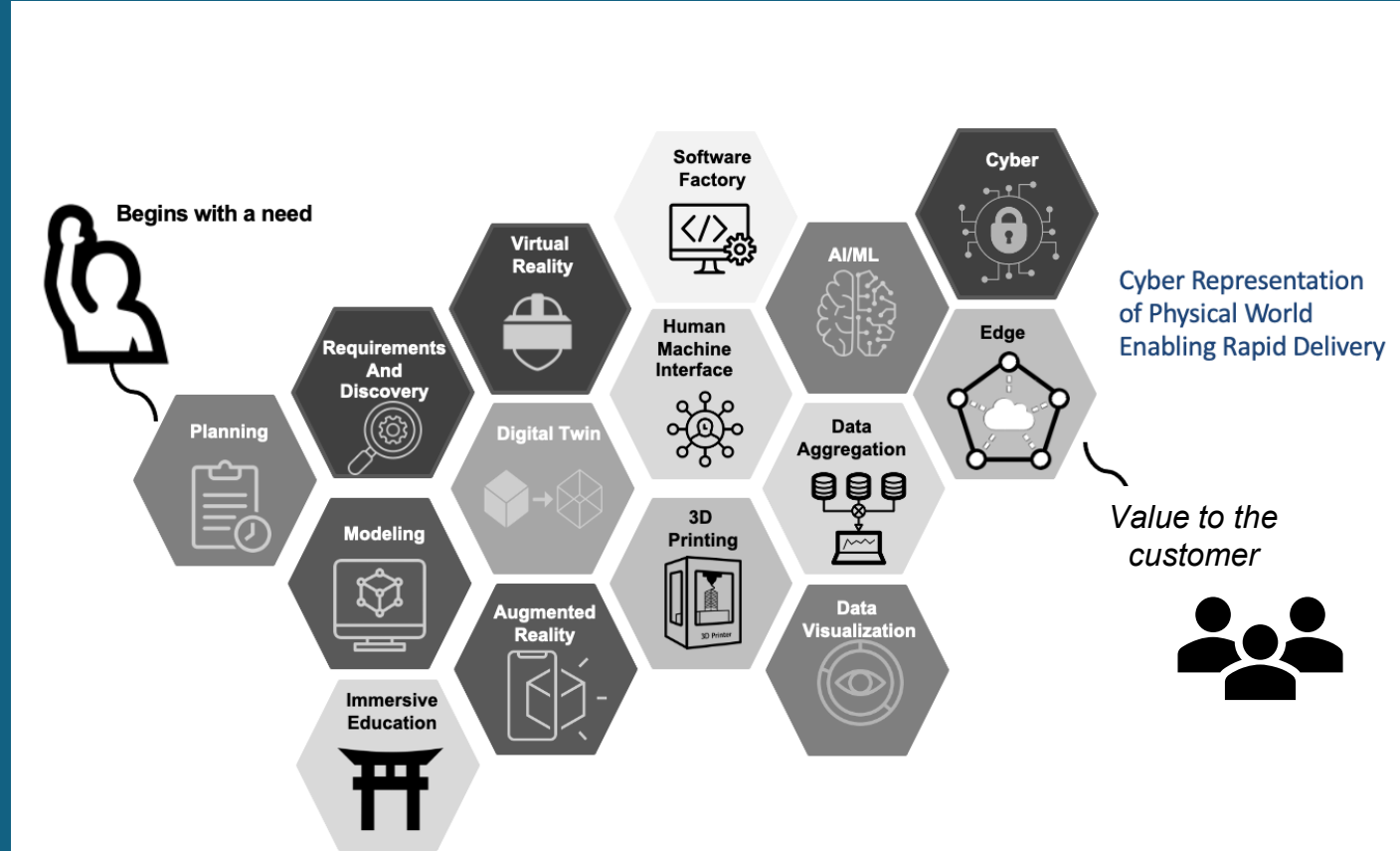
Create an Intentional Culture

A D K A R

Organizational Change Roadmap		
	Q1	**Q2**
Mind-sets	Provide relevant external case-studies that drive the point to change	Develop and publish Internal case-studies to share internally (localized outcomes/success)
Structures	Permission to fail (ie provide awards for failure)	Team-based performance awards
Competency	Role based learning– acknowledge the gaps and build learning plans	Brown-bag lunch & learns
Role-modeling	Leadership commits and uses Lean-Agile language	Leadership participates in an Lean-Agile book club

Reference: Johnson ,et. al Applied Industrial DevOps. 2020. IT Revolution.

1ˢᵗ State of Industrial DevOps

Industrial DevOps is important because it addresses the escalating cybersecurity risks and operational inefficiencies that traditional OT management practices can no longer handle.

By adopting Industrial DevOps, manufacturers can reduce preventable downtime, enhance collaboration between teams, and ensure a secure, agile, and resilient operational environment.

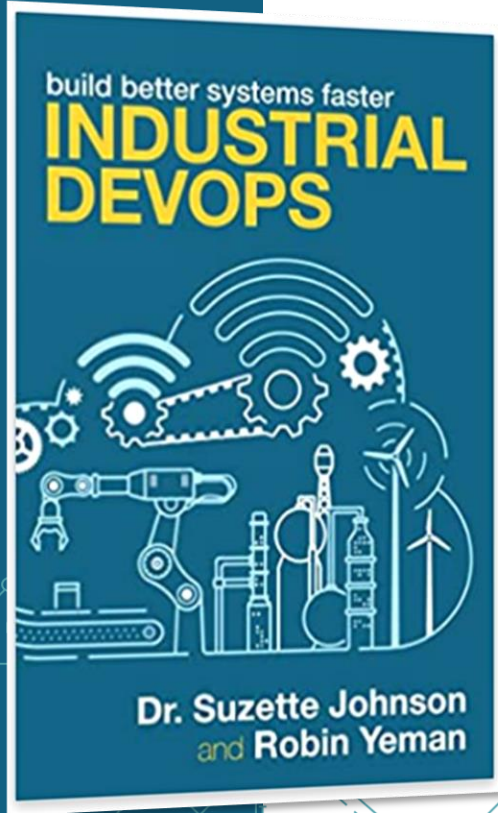**Key Takeaways from the State of Industrial DevOps Report**:
1. **50**% of downtime is attributed to industrial code issues.
2. Cybersecurity breaches are the **#1** cause of unplanned downtime.
3. The average cost of downtime is $**4.2 million per hour**.
4. **10**% of respondents identified as first movers faced no challenges adopting Industrial DevOps.
5. **78**% of respondents reported that ad hoc fixes are commonplace, leading to increased vulnerabilities.
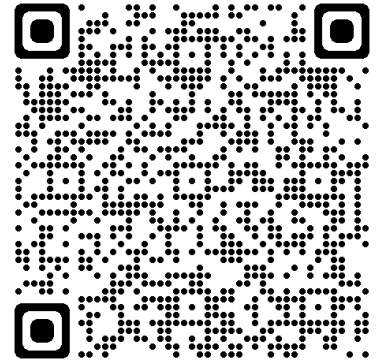
https://hubs.la/Q02FPvnn0

Quote from Jeff Winters, LinkedIn

Industrial DevOps Articles

2018   2020   2022   2024   ?

2019   2021   2024   2024

Free chapters

Conclusion

The goal is to learn faster through validated delivery of value

Q & A

ASK AWAY!