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Human Systems Integration (HSI) and DevOps

Applying Agile Systems Engineering in DoD Systems Acquisition

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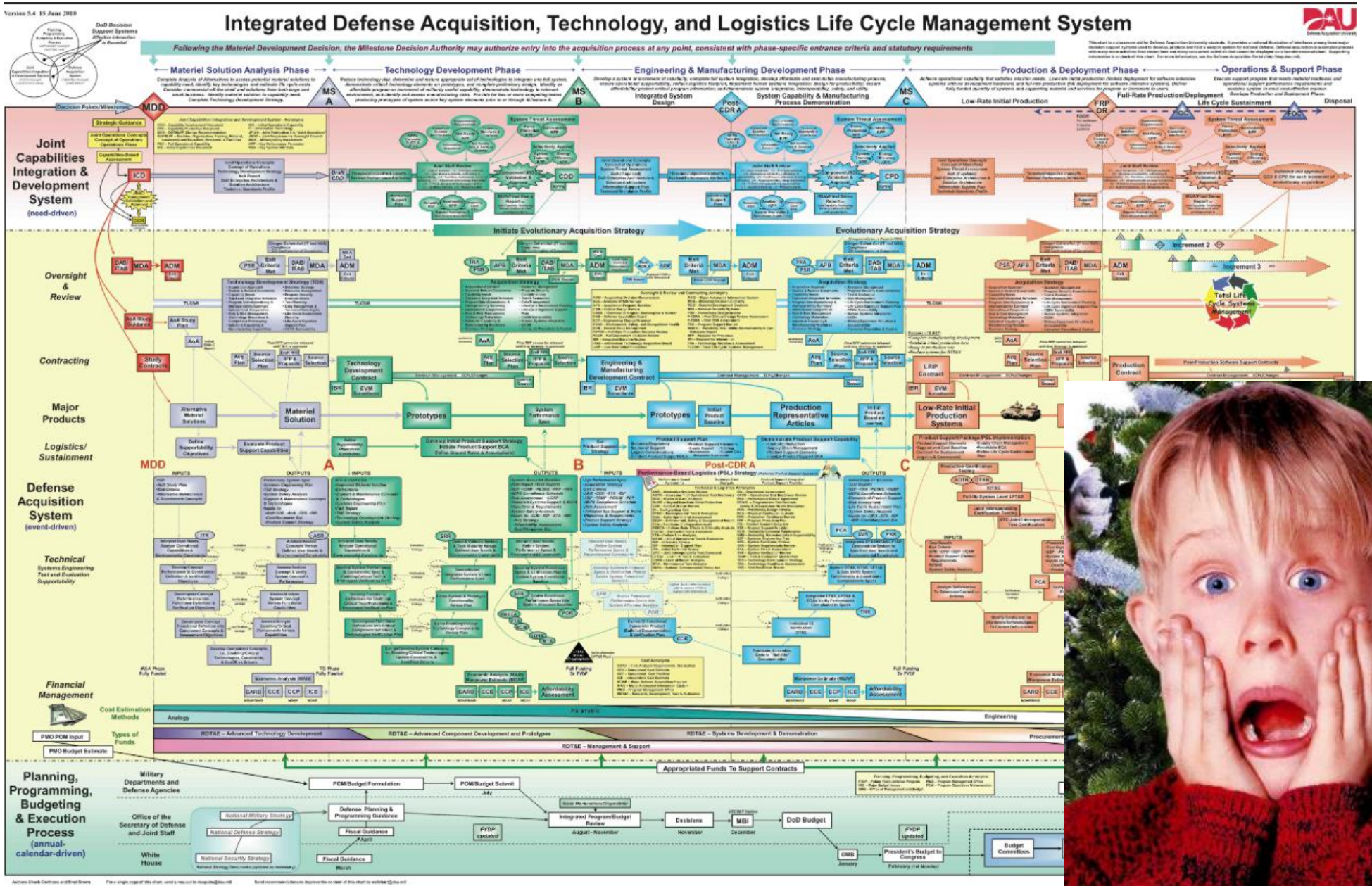
Outline

- DoD Systems Acquisition: Then and Now
- HSI Definitions and Adaptations
- DevOps and The Three Ways
- Mini-Use Cases
- Next Steps

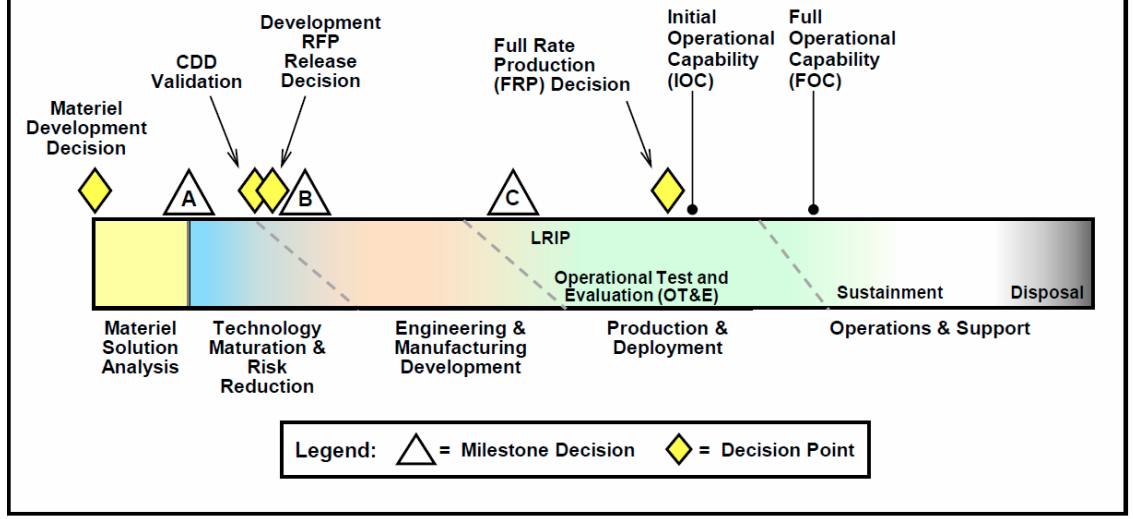
Discussion points scattered throughout: Your feedback is requested!


Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System
Following the Materiel Development Decision, the Milestone Decision Authority may authorize entry into the acquisition process at any point, consistent with phase-specific entrance criteria and statutory requirements
Materiel Solution Analysis Phase
Technology Development Phase
Engineering & Manufacturing Development Phase
Production & Deployment Phase
Operations & Support Phase
MDD
MS A
MS B
MS C
FRP DR
FOC
Joint Capabilities Integration & Development System (need-driven)
Defense Acquisition System (event-driven)
Planning, Programming, Budgeting & Execution Process (annual-calendar-driven)
Initiate Evolutionary Acquisition Strategy
Evolutionary Acquisition Strategy
Increment 2
Increment 3
Total Life Cycle Systems Management
Oversight & Review
Contracting
Major Products
Logistics/ Sustainment
Technical
Financial Management
Technology Development Contract
Engineering & Manufacturing Development Contract
LRIP Contract
Production Contract
Prototypes
Production Representative Articles
Low-Rate Initial Production Systems
Performance-Based Logistics (PBL) Strategy
Appropriated Funds To Support Contracts
DoD Budget
Military Departments and Defense Agencies
Office of the Secretary of Defense and Joint Staff
White House

DoD Systems Acquisition: Then

- Focus on fielding **systems**
  - Hardware-intensive: Major weapons platforms
  - Follows traditional, V-Model of systems engineering
  - Software components utilize Waterfall methodologies
- Useful for fielding systems with stable capabilities and long life cycles
  - F-16 (1974 ->)
  - USS Nimitz (1975 ->)
  - Individual Master File (1960s ->)

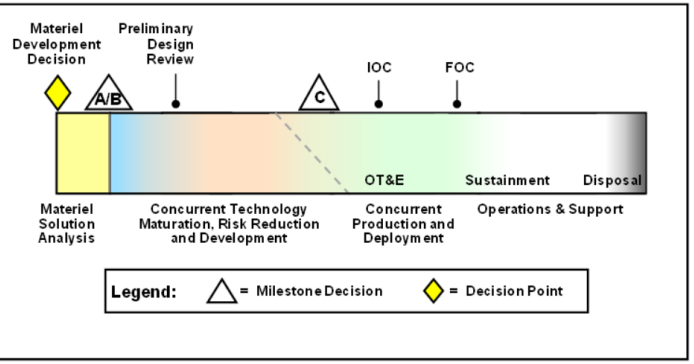
Figure 3. Model 1: Hardware Intensive Program



*Operation of the Defense Acquisition System (DoDI 5000.02, 2017)

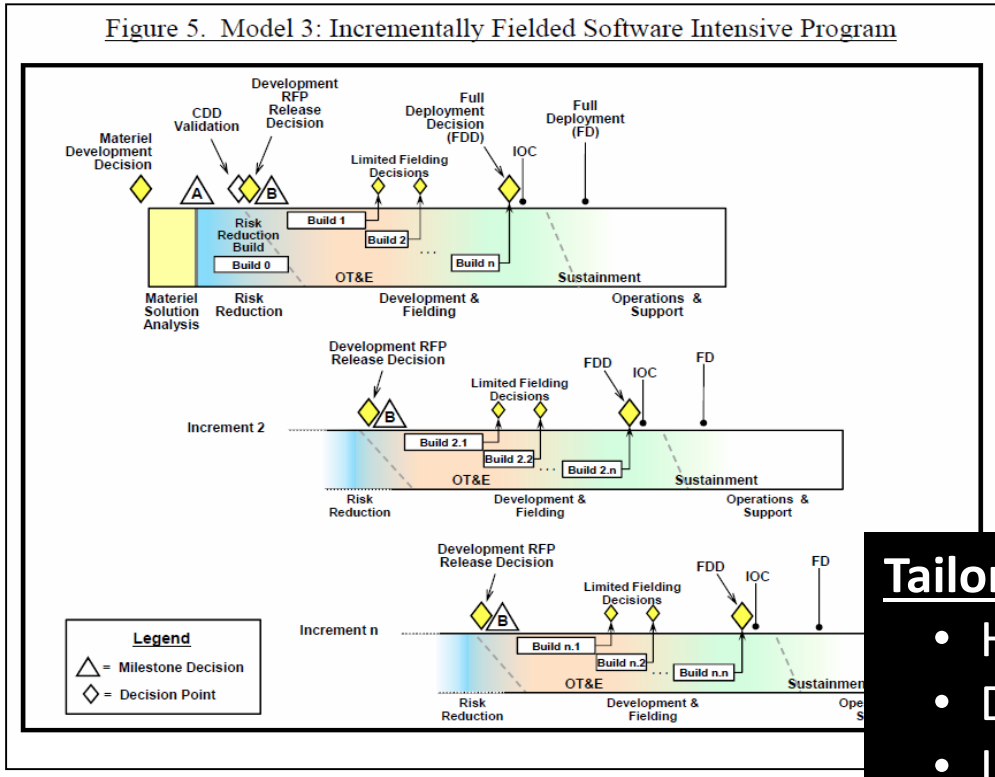
DoD Systems Acquisition: Now

Figure 6. Model 4: Accelerated Acquisition Program



Urgent Operational Need: MRAP

Figure 5. Model 3: Incrementally Fielded Software Intensive Program



Tailored Systems Acquisition

- Hardware
- Defense Unique Software
- Incrementally Fielded Software
- Accelerated
- Hybrid
- Hybrid (software)

DoD Systems Acquisition: Now (cont.)

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- Focus on fielding **capabilities**
  - Mix of software and hardware, System of Systems approaches
  - Utilizes Agile Systems Engineering
  - Software components utilize Agile Development and DevOps concepts
  - Short life cycles (Windows XP = 7 years, iOS 1.0-12.0 = 10 years)
- Challenges
  - **Managing Risk:** More expensive, less time to “figure it out”
  - **Managing Complexity**: Sub-systems as machines vs. natural systems
  - **Ensuring Rigor:** Document vs. Model-Based Systems Engineering
- Opportunities
  - **Flexibility:** Agile SE, Agile Software Dev allows for course correction
  - **User feedback:** Feedback (good and bad) travels fast!

Defining HSI: DoDI 5000.02

HUMAN SYSTEMS INTEGRATION DOMAINS

HUMAN FACTORS ENGINEERING

The integration of human characteristics into system definition, design, development, and evaluation to optimize human-system performance under operational conditions.

PERSONNEL

Determining and selecting the appropriate cognitive, physical, and social capabilities required to train, operate, maintain, and sustain systems based on available personnel inventory or assigned to the mission.

HABITABILITY

Establishing and enforcing requirements for individual and unit physical environments, personnel services, and living conditions, to prevent or mitigate risk conditions that adversely impact performance, quality of life and morale, or degrade recruitment or retention.

MANPOWER

Determining the most efficient and cost-effective mix of manpower and contract support necessary to operate, maintain, provide training and support the system.

TRAINING

Developing efficient and cost-effective options that enhance user capabilities and maintain skill proficiencies for individual, collective, and joint training of operators and maintainers.

SAFETY AND OCCUPATIONAL HEALTH

Consider environmental, safety and occupational health in determining system design characteristics to enhance job performance and minimize risks of illness, disability, injury and death to operators and maintainers.

FORCE PROTECTION AND SURVIVABILITY

Impact system design (e.g., egress, survivability) to protect individuals and units from direct threat events and accidents, including chemical, biological, and nuclear threats.

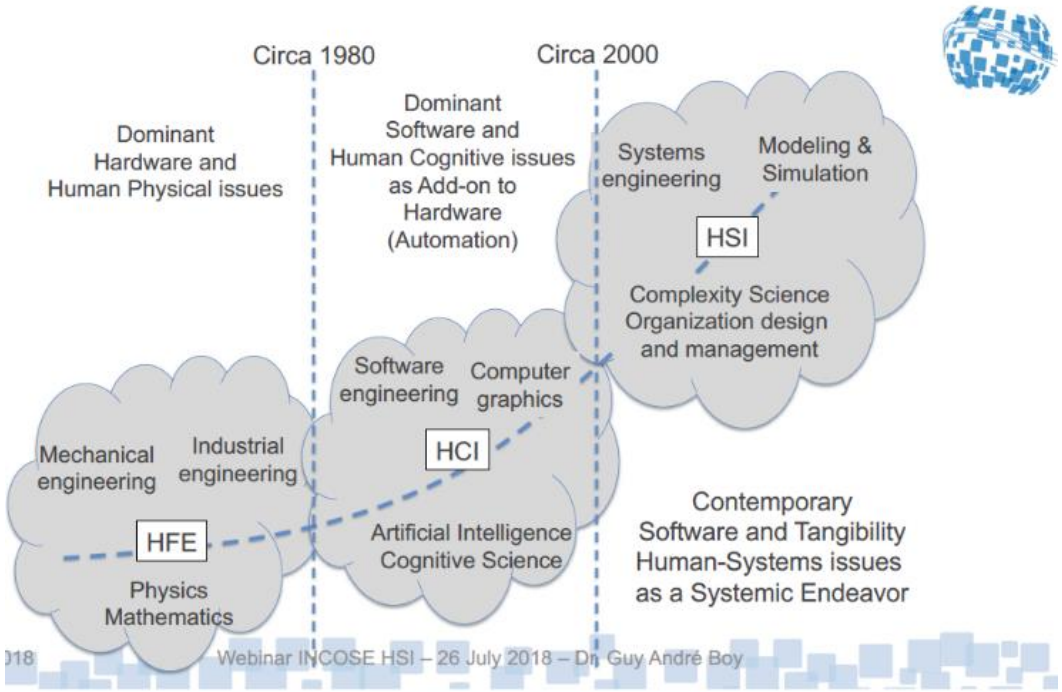
Key activities

- Conduct tradeoffs between domains (tailored HSI)
- Ensure that all user types represented: operator, maintainer, support

Retrieved from:
http://www.armyg1.army.mil/HSI/files/Domains.pdf

Defining HSI: INCOSE HSI Working Group

- "The **interdisciplinary technical** and **management** process for integrating human organizational considerations within and across all elements of a socio-technical system during its **whole life cycle** to improve its safety, performance, and comfort."
- … OR
- A specialty engineering discipline
- Something that gets auto-corrected to "HIS".



*Retrieved from: INCOSE HSI webinar (Dr. Guy Boy, 26 July 2018)

HSI Objectives to Adapt to Agile SE/Development… successfully

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- Challenging “HSI in name only” (unclear HSI tasking)
  - Tends to occur when HSI mentioned only in documentation
  - Missing/weak user-centered requirements (need to be baked in)
- Ensure timely HSI inputs to systems engineering artifacts
  - Respecting organizational boundaries and timelines
  - Providing product-centered value within HSI Domains and between stakeholders
- Avoiding the perception of gold plating (excess HSI tasking)
  - Opportunity cost for critical system development resources: There’s no system to integrate if program is “permanently delayed”
  - Short-term thinking tarnishes reputation of the HSI enterprise

Discuss: What are some adaptation challenges as you conduct systems engineering in your organization?

DevOps: A Partnership

- “DevOps is a set of practices that automates the processes between software development and IT teams…”*
- CAMS: Culture, Automation, Measurement, Sharing [Willis & Edwards, 2010]
- “The Three Ways” (Gene Kim)**
  - Adopt Systems Thinking
  - Amplify Feedback Loops
  - Create a culture of Continual Experimentation

- Why DevOps?
  - Part of the PEO C4I 7-pillar Digital Execution Plan
  - Natural progression for business systems (PEO EIS)
  - Captures the essence of interdisciplinary efforts

*https://www.atlassian.com/devops/
**DevOps images retrieved from https://itrevolution.com/the-three-ways-principles-underpinning-devops/

Use Case Templates and Assumptions

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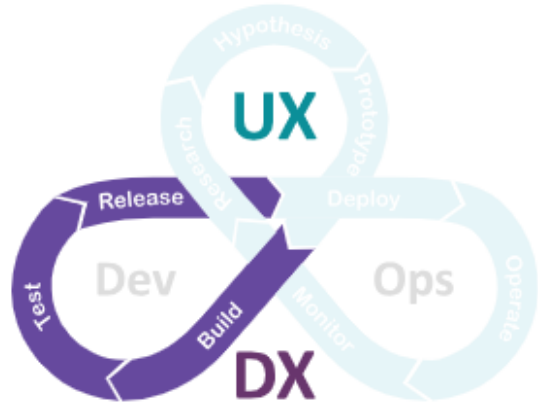
- Mini-use Case structure (a retrospective)
  - Present key DevOps technical practices (The “Ways”)
  - Describe lessons learned on applying (or not applying) each of the Ways to HSI in Systems Engineering
  - Provide a solution (or a call to action)
- Assumptions (for these use cases only)
  - HFE = HSI (one-domain integration)
  - User Experience (UX) is a reasonable approximation to HFE in **software-intensive systems**
  - It’s all DevOps: DesignOps, UXDX*, assumed to fit the generic process



*https://uxdxconf.com/model

The First Way: Adopt Systems Thinking / Mindfulness of Flow

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- Emphasizes system/global performance (vs. siloed/local performance)
- Prevent defective work from being sent downstream

- Continuous delivery – ~50 deploys/day @ Etsy
- Mini-use case 1.1: The “three program managers”
  - Requirements/prototype sponsor
  - Development authority
  - Operations/sustainment
- Mini-use case 1.2: The andon cord @ Toyota

*DevOps images retrieved from https://itrevolution.com/the-three-ways-principles-underpinning-devops/

The First Way: Systems Thinking / Flow (cont.)

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- Solutions
  - Understand relationships between local and system-level metrics
  - Automate* (as much as possible) user-centered testing
  - Establish a swarm mentality in solving problems

TABLE I
LEVELS OF AUTOMATION OF DECISION AND ACTION SELECTION

HIGH	10. The computer decides everything, acts autonomously, ignoring the human.
	9. informs the human only if it, the computer, decides to
	8. informs the human only if asked, or
	7. executes automatically, then necessarily informs the human, and
	6. allows the human a restricted time to veto before automatic execution, or
	5. executes that suggestion if the human approves, or
	4. suggests one alternative
	3. narrows the selection down to a few, or
	2. The computer offers a complete set of decision/action alternatives, or
LOW	1. The computer offers no assistance: human must take all decisions and actions.

Parasuraman, Sheridan, & Wickens (2000). A Model for Types and Levels of Human Interaction with Automation.

- Discuss: How do you communicate and declare risk downstream in your work?

The Second Way: Amplify Feedback Loops

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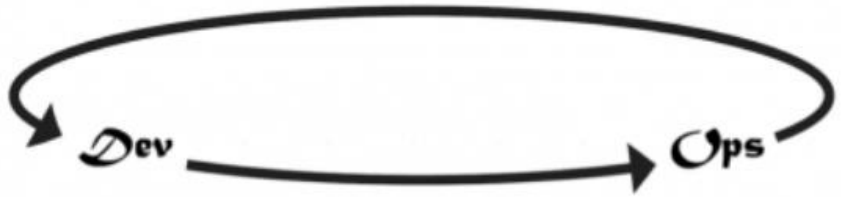
- Shorten and amplify feedback loops to make necessary corrections
- Emphasize collaboration over process



- Mini-use case 2.1: BETA prototype for a Navy HR system
  - End-user involvement in sprint demonstrations
  - Multiple organizations, design integrations/dependencies

- Lessons learned
  - Apply Lean UX principles
  - Challenge the notion of centralized design leadership
  - Rely on design hypotheses instead of pixel-perfect designs
- Discuss: What's your "pixel-perfect" trap?

DevOps images retrieved from: https://itrevolution.com/the-three-ways-principles-underpinning-devops/

The Third Way: Create a culture of Continual Experimentation and Learning

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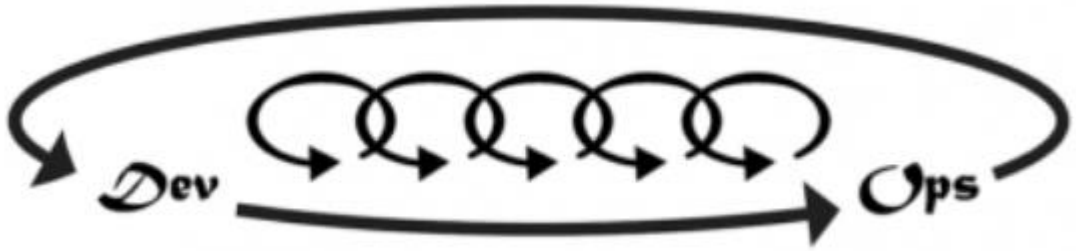
- Create a culture of continual experimentation and risk taking
- Accept learning from failure
- Mini-use case 3.1: Systems Engineering Technical Reviews (SETR)
  - Establishes risks and issues throughout the system lifecycle
  - Independent, event-based review of HSI sufficiency in documentation
- Mini-use case 3.2: Aviation Safety Reporting System @ NASA
- Mini-use case 3.3: Chaos Monkey @ Netflix



*https://itrevolution.com/the-three-ways-principles-underpinning-devops/
**https://asrs.arc.nasa.gov/
***
https://netflix.github.io/chaosmonkey/

The Third Way: Create a culture of Continual Experimentation (cont.)

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- Solutions
  - Apply the blameless post-mortem to all learning events
  - Stress-test your systems and people (safely?)
  - Set up an internal data collection/metrics system to gauge performance
- Discuss: What data do you have lying around that could be analyzed?

Summary and Next Steps

- Systems Engineering and HSI is moving faster than ever… enjoy the ride!
- Think about the Three Ways in DevOps
- Consider a shift from process and tools towards individuals and interactions
- Next Steps
  - Identify links with DevOps and Cybersecurity (DevSecOps concept)
  - Apply Way #3 to this brief, mature use cases with specific HSI and Systems Engineering examples
  - Spread the word!

Helpful Resources

- A DevOps reading list
  - The Goal
  - The Phoenix Project
  - The DevOps Handbook
- Websites
  - INCOSE HSI WG: https://www.incose.org/incose-member-resources/working-groups/analytic/human-systems-integration
  - DoD HFE TAG: https://www.acq.osd.mil/rd/hptb/hfetag/
  - Army HSI (formerly MANPRINT) http://www.armyg1.army.mil/HSI/
  - Defense Acquisition University: https://www.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=4d39f620-2f41-4522-a1b0-64958c8aa0eb

Thank You!

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