

Architecture-As-Code: DevOps for System Engineering

Engineering Rigor, MBSE, & Continuous Delivery
Enabling Full Government Lifecycle Engineering

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Who Am I?

History

- 24 years engineering, developing, and managing complex government systems
- 18 of those supporting the missile defense mission

Experience

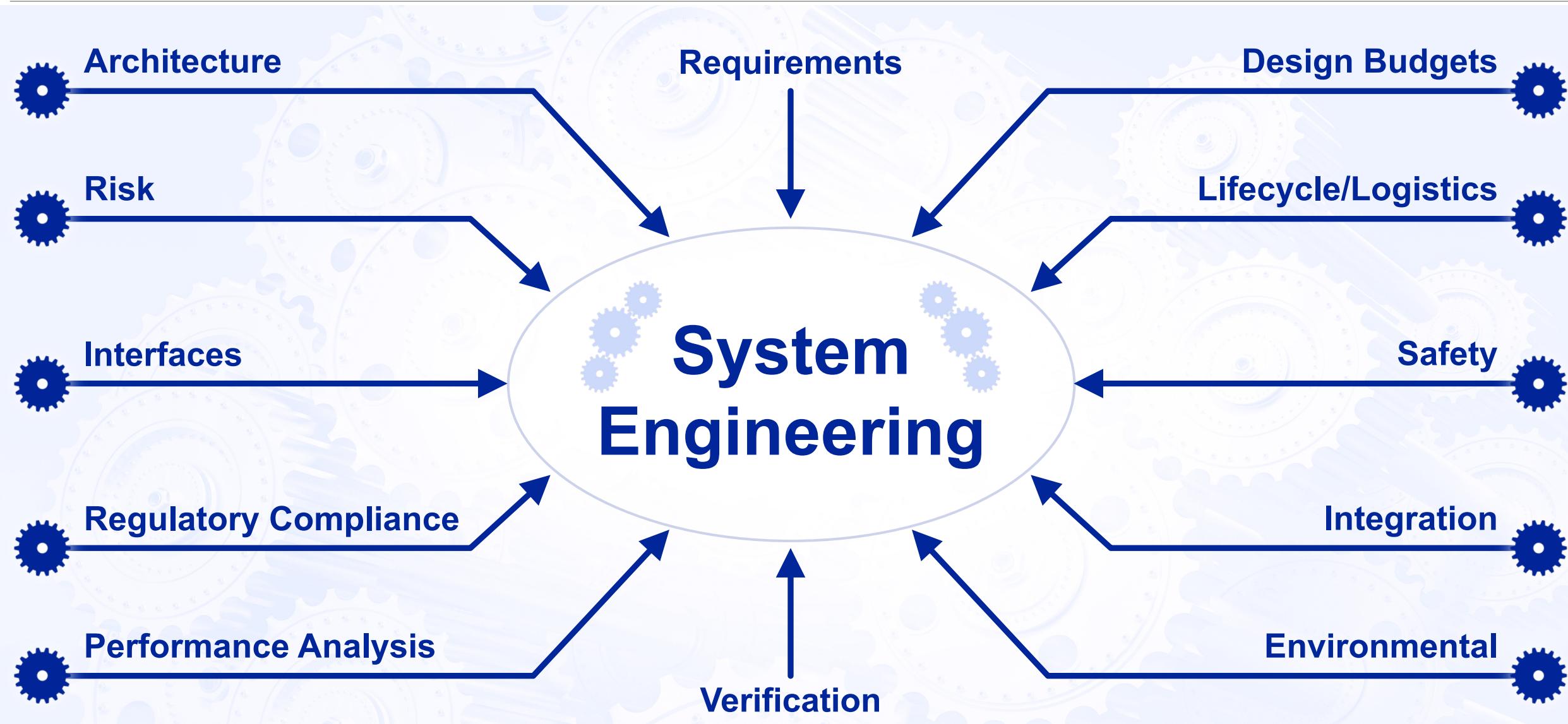
- Program Director, Technical Director, Chief Engineer, Architect, Proposal Leadership, Developer, Algorithms, Modeling & Simulation, Analysis, Tester, ...
- 24/7/365 Global System Operation
- DevOps for Defense Meetup Organizer



Fun Stories for Between Sessions

- Census system to officially recognize Jedi Knight as a religion
- World's largest SAN and transition to OPS in 1 shift
- Avoid orbital object collisions of a space launch vehicle
- Obtain the first “proper” approval to publish a FOSS project

System Engineering 101



DevOps Dilemma in System Engineering

“DevOps Practices don’t work for / apply to SE work products.”

DevOps Practices

- Working in small batches
- Rigorous Version Control
- Trunk-Based Development
- Continuous Integration
- Continuous Delivery
- Test Automation
- Deployment Automation
- WIP Limits
- Lightweight Change Approval Process
- Collaboration Among Teams
- ...

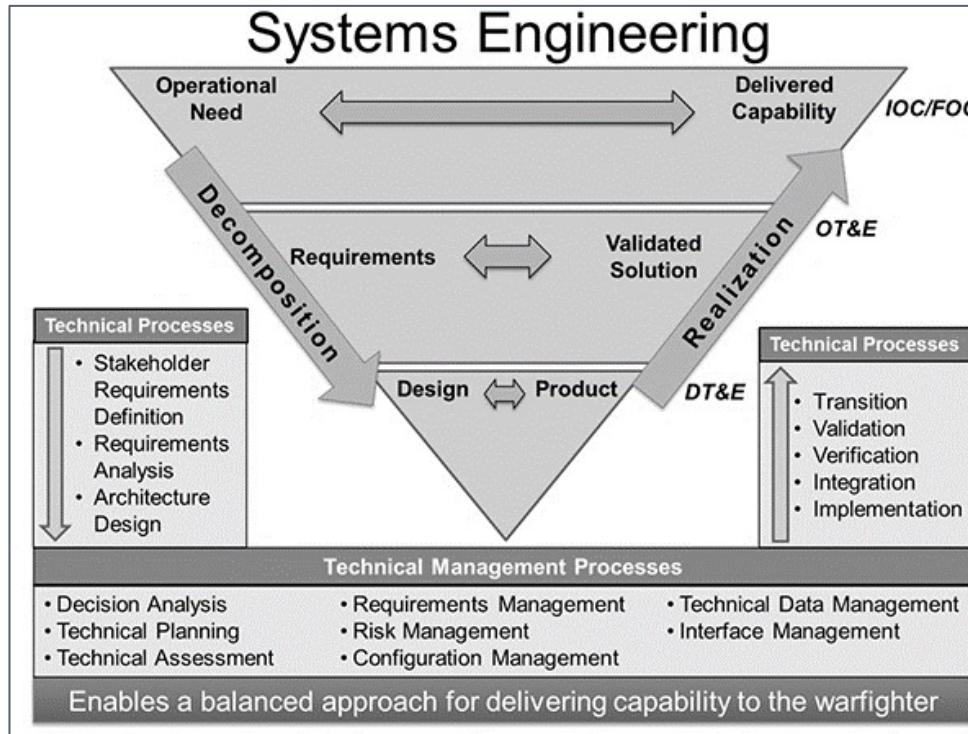
SE Work Products

- Use Cases
- Requirements Specifications
- Requirements Decomposition
- System / Cyber Architecture
- Interface Control Documents
- Test Specification
- Traceability Matrices
- Gate Review Presentations and Objective Evidence
- ...



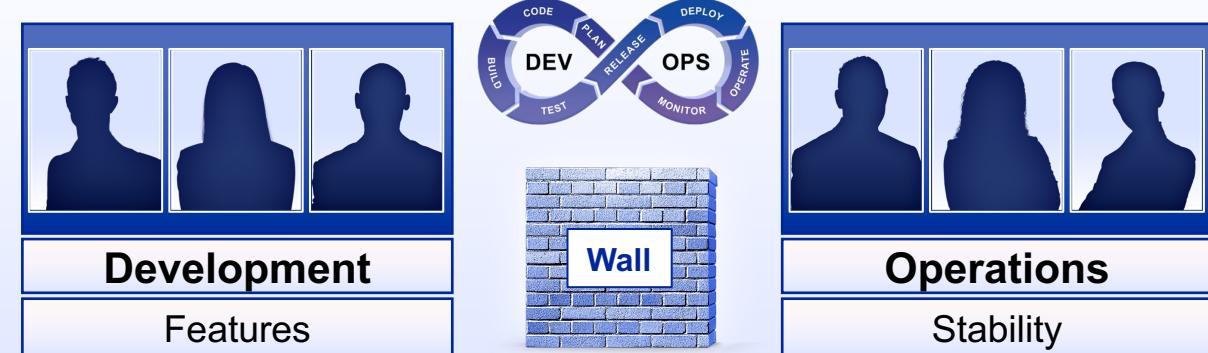
Living In the “Engineering V”

DAU System Engineering Process

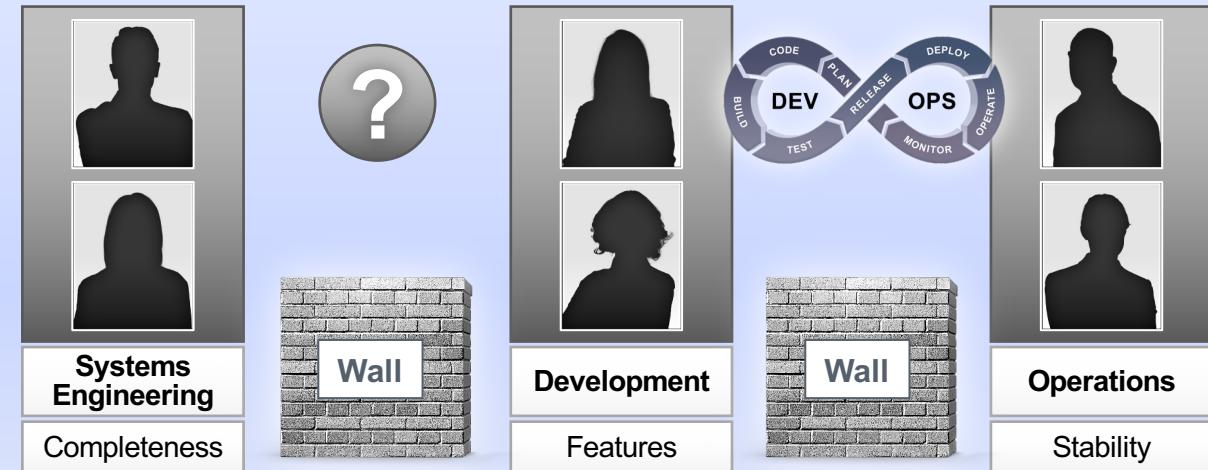


Source: <https://www.dau.edu/acquipedia/pages/ArticleContent.aspx?itemid=204>

Commercial DevOps



Government DevOps



Can We Adopt Commercial DevOps Practice Throughout the Engineering Lifecycle?

Hypothesis

We observe ...

- Rigorous Systems Engineering → Value
- Tailored DevOps Practices → Value
- A Key Platform DevOps “Tipping Point”: Infrastructure-as-Code (IaC)

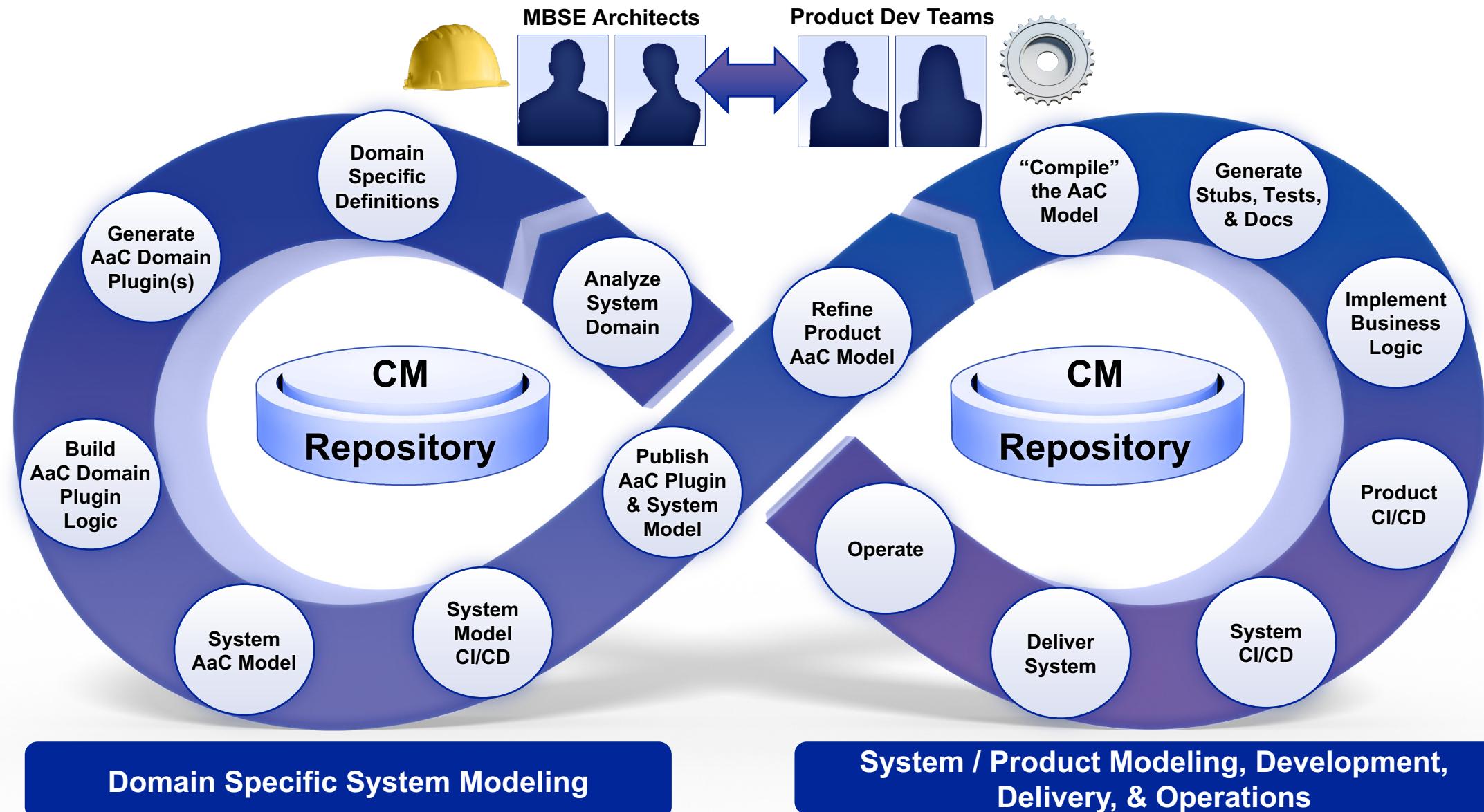
We believe ...

- System Engineering Products can be Defined Declaratively
- Complex Systems → Unique Domains
- Version Control, Quick Feedback, and CI/CD → Greater SE Team Effectiveness
- Open / Transparent MBSE

What if we could ...

- Model-Based System Engineering (MBSE) Solution Inspired by Infrastructure-As-Code (IaC)
- System Engineering Automation → Quality Assessment, Artifact Generation, CI/CD

Experiment: Architecture-as-Code



Outcomes

- Rapid Iterative Architecture Development
 - Multiple system architecture updates in sprint without disruption
 - Quickly overcome “late discovery” of interface incompatibility
 - Rapidly generate updated customer documentation
 - Auto-generate software interface code from update model
- Operational Mission Critical System Development
 - Fully automated safety-critical system modeling, documentation, & delivery
 - Transition from manual probability-based to exhaustive safety testing
 - Transition 6-8 week delivery process to 40 minutes with cross-domain continuous integration pipeline
 - Fully automate testing, data collection, analysis, and document generation for customer delivery
- Early Complex Product Modeling
 - System architecture, requirements, behavior, and interface engineering
 - Vertical (top-down) and horizontal (end-to-end) system traceability
 - Human / machine readable trace of system engineering artifacts to product
 - Requirements → Acceptance Test Specification → System Module → Automated Test → Test Report
 - Automated quality assessment for use in continuous integration

Future & Help Needed

Future / Aspirations

- Collaborate to create / tailor system engineering practices for modern mission speed
 - Maintain rigor that drives success in complex, safety-critical system delivery
- Apply high performance DevOps attributes to system engineering work
 - Robust Version Control, Small Batch Execution, Continuous Integration, ...
- Share outcomes and knowledge to help others succeed
 - Experience Reports, Guidance, Processes, Technology

Help Needed

- Share your challenges and opportunities in breaking down the SE “silo”
- How do you configuration manage and employ automation for your MBSE?
- Help us experiment & share your thoughts
 - <https://arch-as-code.org>
 - <https://github.com/DevOps-MBSE/AaC>
 - ‘pip install aac’

NORTHROP ▶
GRUMMAN ▶