Integrating the Risk Management Framework (RMF) with DevOps

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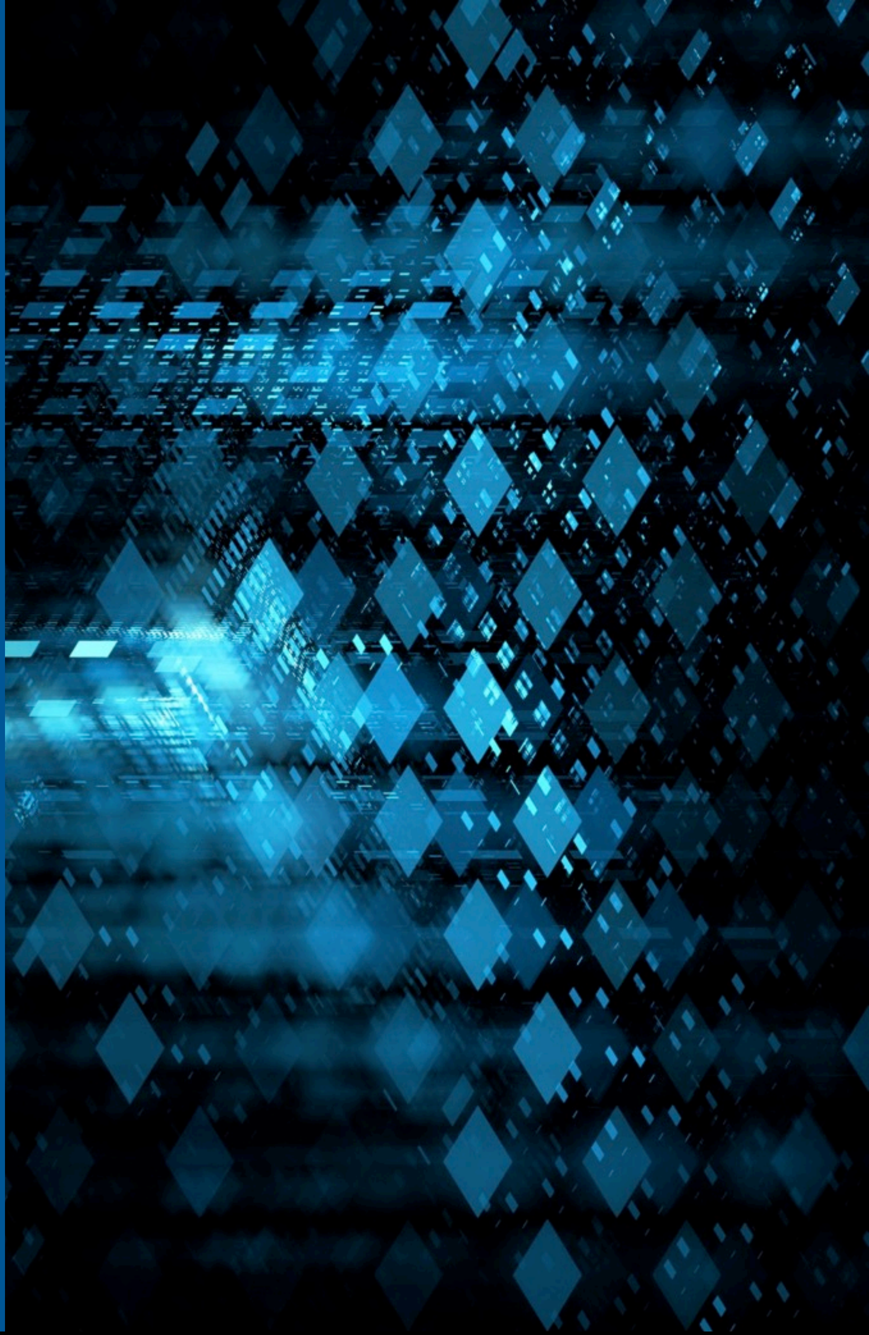

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Topics

What is DevOps

What is RMF

Security in an Agile World

Achieving Ongoing Authorization Decisions

DevOps Strategies

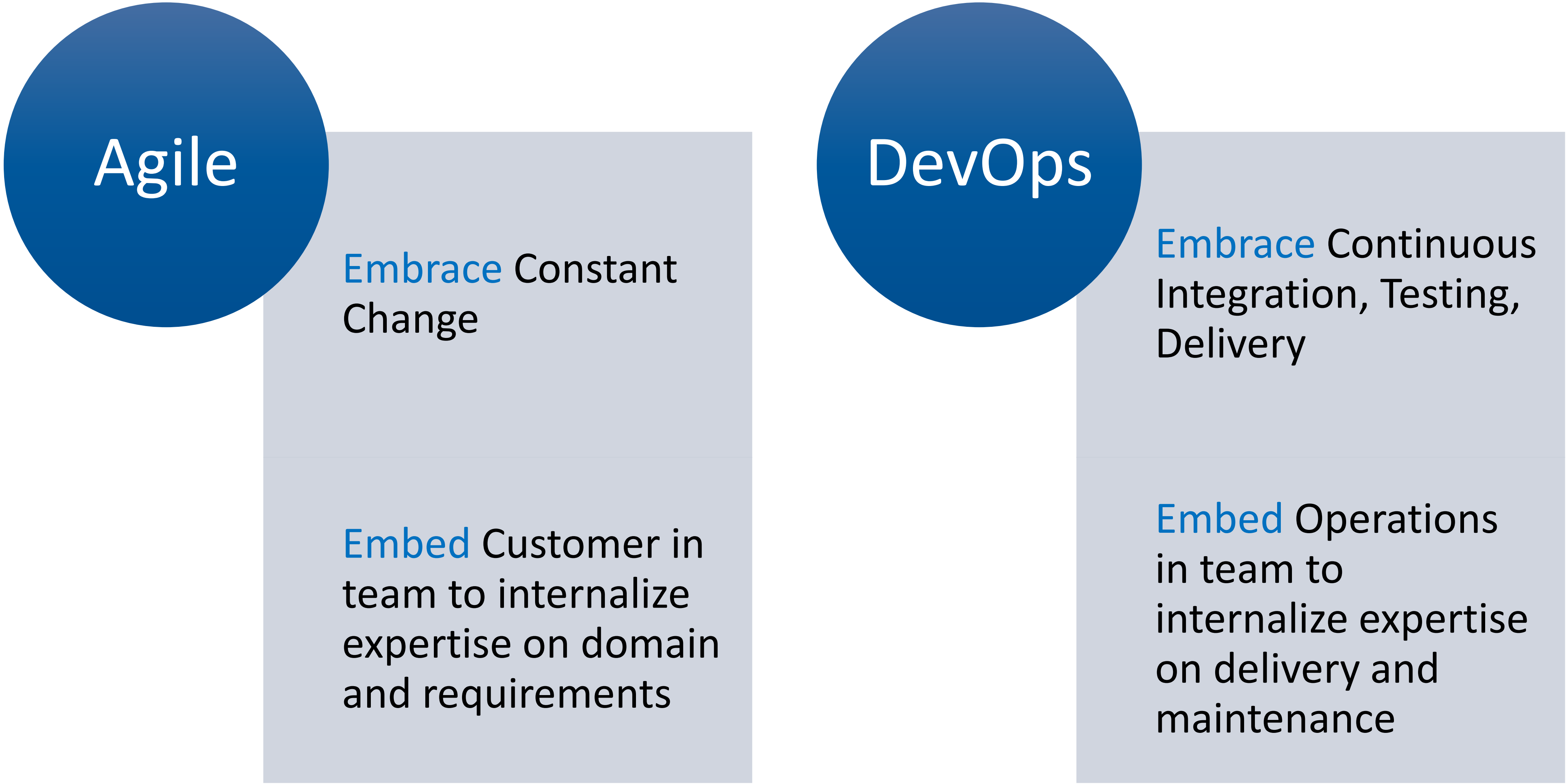
What are the core strategies of the DevOps paradigm?

Design flexible software architecture encompassing simple, independent components

Implement frequent, incremental changes

Integrate innovative, customizable tools that can automate maintenance processes to include communications, testing, deployment, cyber security . . .

DevOps is an Extension of Agile Thinking



Agile

Embrace Constant Change

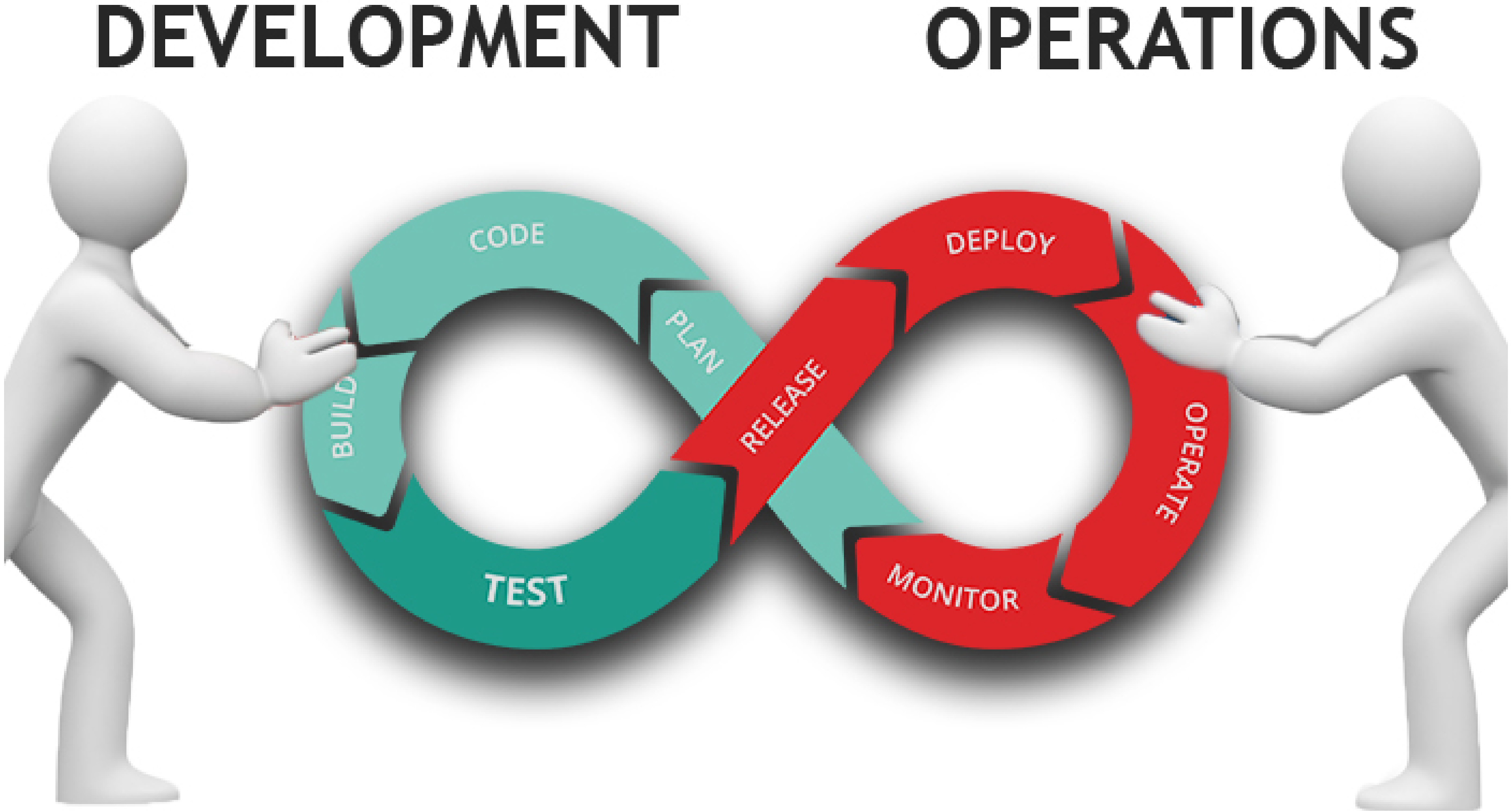
Embed Customer in team to internalize expertise on domain and requirements

DevOps

Embrace Continuous Integration, Testing, Delivery

Embed Operations in team to internalize expertise on delivery and maintenance

DevOps Phases



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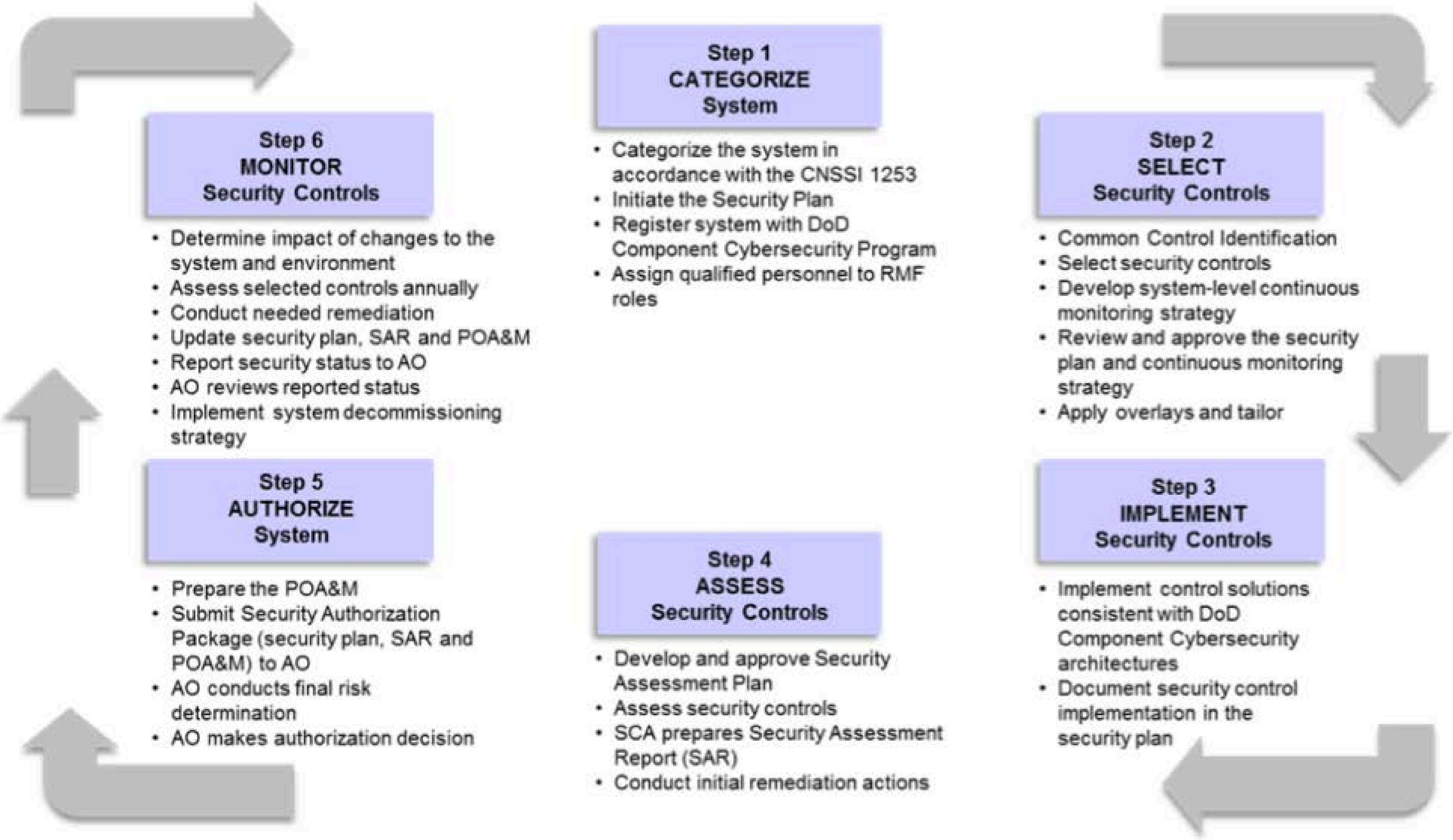
What is the Risk Management Framework (RMF)?

In 2014, the DoD started transitioning from the DoD Information Assurance Certification and Accreditation Process (DIACAP) to the Risk Management Framework for the DoD IT (RMF).

NIST Special Publication 800-37, "Guide for Applying the Risk Management Framework to Federal Information Systems", transforms the traditional Certification and Accreditation (C&A) process into the six-step Risk Management Framework (RMF).

The Risk Management Framework (RMF) provides a disciplined and structured process that integrates information security and risk management activities into the system development lifecycle.

What is the RMF?



Step 1 CATEGORIZE System

- Categorize the system in accordance with the CNSSI 1253
- Initiate the Security Plan
- Register system with DoD Component Cybersecurity Program
- Assign qualified personnel to RMF roles

Step 2 SELECT Security Controls

- Common Control Identification
- Select security controls
- Develop system-level continuous monitoring strategy
- Review and approve the security plan and continuous monitoring strategy
- Apply overlays and tailor

Step 3 IMPLEMENT Security Controls

- Implement control solutions consistent with DoD Component Cybersecurity architectures
- Document security control implementation in the security plan

Step 4 ASSESS Security Controls

- Develop and approve Security Assessment Plan
- Assess security controls
- SCA prepares Security Assessment Report (SAR)
- Conduct initial remediation actions

Step 5 AUTHORIZE System

- Prepare the POA&M
- Submit Security Authorization Package (security plan, SAR and POA&M) to AO
- AO conducts final risk determination
- AO makes authorization decision

Step 6 MONITOR Security Controls

- Determine impact of changes to the system and environment
- Assess selected controls annually
- Conduct needed remediation
- Update security plan, SAR and POA&M
- Report security status to AO
- AO reviews reported status
- Implement system decommissioning strategy

The RMF/ATO Problem

Every system has **inherent risks** associated with it.

Program Manger (PM) is **graded** against the system’s **KPP** and their compliance with all **regulations**, along with **cost** and **schedule** parameters.

PM makes **trades** between cost, schedule, quality, and functionality. With each trade **residual risks** occur.

Someone must **accept ALL residual risk** associated with the system before placing it into operations.

The Authorizing Official (AO) is responsible to **accepting information security risks**, which is done through the RMF process.

An ATO is usually good for 3 years, but **assumes no major changes** to the system’s cybersecurity posture will be made during that time.

When **changes** do occur the AO may require a **reassessment** and **reauthorization**, which impacts the PM’s cost and schedule and is **contrary to being Agile**.

RMF’s Solution to Problem

RMF encourages an alternative approach to the traditional 3 year ATO process through ongoing authorization decisions or continuous reauthorization.

RMF assumes these systems have “been evaluated as having sufficiently robust system-level continuous monitoring programs”

Topics

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Security in an Agile World - 1

Security is often focused on testing, and security activities are often conducted outside and apart from the software development process.

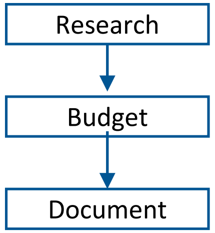
As a result, the outcomes of security activities are presented in documents and outputs that do not naturally fit any of the software development activities.

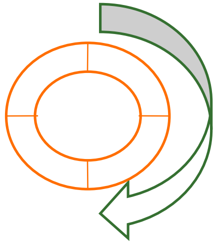
Water - Scrum - Fall

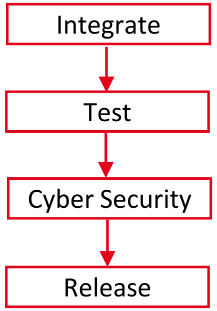
Business

Development

QA
Operations







Security in an Agile World - 2

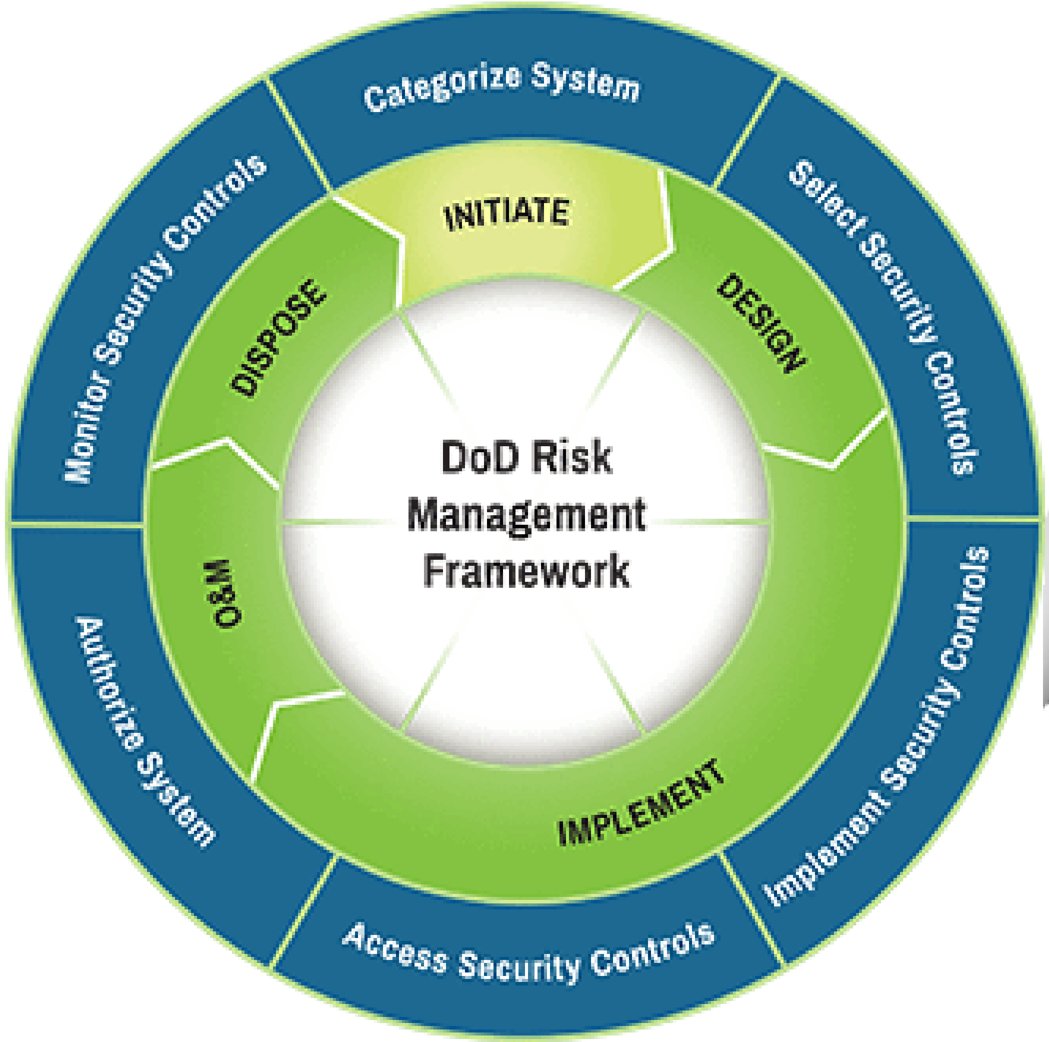
The goal is to guide the development of new activities and make adjustments to existing activities to make it natural and efficient to build security into an agile process.

DevSecOps Manifesto (http://www.devsecops.org)

Leaning in over Always Saying “No”
Data & Security Science over Fear, Uncertainty and Doubt
Open Contribution & Collaboration over Security-Only Requirements
Consumable Security Services with APIs over Mandated Security Controls & Paperwork
Business Driven Security Scores over Rubber Stamp Security
Red & Blue Team Exploit Testing over Relying on Scans & Theoretical Vulnerabilities
24x7 Proactive Security Monitoring over Reacting after being Informed of an Incident
Shared Threat Intelligence over Keeping Info to Ourselves
Compliance Operations over Clipboards & Checklists

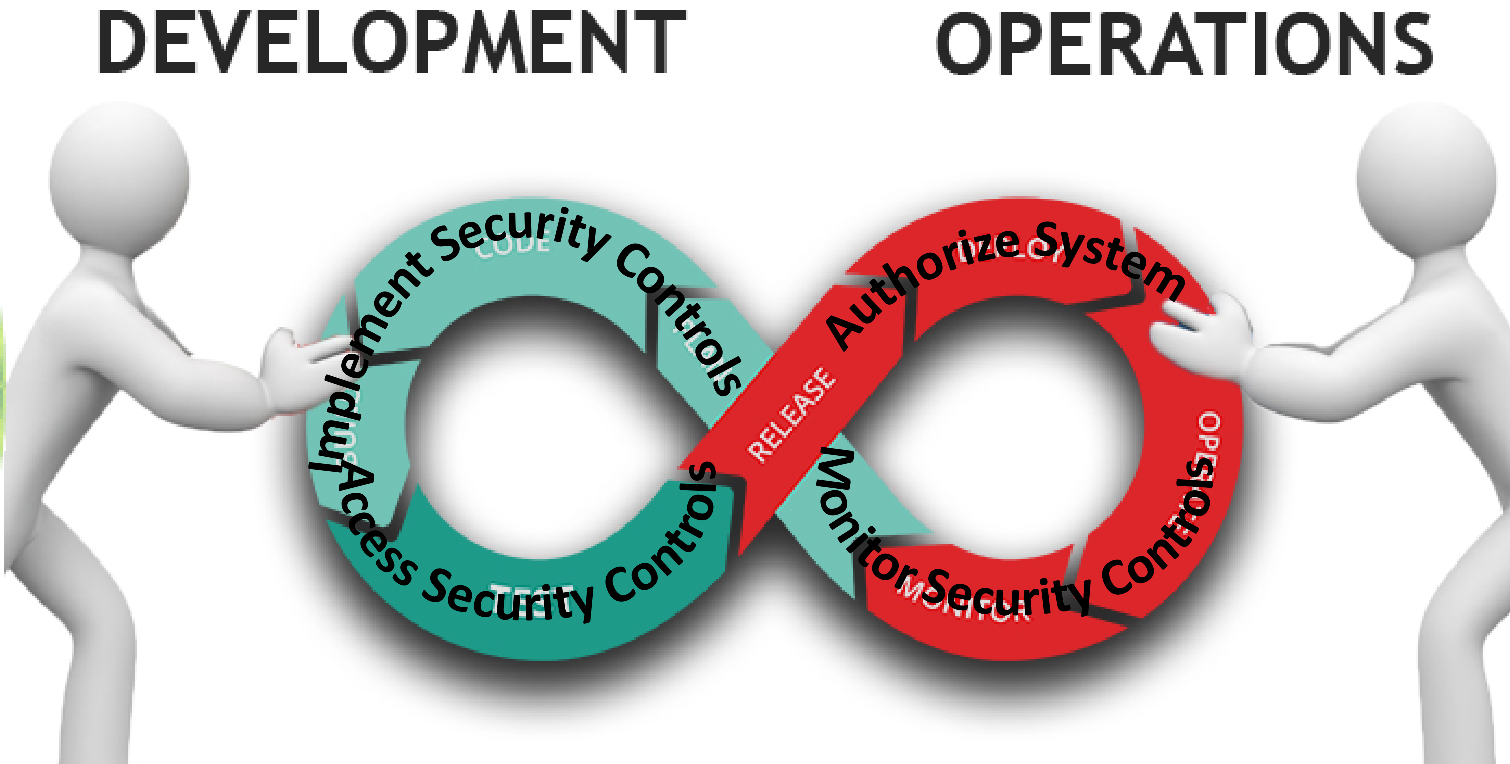
“By developing security as code, we will strive to create awesome products and services, provide insights directly to developers, and generally favor iteration over trying to always come up with the best answer before a deployment.”

DoD SDLC, RMF, and DevOps



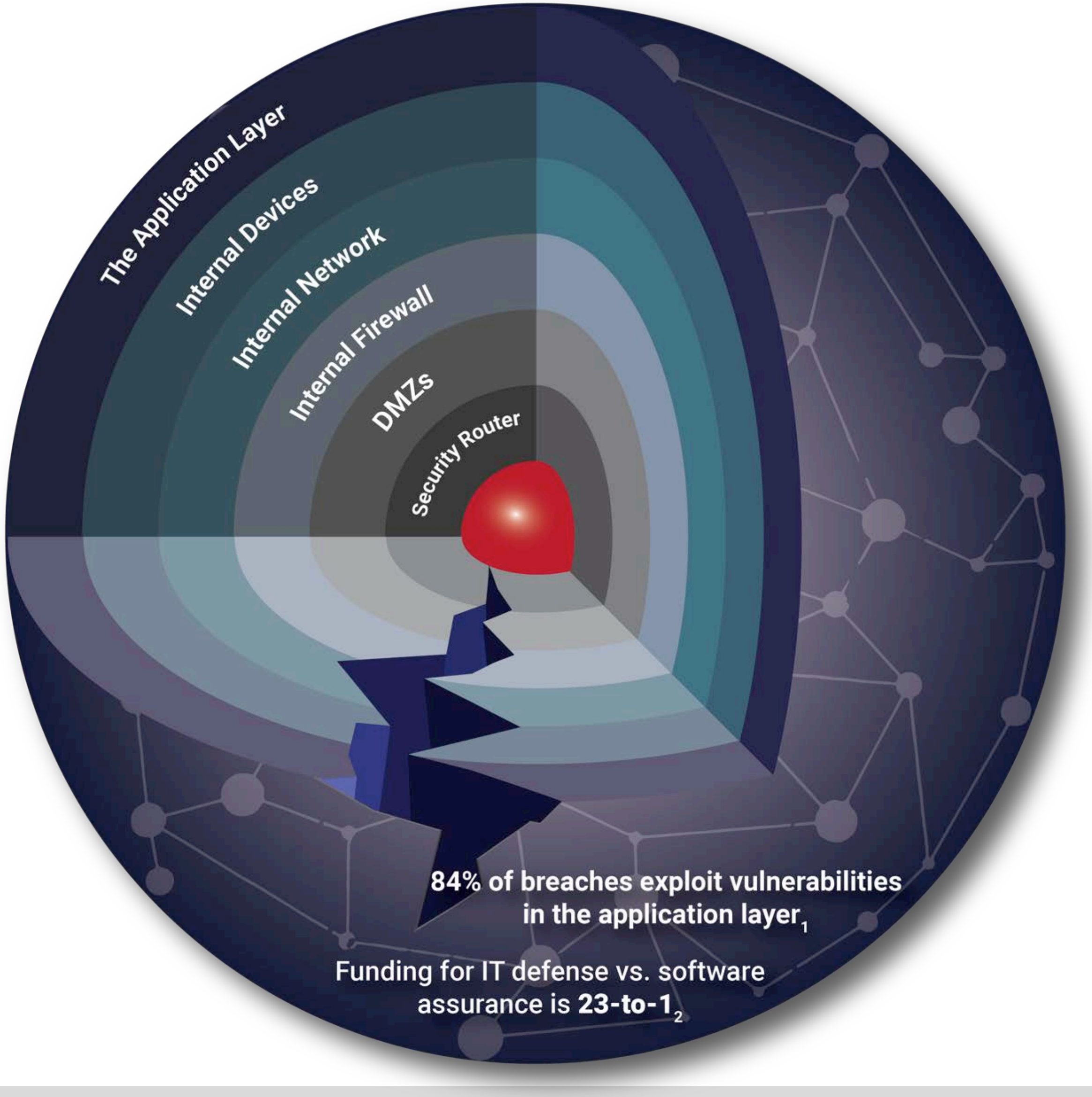
http://www.truestonefed.com/wp-content/uploads/2016/09/risk-management-wheel.gif

RMF's Continuous Reauthorization concept directly aligns with DevOps



CYBER SECURITY

Security Must be Integrated in order to be Effective



84% of breaches exploit vulnerabilities in the application layer[1]

Funding for IT defense vs. software assurance is **23-to-1**[2]

The Application Layer is the new perimeter

Security must be Engineered into the Lifecycle of Applications

2017 less than 5% of DevOps initiatives have achieved the level of security automation required to be considered fully DevSecOps.[3]

1. Clark, Tim, *Most cyber Attacks Occur from this Common Vulnerability,* Forbes. 03-10-2015
2. Feiman, Joseph, *Maverick Research: Stop Protecting Your Apps; It's Time for Apps to Protect Themselves,* Gartner. 09-25-2014. G00269825
3. *Horvath, Mark, Neil MacDonald, Ayal Tirosh: Integrating Security Into the DevSecOps Toolchain, Gartner. 11-16-2017. G00334264*

Topics

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DevOps Has Four Primary Focus Areas

Collaboration between project team roles

Infrastructure as Code: Scripted Infrastructure Configuration

Automation of Tasks / Processes / Workflows

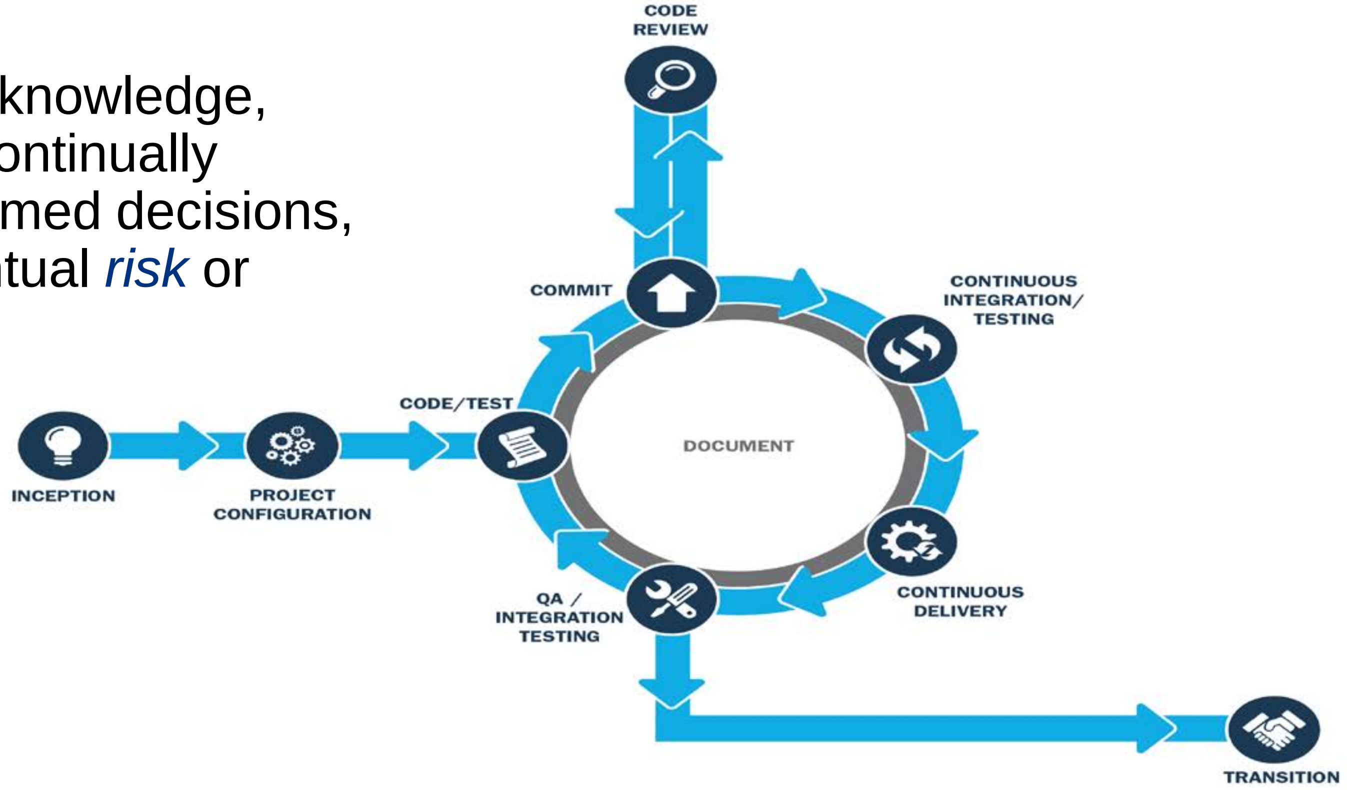
Monitoring Applications and Infrastructure

DevOps Uses Automation to facilitate Communication

- Define Problem Domain
- Capture, Analyze, Track, and Communicate changes
- Collaborate Across Cross-Functional Team
- Used in support controls such as:
  - CA-7(1) Continuous Monitoring
  - CM-2 Baseline Configuration
  - CM-3 Configuration Change Control
  - CM-4 Security Impact Analysis
  - IR-4 Incident Handling
  - MA-6 Timely Maintenance

The SDLC is Full of Decision Points

Without Ops knowledge, developers continually make uninformed decisions, causing eventual *risk* or *inefficiency*



The SDLC contains many Decision Points with Security Implications

What OS?

What ports?

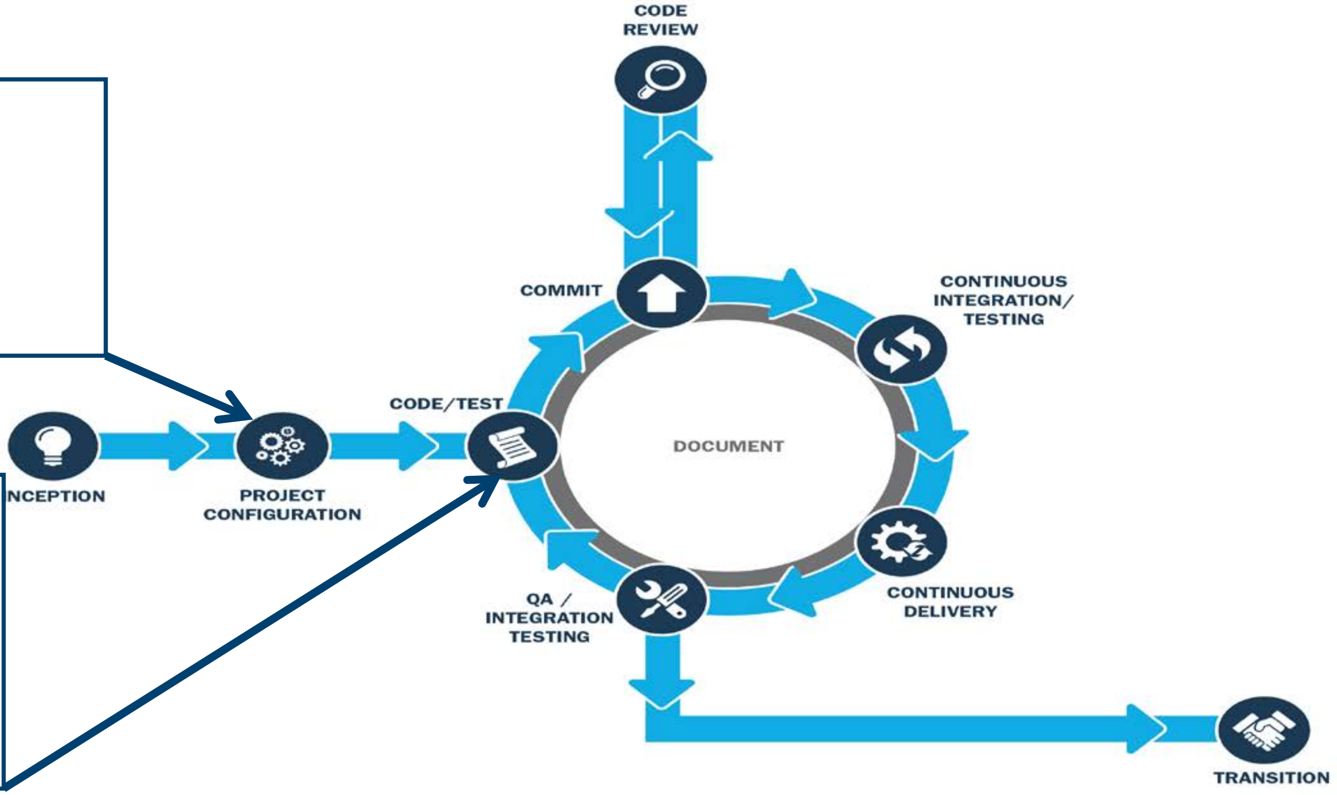
VMs or containers?

Entry points?

What kind of user authentication?

REST vs SOAP?

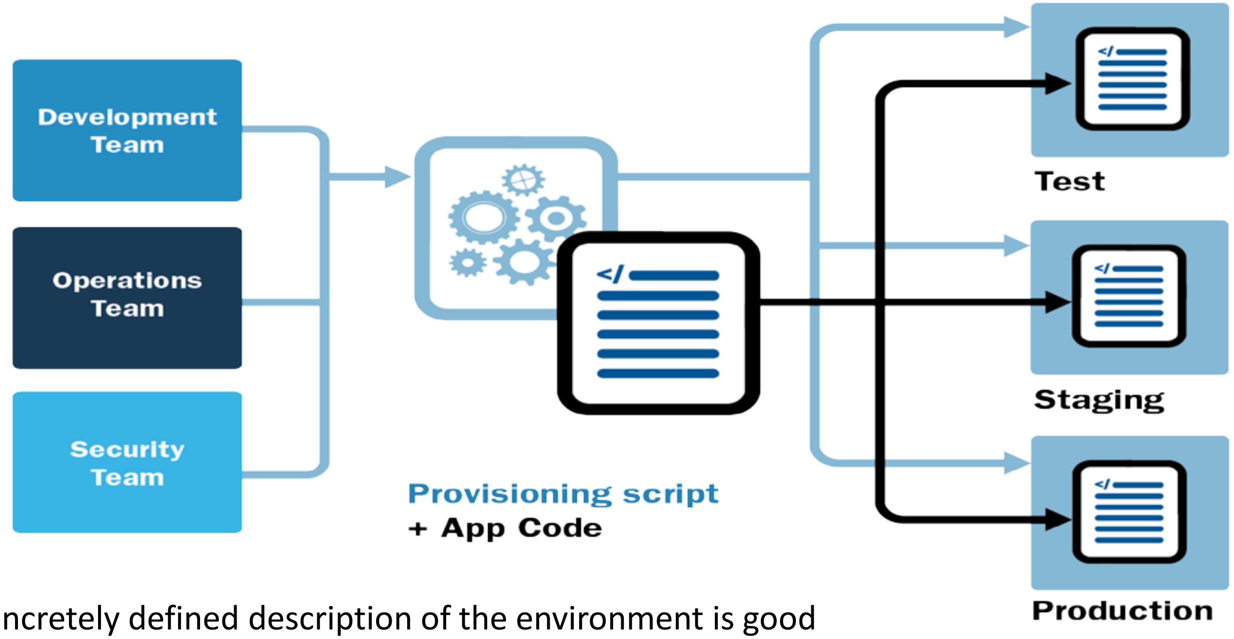
How to architect for scalability?



Infrastructure as Code

What is IaC?

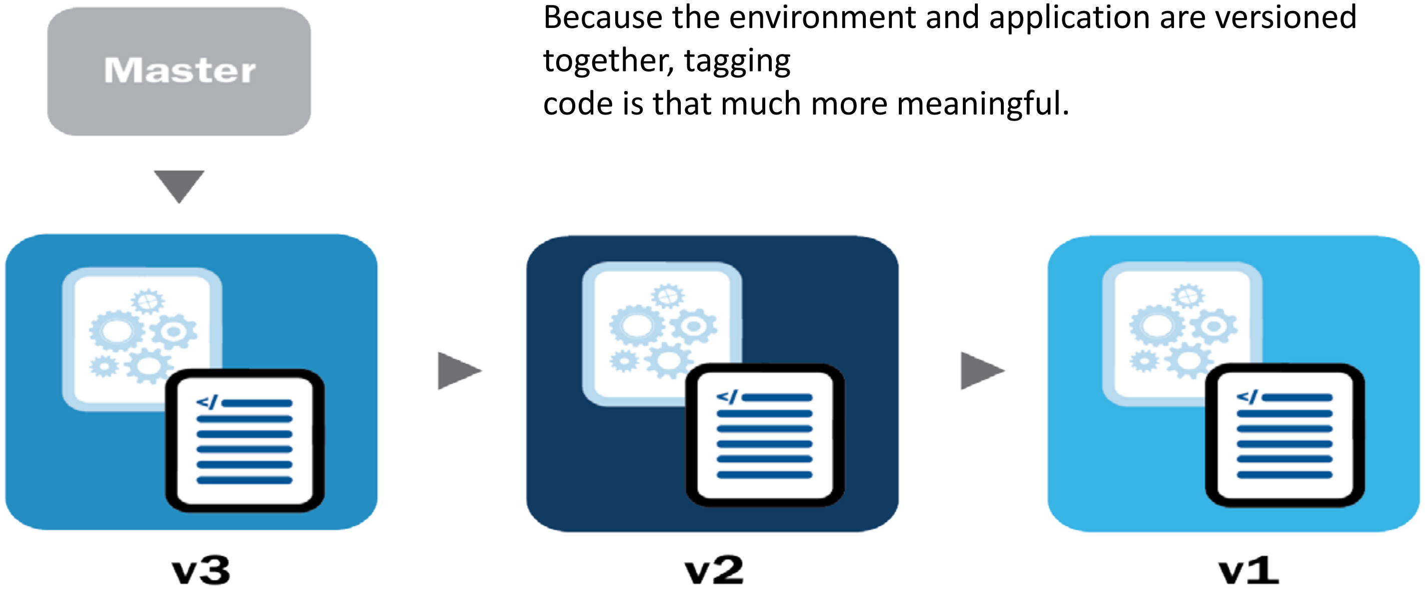
A program that creates infrastructure



* A concretely defined description of the environment is good material for conversation between team members.

IaC Apparent Benefits

Because the environment and application are versioned together, tagging
code is that much more meaningful.



IaC Provides a Solution – Scenario #1

Scenario #1

A vulnerability is being exploited in production that cannot be reproduced in development. Even rolling back development code to the production version doesn’t allow it to manifest. It may be an issue with updated packages or OS in development.

Examples of related RMF Controls:

- IR-3 Incident Response Testing
- IR-10 Integrated Information Security Analysis Team
- SA-10 Developer Configuration Management

Versioned Environment

IaC Provides a Solution – Scenario #2

Scenario #2

The operations team is following recovery instructions for the production environment based on documentation. It turns out there is a dependency problem because an incorrect version of a package was cited.

Examples of related RMF Controls:

- CP-2 Contingency Plan
- CP-6 Alternative Storage Site
- CP-7 Alternative Processing Site
- CP-10 Information System Recovery and Reconstitution

Scripted Environment

IaC Provides a Solution – Scenario #3

Scenario #3

Security features that worked perfectly during testing fails when deployed to the production infrastructure.

Examples of related RMF Controls:

- CA-8 Penetration Testing
- CM-2 Baseline Configuration
- CM-3 Configuration Change Control
- CM-4(2) Security Impact Analysis | Verification of Security Functionality
- CM-6 Configuration Settings

Environment Parity

Common Tools

Shell scripts – scripting platform-specific commands

Vagrant - assists in managing virtual machines and provisioning

Chef or **Puppet -** wrappers around your shell

provide hooks and convenience methods

layer of indirection between script and OS-specifics

provides portability

Docker – deployable Linux containers

runs on Linux only (for now)

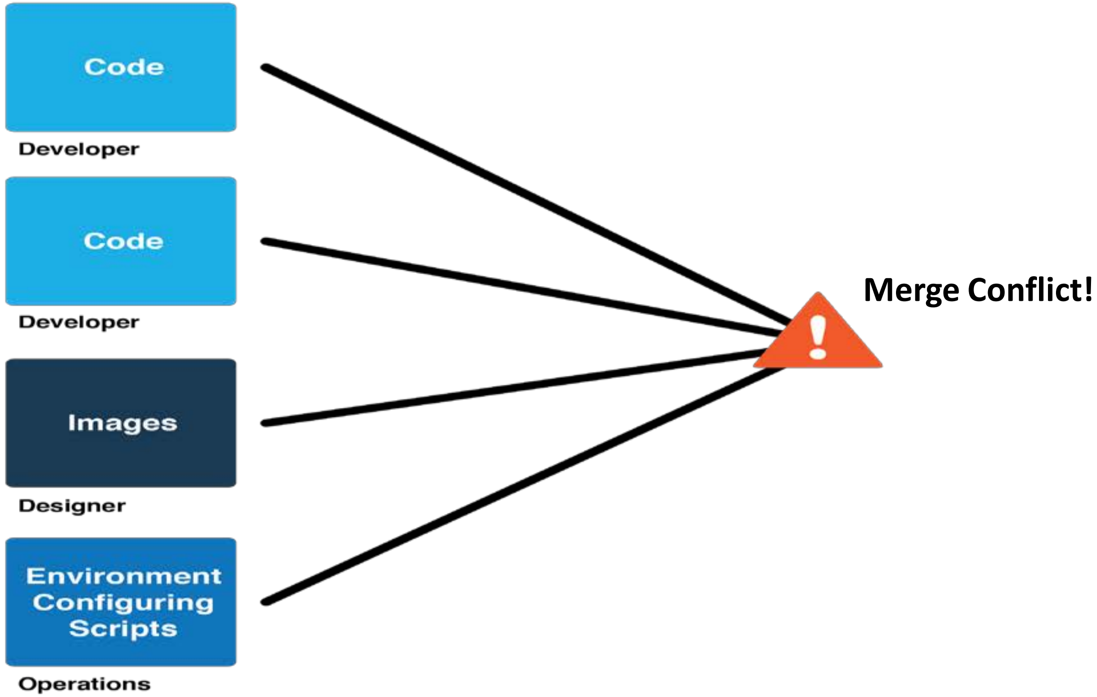
whole environments can be easily shared

Automation of Tasks, Processes, and Workflows

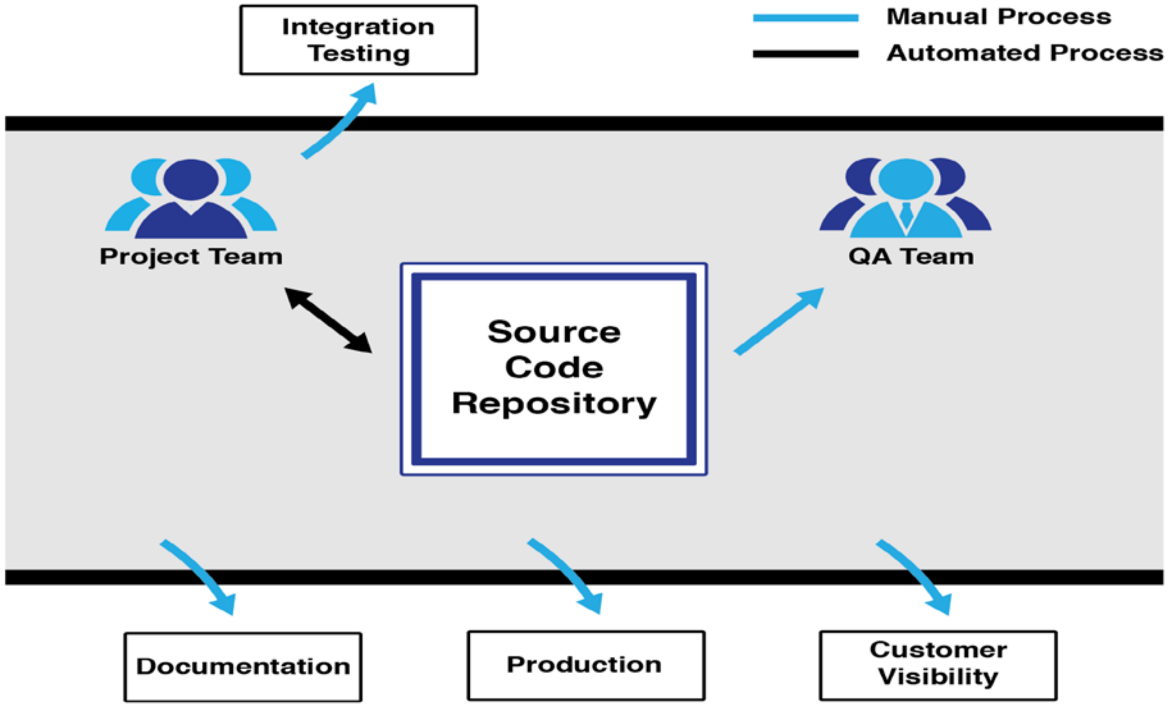
(SA-15 Development Process, Standards, and Tools)

Software projects consist of many artifacts

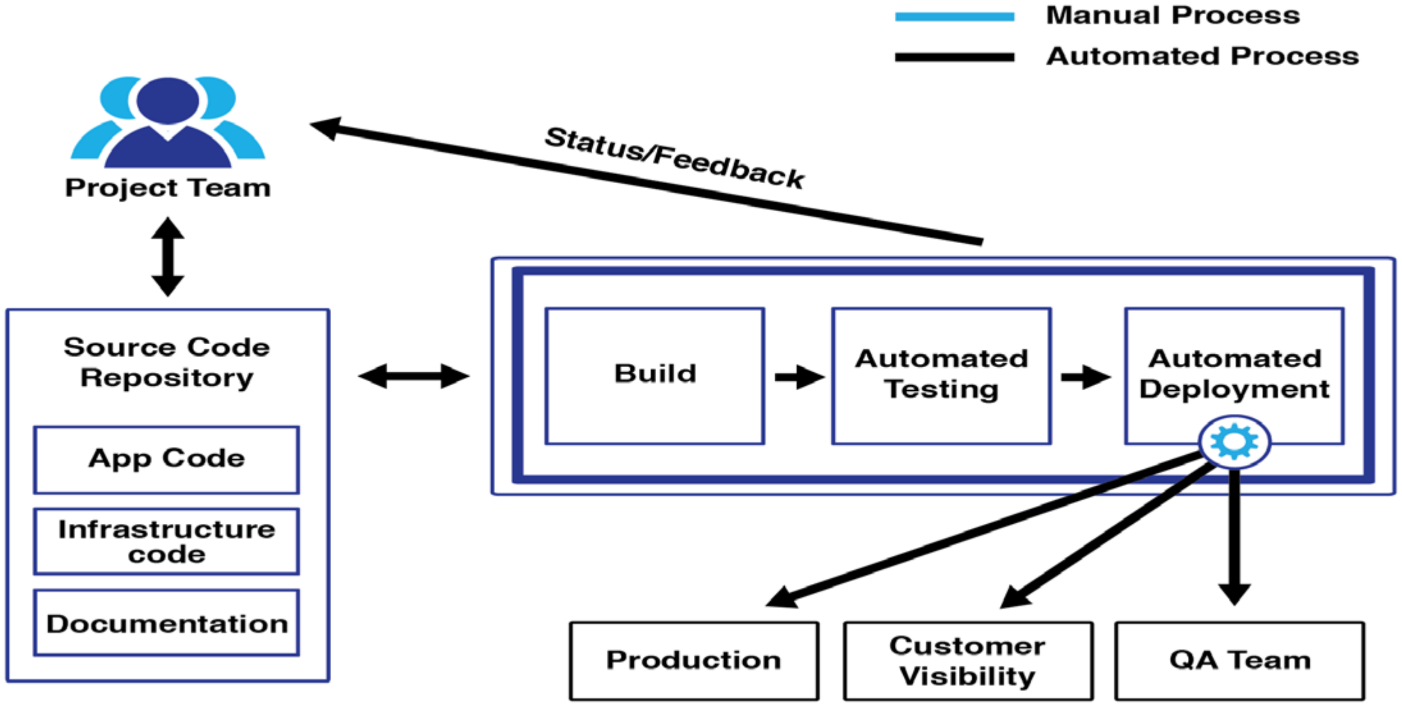
Integration can be challenging



This is often a manual process



Continuous Integration (CI) Model



Fail the Build When Software isn’t Good Enough

Don’t just configure failure for compile/build errors!

- Does the changes include a know weak coding practices (CWE)?
  - Automatically run changes against a static code analysis tool and fail the build if a new CWE is found
- Do any of the current or new libraries have known vulnerabilities (CVE)?
- Did any Functional Security Tests Fail?
- Example Security Controls:
  - SA-11 Developer Security Testing and Evaluation
  - SA-12 Supply Chain Protection
  - CM-4 Security Impact Analysis
  - RA-3 Risk Assessment

CI is your best tool to enforce security standards

Functional Security Tests

Automated unit, integration and acceptance testing tools can be used to verify security controls.

A large proportion of security tests are essentially checks that known weaknesses have not been introduced.

The following security controls are examples of controls that can be monitored/tested using existing acceptance testing browser automation tools like Selenium:

- AC-2(4) Account Management | Automated Audit Actions
- AC-2(5) Account Management | Inactivity Logout
- AC-2(11) Account Management | Usage Conditions
- AC-6 Least Privilege
- AC-12(1) Session Termination | User-Initiated Logouts/Message Displays
- AC-7 Unsuccessful Login Attempts
- CM-2 Least Functionality
- IA-2 Identification and Authentication (multi-factor)

Continuous Integration Systems

Monitoring Applications and Infrastructure

Clarifying Terms

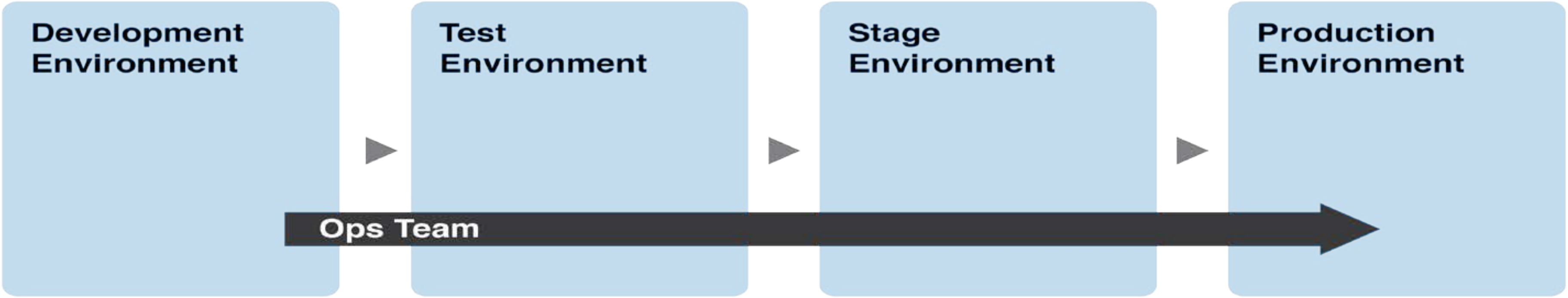
Continuous Deployment

Changes are deployed ASAP into production

Continuous Delivery

Changes are deployed immediately into a *production-like environment*, to ensure that they *could* be deployed into production

Shift Left Operational Concerns



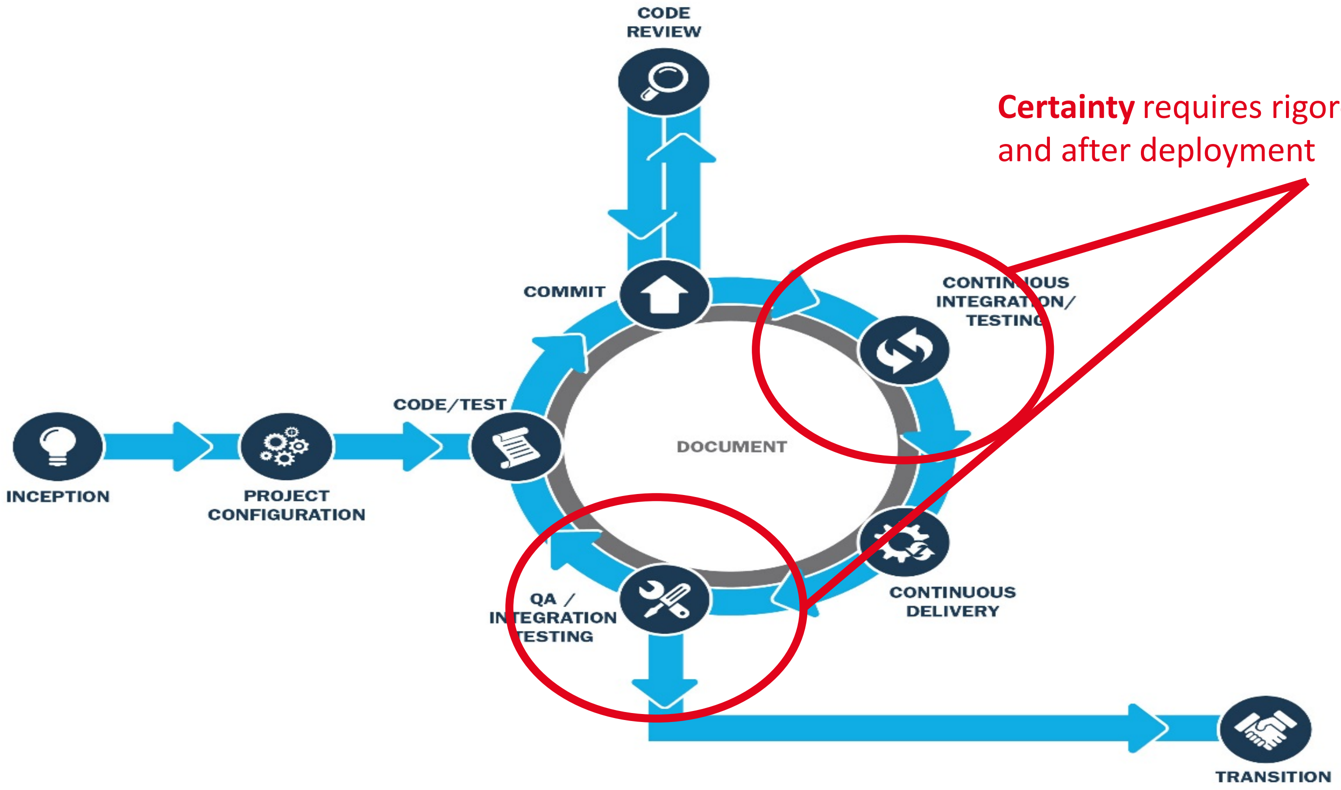
Benefits of Continuous Delivery

- Speed time to market
- Reduce cost
- Reduce risk
- Scale

Gold-standard deployment

- Environment Parity
- Process Parity
- Automate
- Perform incremental changes
- Appropriate Testing

Continuous Delivery Is REALLY About Rigorous Testing



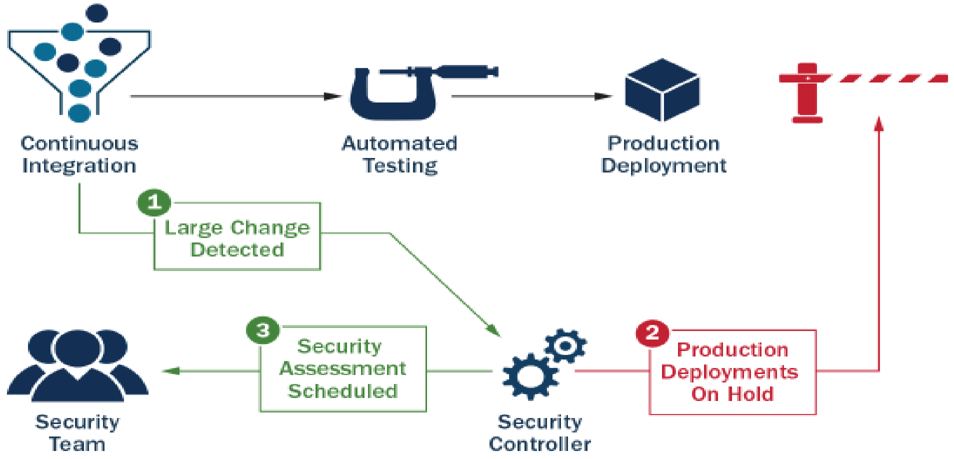
Certainty requires rigorous testing before and after deployment

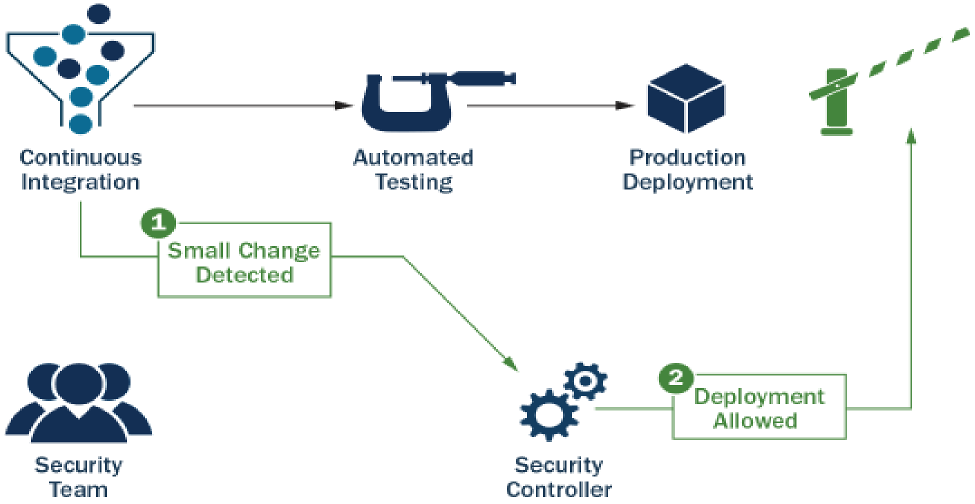
Test Enough That You Are Sure You Could Deploy Successfully

How much is enough?

What factors are important to you and your organization?

Security? Automate a large number of security-focused unit/integration tests





Design your CI/CD success criteria to enforce your goals

DevOps Operate Phase

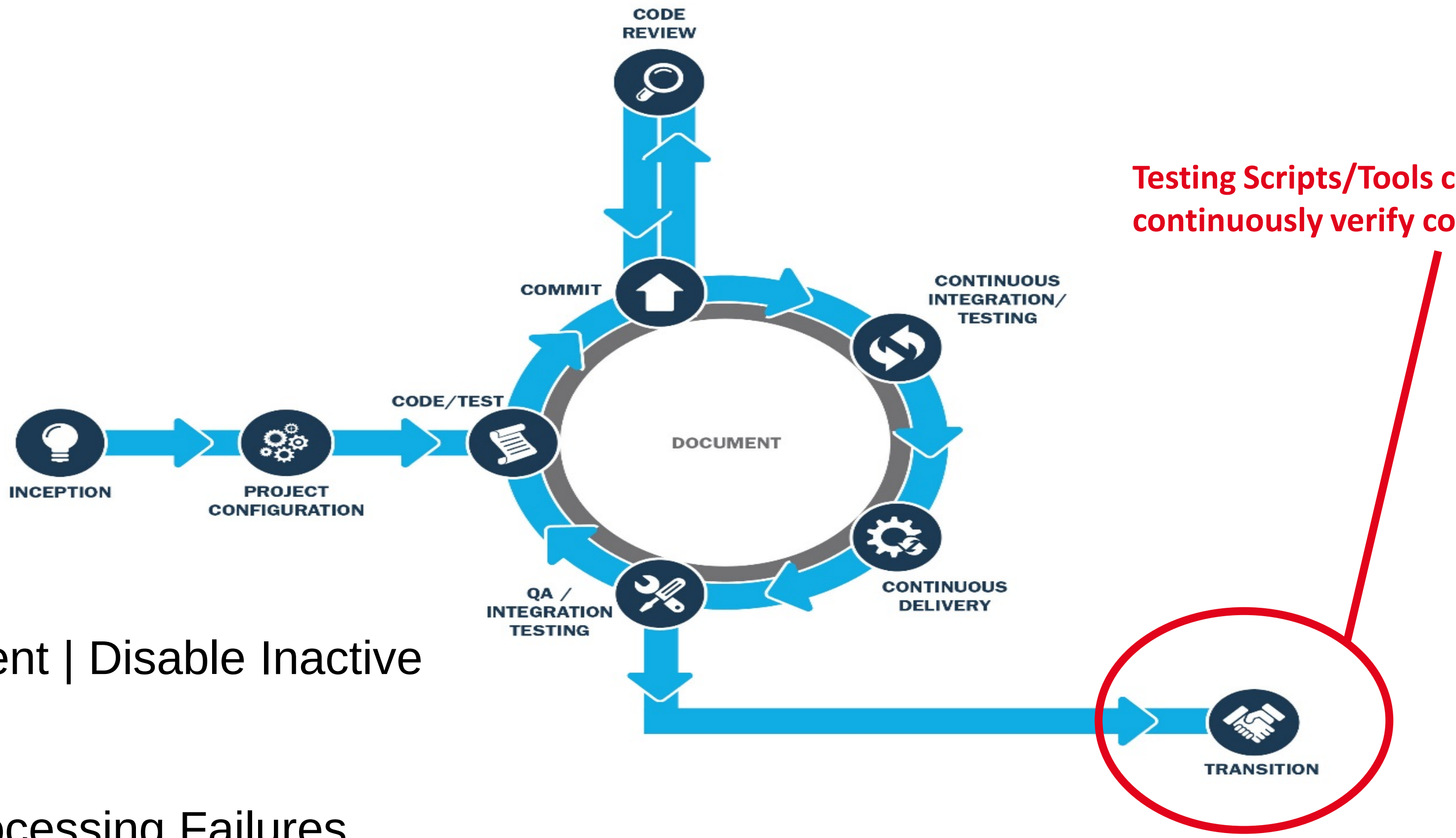
- Continuous Monitoring
- Performance Measurement
- Incident Management
- System Security
- Auditing

DevOps and RMF Integration

There are several RMF process steps that can be executed throughout the DevOps deployment pipeline including:

- Develop Security Assessment Plan
  - DevOps team provides details/scripts regarding the implementation and configuration of automated testing tools
- Assess security controls
  - DevOps practices improve this process by automatically providing outputs from team code reviews, application scanning and regression tests
- Prepare Security Assessment Report
  - Automated test tool output can be generated into a suitable format for inclusion as input
  - These reports are generated as part of the Continuous Testing cycle (not just annually), so assessment data is fresh and reports can be compared for differences
- Conduct initial remediation actions

Continue Automated Testing in Production



Testing Scripts/Tools can be used to continuously verify controls are in place

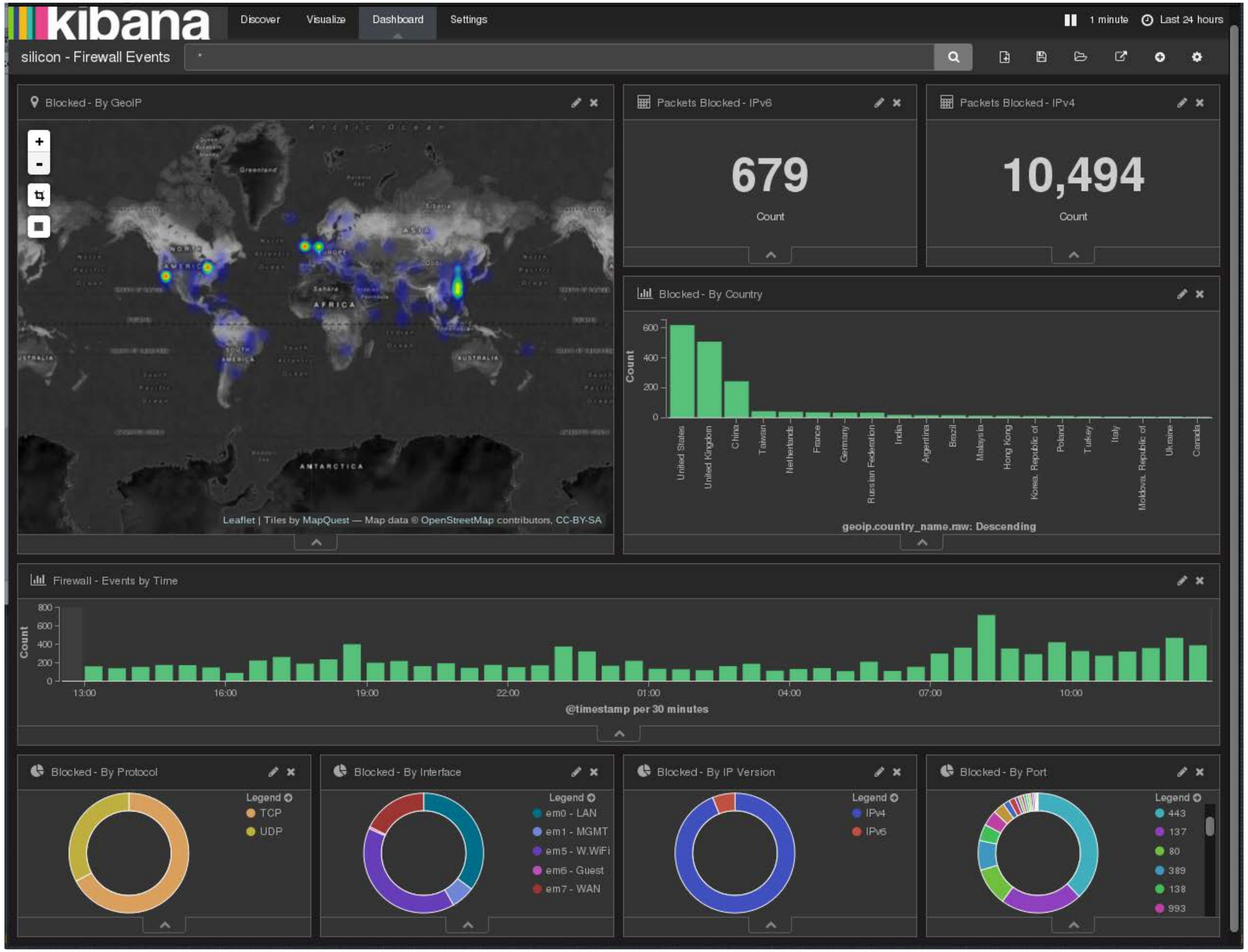
Example Security Controls:

- AC-2(3) Account Management | Disable Inactive Accounts
- AU-2 Audit Events
- AU-5 Response to Audit Processing Failures
- AU-9 Protection of Audit Information
- AU-11Audit Record Retention
- SI-7 Software Firmware, and Information Integrity
- SI-11 Error Handling

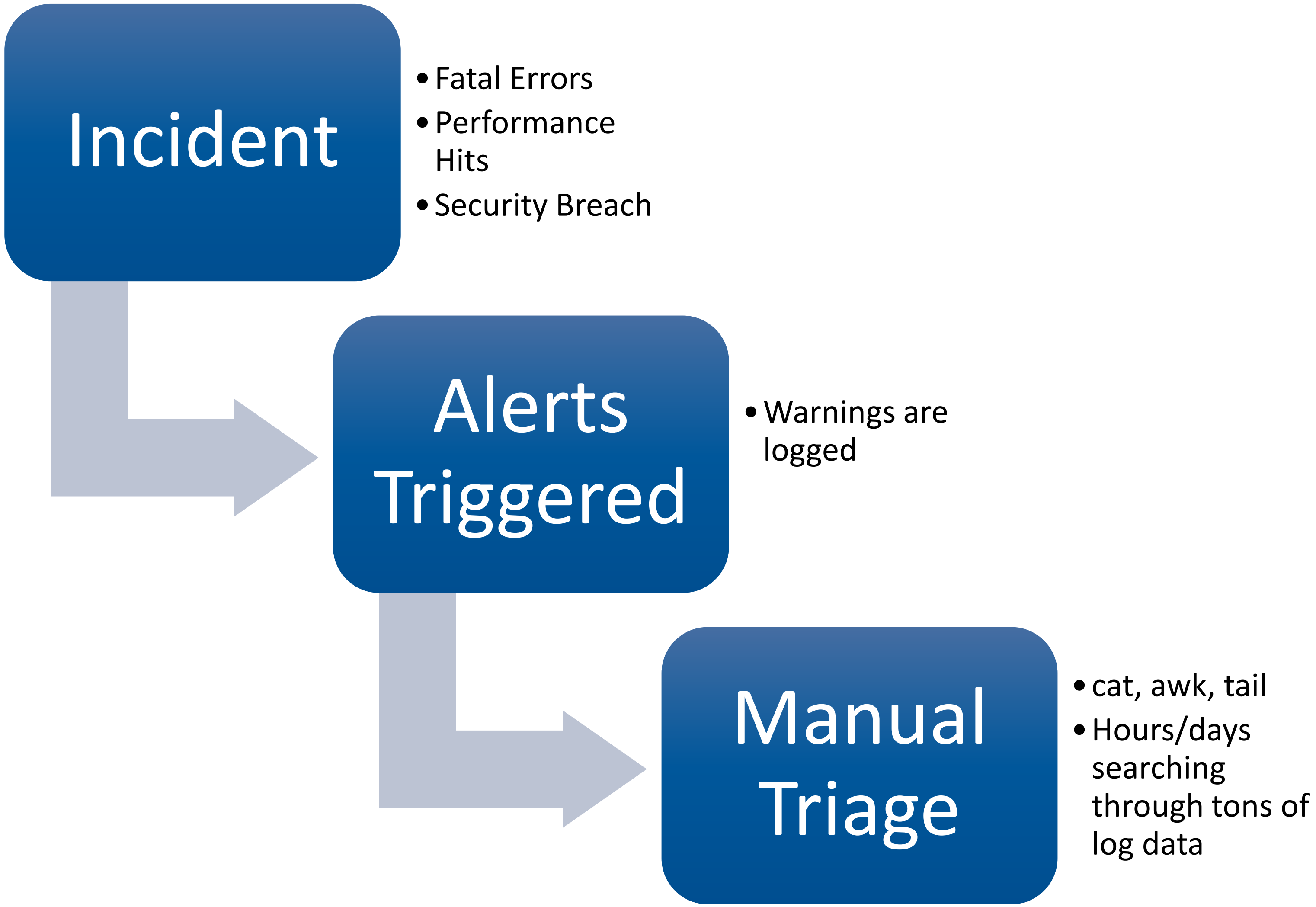
DevOps Operate Phase: Integrate the Necessary Tools

docker
Nagios®
elasticsearch.
logstash
pagerduty
Prometheus
An open-source service monitoring system and time series database.
Kibana
ANSIBLE
Nessus N ™
MONIT
SNORT™
splunk>

DevOps Operate Phase: Performance Measurement



DevOps Operate Phase: Incident Management



Incident

- Fatal Errors
- Performance Hits
- Security Breach

Alerts Triggered

- Warnings are logged

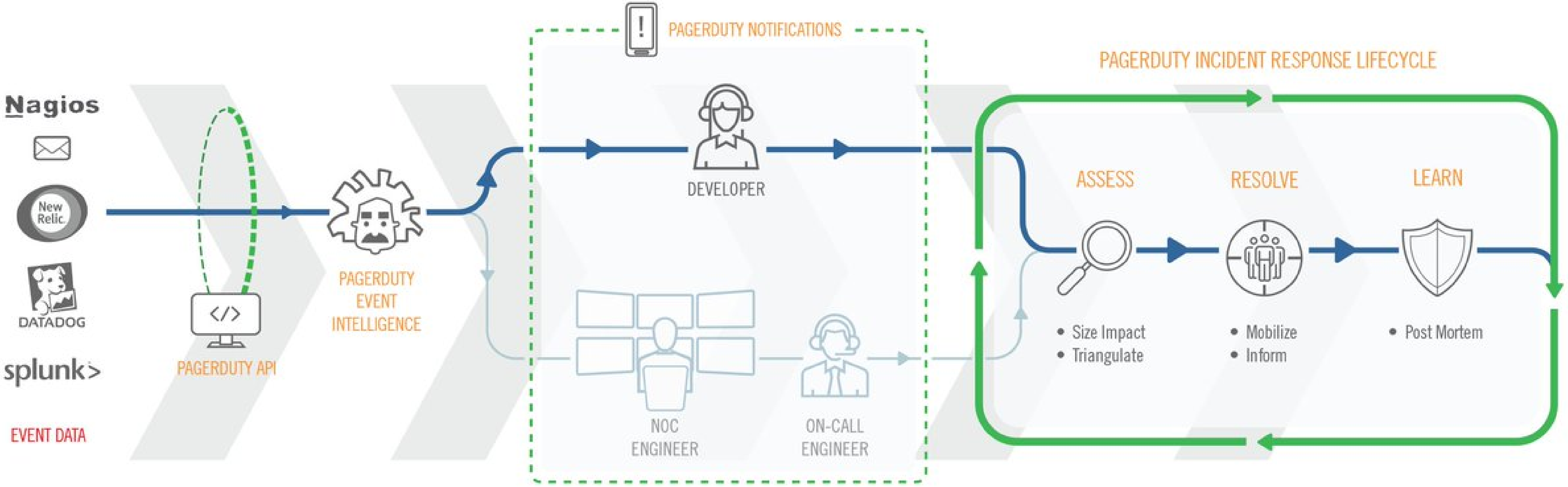
Manual Triage

- cat, awk, tail
- Hours/days searching through tons of log data

Before the advent of DevOps strategies and associated tools, handling production incidents (application errors, performance hiccups, security breaches) was a tedious and time-consuming process.

Integrating DevOps tools (e.g. PagerDuty) can automate the process of incident monitoring, handling and reporting (IR-4, IR-5, IR-6, SI-4 Security Controls)

DevOps Operate Phase: Incident Management



DevOps Operate Phase: System Security

DevOps strategies and tools greatly enhance the tedium of implementing and managing application security (SI-4, SI-5, SI-6 Security Controls).

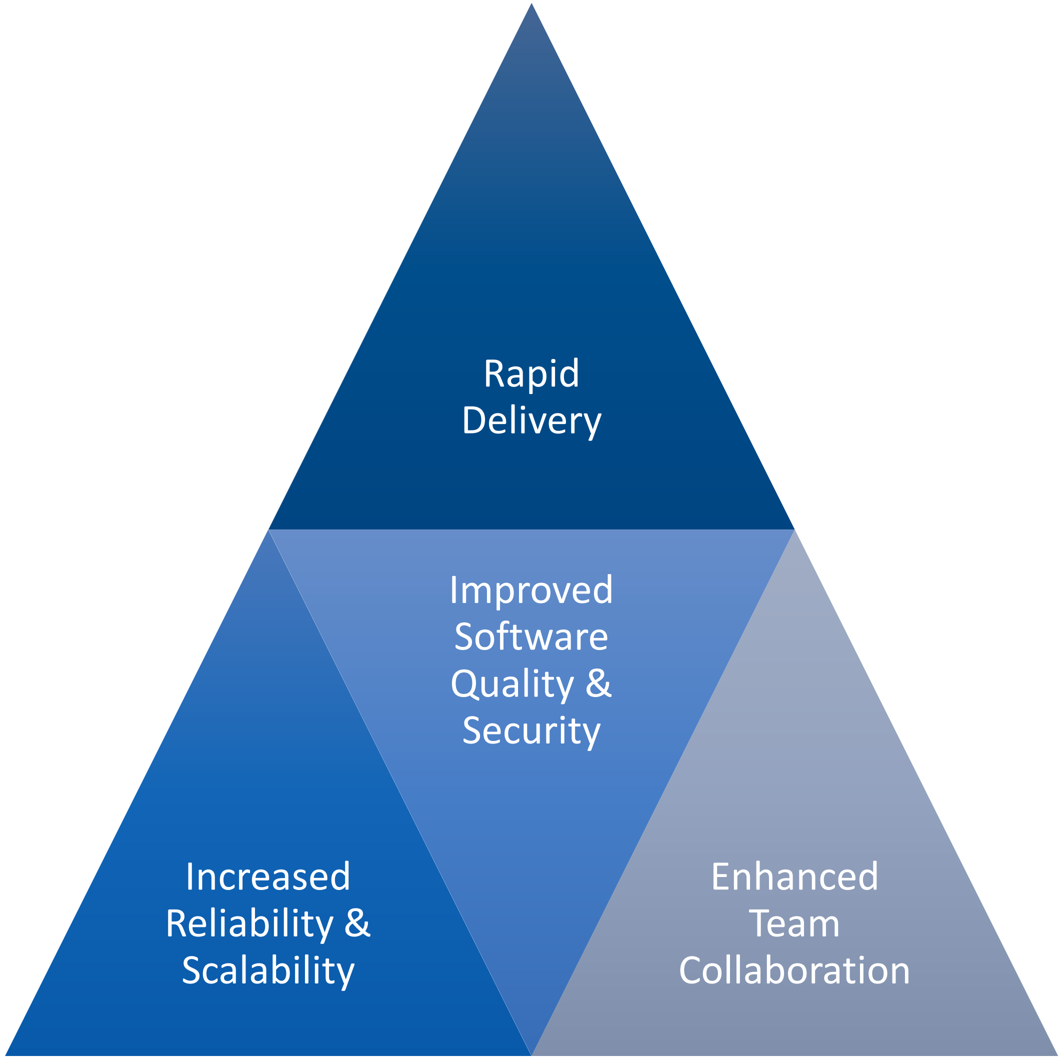
IaC tools such as Puppet can be used to configure, deploy and manage tools like Nessus and Snort.

Nessus scans systems and applications for weaknesses and vulnerabilities (RA-5). Reports are automatically generated and sent to necessary members of cross-functional team.

Snort can be deployed to automate intrusion detection (SC-38).

Benefits of DevOps

When security is fully integrated into the full Software Development, Maintenance, and Operational lifecycle a sufficiently robust system-level continuous monitoring program can be demonstrated in order to achieve a continuous reauthorization (ATO)



Rapid Delivery

Improved Software Quality & Security

Increased Reliability & Scalability

Enhanced Team Collaboration

Contact Information

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Security Controls

AC – Access Control

AT – Awareness and Training

AU – Audit and Accountability

CA – Security Assessment and Authorization

CM – Configuration Management

CP – Contingency Planning

IA – Identification and Authentication

IR – Incident Response

MA – Maintenance

MP – Media Protection

PE – Physical and Environmental Protection

PL – Planning

PS – Personnel Security

RA – Risk Assessment

SA – System and Services Acquisition

SC – System and Communications Protection

SI – System and Information Integrity