aws marketplace

A Roadmap to Continuous Delivery Pipeline Maturity

Learn How to Simplify Your Software Delivery Toolchain in Amazon Web Services (AWS)

Introduction

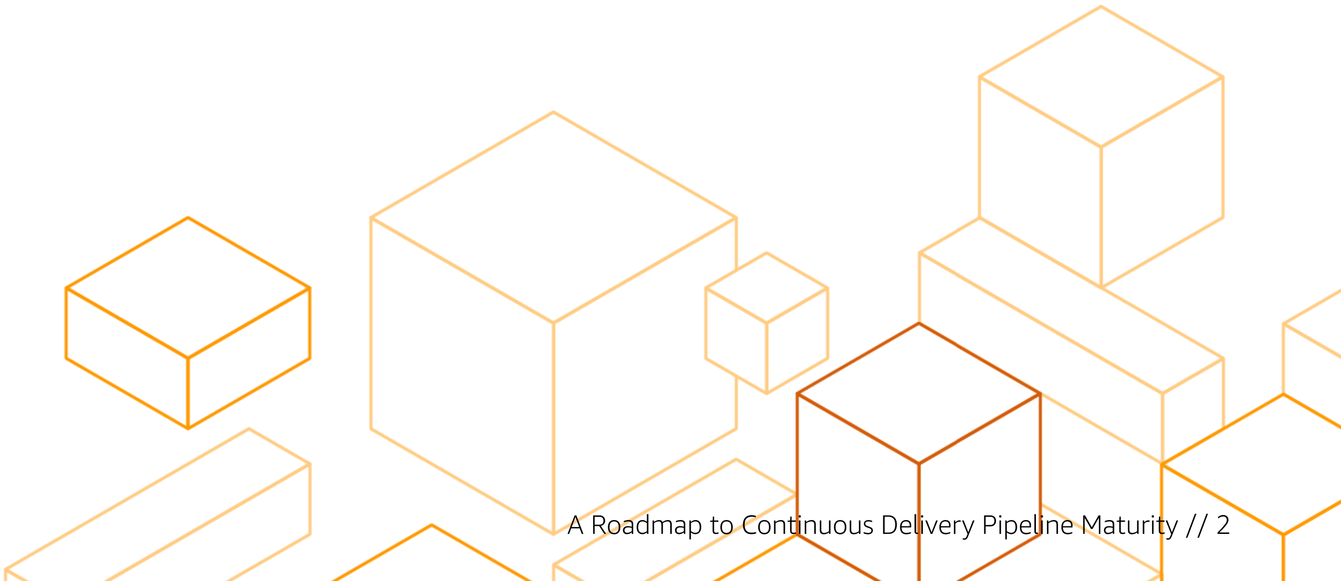
As application development becomes more complex, organizations need to stay quick and agile about delivering mature products that delight customers. Continuous Delivery is a critical approach to transforming the people, process, and technology to ensure delivery toolchains are seamless, reliable, and efficient.

This whitepaper provides a blueprint for mature Continuous Delivery pipelines. It explains why well-engineered, mature delivery pipelines are important to provide both agility and quality.

We will explore:

- The importance and benefits of Continuous Delivery pipeline maturity
- Best practices for configuring mature Continuous Delivery pipelines
- A Continuous Delivery Maturity Model framework to help you self-assess and plan a roadmap to advance your maturity level

The suggested framework and guidelines can help you improve both the agility and quality of your application delivery.



aws marketplace

Continuous Delivery Pipeline Maturity

The abbreviation "CD" is ambiguous because it is often used to refer to the "Continuous Delivery pipeline," "Continuous Delivery," and "Continuous Deployment," which are three related but separate things. According to Jez Humble, Continuous Delivery is the ability to get changes into production or into the hands of users safely and quickly in a sustainable way.

A key distinction is that Continuous Delivery is about the ability to get changes into production but does not necessarily include deployment to production. There are a lot of cases, such as new platform products, in which it is not desirable to deploy all software releases to production, even though, from an internal process point of view, there are many reasons to get the software release ready to deploy to production.

Continuous Deployment is a set of practices that enable every change that passes automated tests to be automatically deployed to production. Continuous Deployment takes continuous delivery to a higher level of automation. Continuous Deployment depends on Continuous Delivery but takes the changes all the way to production.

> *"Continuous Delivery and Deployment both depend on Continuous Delivery pipelines that continuously integrate software developed by the development team, build release candidate artifacts, and run automated tests on those artifacts to detect problems. The best practice for CD pipelines requires pushing artifacts into increasingly production-like environments to minimize the chance that software may fail when deployed to the production environment."*
>
> Book Reference "Engineering DevOps" by Marc Hornbeek

Why Is Continuous Delivery Pipeline Maturity Important to DevOps?

Benefits of mature, well-engineered Continuous Delivery Pipelines include the following:

- A well-engineered Continuous Delivery pipeline provides visibility for software as it propagates through each stage.
- Quick lead times and more frequent releases provide quicker access to user feedback.
- Smaller, incremental, controlled releases are less painful, and failure events are lower risk.
- Reduced lead improves time-to-market for innovative new features.
- Software quality and stability are improved when each change is following a disciplined, well-engineered Continuous Delivery pipeline.
- Cost of software change is reduced when lean engineering practices are applied to the Continuous Delivery pipeline.
- Customer and employee satisfaction improve when they see positive results of the Continuous Delivery practices.

Mature, well-engineered Continuous Delivery and Deployment avoids the following types of problems:

- Inefficient Change Review Board meetings required to approve releases
- Voluminous release documentation instead of automated deployments
- Reliance on manual error prone testing
- Frequent corrections to the manual release process
- Manual configuration errors
- Lengthy manual deployments
- Frequent release roll-backs caused by manual errors
- Unexpected interruptions during a long release
- Sitting bleary-eyed in front of a monitor during release hell nights and weekends

How are Continuous Delivery Pipelines Engineered for DevOps?

Figure 1—DevOps Continuous Delivery Pipeline Blueprint shows how mature continuous delivery pipelines are configured.

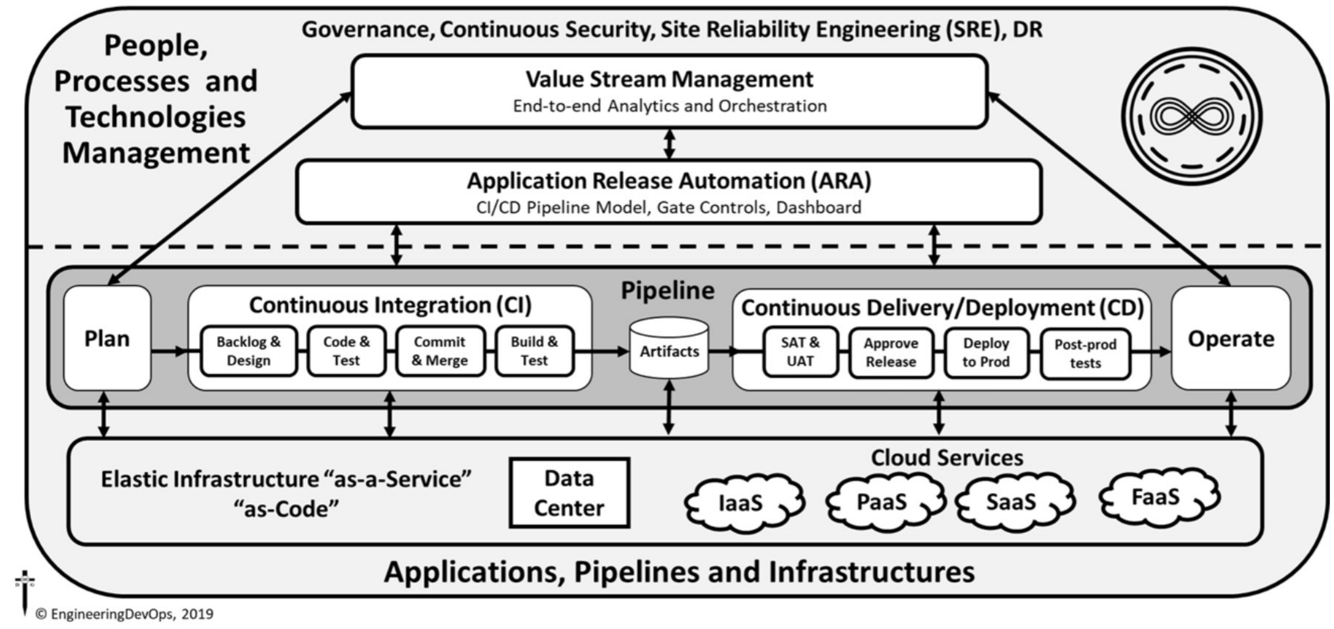

Governance, Continuous Security, Site Reliability Engineering (SRE), DR
People, Processes and Technologies Management
Value Stream Management
End-to-end Analytics and Orchestration
Application Release Automation (ARA)
CI/CD Pipeline Model, Gate Controls, Dashboard
Pipeline
Plan
Continuous Integration (CI)
Backlog & Design
Code & Test
Commit & Merge
Build & Test
Artifacts
Continuous Delivery/Deployment (CD)
SAT & UAT
Approve Release
Deploy to Prod
Post-prod tests
Operate
Elastic Infrastructure "as-a-Service" "as-Code"
Data Center
Cloud Services
IaaS
PaaS
SaaS
FaaS
Applications, Pipelines and Infrastructures
© EngineeringDevOps, 2019

Figure 1—DevOps Continuous Delivery Pipeline Blueprint

The CD pipeline starts with release candidate artifacts delivered from the CI pipeline into an artifact repository. The CD pipeline is automated, and artifacts are deployed to a pre-production staging environment for system and user acceptance testing. These tests are automated as much as possible to minimize processing delays and bottlenecks. Once the tests pass, the artifacts are assessed with release polices to win approval for deployment. The release acceptance criteria determined by a Change Approval Board (CAB) are implemented as codified policies as much as possible. Once approved, the artifacts are deployed to production according to a deployment schedule. To minimize risk, the deployments are conducted using the safe Green/Blue and Dark Launch methods that are explained in this section. Once deployed, there may be additional post-deployment tests to evaluate software options using A/B testing and Canary testing methods.

The following are engineering practices consistent with mature well-engineering continuous delivery pipelines:

- Automate the build, deploy, test, and release process. This ensures consistent configuration of the system, environments, and the release process. This enables your processes to be less error-prone, more traceable, and easier to control, and it will help you remediate problems. Overall, you get a better-quality result.
- Frequent small releases are safer. Smaller, frequent releases reduce the risk associated with bigger, less frequent releases. It's much easier to roll back the application and its associated configuration (including its environment, deployment process, and data).
- Fast feedback is essential. Any change, of whatever kind, needs to trigger the feedback process. The feedback must be delivered as soon as possible. The delivery team must receive feedback and act.

Many organizations have not achieved the level of continuous delivery pipeline maturity described above. For an organization to mature their continuous delivery pipeline capabilities they need to know their current state of maturity and target future state. **There are three dimensions to consider at each level: People, Process and Technology.** Technology such as better test tools will not accomplish a higher level of maturity unless the People and Processes use the tools effectively.

Continuous Delivery Pipeline Maturity Levels

There is no standard continuous delivery pipeline maturity model. As a practical matter, I have found it useful to apply a five-level maturity model adapted from the "standard" software Capability Maturity Model. I define five levels of continuous delivery pipeline maturity as described in the following paragraphs.

Continuous Delivery Pipeline Maturity Level 1: Chaos

Figure 2 shows key characteristics of People, Process and Technology evident at this level of maturity. At this level there is little evidence of continuous delivery skills. Pipeline processes are not well integrated and pipeline automation technology has major gaps. Typical outcomes are releases are unpredictable, reactive, and the pipeline is wasteful.

People	Process	Tech
▢ Silo team organization ▢ Little communication ▢ Blame, finger-pointing	▢ Requirements, planning and tracking processes poorly defined and operated manually ▢ Unpredictable and reactive	▢ Manual builds and deployments ▢ Manual quality assurance ▢ Environment inconsistencies

Figure 2—Continuous Delivery Pipeline Maturity Level 1: Chaos

Continuous Delivery Pipeline Maturity Level 2: Continuous Integration

Figure 3 shows key characteristics of People, Process and Technology evident at this level of maturity. At this level there is some knowledge of continuous delivery pipelines. The builds, integrations, and build tests are well supported by processes and technology, End-to-end continuous delivery, especially delivery and deployment stages are not well supported with automation. Build quality is good, but typically there are deployment quality problems, and the infrastructure is used inefficiently.

People	Process	Tech
▢ Managed work backlog ▢ Communication between silos ▢ Limited knowledge sharing ▢ Ad hoc training	▢ Processes definied within silos ▢ Lack E2E process standards ▢ Can repeat what is known, but can't react to unknowns	▢ Source code version management ▢ Automated builds, release artifacts and automated tests ▢ Painful but repeatable releases

Figure 3—Continuous Delivery Pipeline Maturity Level 2: Continuous Integration

Continuous Delivery Pipeline Maturity Level 3: Continuous Flow

Figure 4 shows key characteristics of People, Process and Technology evident at this level of maturity. At this level continuous delivery processes extend from end-to-end across the pipeline. Dev and QA teams cooperate to ensure a good level of test coverage is automated. Release standards are using automated testing metrics. Typical outcomes include repeatable quality releases with some bottlenecks and inefficiencies.

People	Process	Tech
☐ DevOps leadership ☐ Collaboration between cross-functional teams ☐ DevOps training program	☐ End-to-end CI/CD pipeline automated ☐ Standards across the org for applications, releases processes and infrastructure	☐ Toolchain orchestrates and automates builds, tests and packaging deliverables ☐ Infrastructure as code ☐ Metrics and analysis for release acceptance and deployment

Figure 4—Continuous Delivery Pipeline Maturity Level 3: Continuous Flow

Continuous Delivery Pipeline Maturity Level 4: Continuous Feedback

Figure 5 shows key characteristics of People, Process and Technology evident at this level of maturity. At this level more advanced knowledge of continuous delivery pipelines is apparent. Goals and metrics are set for each stage in the pipeline. The culture includes training and mentoring for continuous delivery. There is a focus on end-to-end performance trends rather than spot results. Automation is applied to test environment orchestration and analytics. Typical outcomes at this level reflect a general confidence to obtain repeatable quality releases, with a metrics-driven culture.

People	Process	Tech
☐ Collaboration based on shared metrics to remove bottlenecks ☐ SLIs, SLOs and SLAs to ensure stakeholder alignment ☐ DevOps Mentors and Guilds	☐ Proactive monitoring ☐ Metrics collected and analyzed against business goals ☐ Visibility and repeatability	☐ Applications, pipelines and infrastructure fully instrumented ☐ Metrics and analytics dashboards ☐ Orchestrated deployments with automated rollbacks

Figure 5—Continuous Delivery Pipeline Maturity Level 4: Continuous Feedback

Continuous Delivery Pipeline Maturity Level 5: Continuous Improvement

Figure 6 shows key characteristics of People, Process and Technology evident at this level of maturity. At this level there is a high level or knowledge and confidence regarding continuous delivery pipelines. Dev and QA teams are tightly integrated to optimize knowledge and efficiency. End-to-end processes focus on the end customer experience and more sophisticated risk-based strategies. Typical Outcomes include an extremely high confidence and satisfaction by all stakeholders, with an innovation-driven culture. Achievement at this level provides a platform for autonomous continuous improvement strategies in which automation and intelligence drives innovation.

People	**Process**	**Tech**
▢ Culture of continuous experimentation and improvement	▢ Self-service automation	▢ Zero downtime deployments
	▢ Risk and cost optimization	▢ Immutable infrastructure
	▢ High degree of experimentation	▢ Actively enforce resiliency by forcing failures

Figure 6—Continuous Delivery Pipeline Maturity Level 5: Continuous Improvement

Continuous Delivery Pipeline Maturity Assessment

While the above five levels of continuous delivery pipeline maturity provide a practical guide for defining maturity against characteristics of People, Process and Technology, they are not an absolute measure of maturity. Organizations, or specific applications within an organization, may match some of the characteristics for different levels. *Figure 7—Continuous Delivery Pipeline Maturity Model* is a useful tool to determine the "best fit" for the maturity of an organization or application within an organization. By marking the characteristics that best match, gives a visual picture of the dominant level of maturity. This also is a quick way to determine areas to address to improve the level of maturity.

	People	Process	Tech
Chaos ❯	☐ Silo team organization ☐ Little communication ☐ Blame, finger-pointing	☐ Requirements, planning and tracking processes poorly defined and operated manually ☐ Unpredictable and reactive	☐ Manual builds and deployments ☐ Manual quality assurance ☐ Environment inconsistencies
Continuous Integration ❯	☐ Managed work backlog ☐ Communication between silos ☐ Limited knowledge sharing ☐ Ad hoc training	☐ Processes definied within silos ☐ Lack E2E process standards ☐ Can repeat what is known, but can't react to unknowns	☐ Source code version management ☐ Automated builds, release artifacts and automated tests ☐ Painful but repeatable releases
Continuous Flow ❯	☐ DevOps leadership ☐ Collaboration between cross-functional teams ☐ DevOps training program	☐ End-to-end CI/CD pipeline automated ☐ Standards across the org for applications, releases processes and infrastructure	☐ Toolchain orchestrates and automates builds, tests and packaging deliverables ☐ Infrastructure as code ☐ Metrics and analysis for release acceptance and deployment
Continuous Feedback ❯	☐ Collaboration based on shared metrics to remove bottlenecks ☐ SLIs, SLOs and SLAs to ensure stakeholder alignment ☐ DevOps Mentors and Guilds	☐ Proactive monitoring ☐ Metrics collected and analyzed against business goals ☐ Visibility and repeatability	☐ Applications, pipelines and infrastructure fully instrumented ☐ Metrics and analytics dashboards ☐ Orchestrated deployments with automated rollbacks
Continuous Improvement ❯	☐ Culture of continuous experimentation and improvement	☐ Self-service automation ☐ Risk and cost optimization ☐ High degree of experimentation	☐ Zero downtime deployments ☐ Immutable infrastructure ☐ Actively enforce resiliency by forcing failures

Figure 7—Continuous Delivery Pipeline Maturity Assessment Model

Conclusion

Software development organizations must move beyond the "chaos reigns" state of low repeatability and reliability to one that brings cloud-native applications to market faster and more securely than ever before. Automating the build, test, deploy process with frequent small releases is critical to deliver value to customers quickly and get fast feedback. This, in turn, requires a Continuous Delivery solution that facilitates the AWS well-architected design benchmarks of operational excellence and performance efficiency.

Getting started with the right tools

Finding the tools that work best for your organization is critical for automating and scaling your application delivery pipelines. AWS Marketplace provides third-party software that is purpose-built for implementing a Continuous Delivery practice in AWS. These solutions help apply security, provide support, and integrate with a broad range of DevOps tooling.

Continuous Delivery tools available in AWS Marketplace

Armory

Enterprise-grade open source based CD platform that deploys workloads in Amazon EC2, Amazon EKS, Amazon ECS, and more.

Try now >

CircleCI - CI/CD

CI/CD delivery platform that enables teams to orchestrate complex workflows and automate software delivery at scale.

Try now >

CloudBees Products

Connect, automate and orchestrate tools across development, operations and shared service teams to optimize software delivery.

Try now >

GitLab Ultimate

Source code management, CI/CD, monitoring, and more all in a single application to enable concurrent DevOps.

Try now >

Harness Continuous Delivery

CD-as-a-service platform with machine learning to detect the quality of deployments and automate rollbacks.

Try now >

Stackery

Point-and-click serverless development and deployment platform.

Try now >

View all solutions and learn more about CI/CD >

*2020 Amazon Web Services Marketplace online survey with 200 IT decision-makers and influencers in the U.S.

About AWS Marketplace

AWS Marketplace is a curated digital catalog that simplifies software discovery, procurement, provisioning, and management. With AWS Marketplace, customers can also utilize features that speed up product evaluation, improve governance and cost transparency, and enhance control over software spend. AWS Marketplace offers third-party solutions across software, data, and machine learning tools that enable builders to find and deploy solutions to expedite innovation.

Customers can launch pre-configured solutions in just a few clicks in both Amazon Machine Image (AMI) formats and software-as-a-service (SaaS) subscriptions, with entitlement options such as hourly, monthly, annual, and multi-year contracts.

AWS Marketplace is supported by a global team of solution architects, product specialists, and other experts to help IT teams connect with the tools and resources needed to streamline migration journeys to AWS.

Key benefits of building your DevOps practice with solutions in AWS Marketplace

Find solutions 46% faster*

Find the market-leading tools you need to orchestrate your ideal DevOps toolchain.

Adopt new tools 53% faster*

Try leading-edge developer tools and simplify procurement with integrated AWS billing.

Deploy your way, 48% faster*

Deploy DevOps solutions with methods that best fit your use case using containers, SaaS, AMIs, APIs, or CloudFormation Templates, and more.

Trust AWS interoperable technologies

Count on tools that are designed for AWS interoperability and are regularly scanned for security vulnerabilities.

About DevOps Institute

DevOps Institute works to advance the human elements of DevOps. We create a safe and interactive environment where members can network, gain knowledge, grow their careers, support enterprise transformation, and celebrate professional achievements.

We are not just an information source; we connect and enable the global member community to drive human transformation in the digital age.

Contributors:

Marc Hornbeek
Ambassador – DevOps Institute
CEO – Engineering DevOps Consulting
Analyst – Accelerated Strategies Group
Author – "Engineering DevOps"

Alex Jones
Sr. Digital Demand Generation Manager
AWS Marketplace

*2020 Amazon Web Services Marketplace online survey with 200 IT decision-makers and influencers in the U.S.