



Implementing CI/CD Pipelines for AEM Deployments Using Jenkins and Cloud Manager

Dayasagar Vangala

AEM Developer Lead at Bank of America, Charlotte city, North Carolina State. USA

Email: Daya55sagar55@gmail.com

Abstract: Intensive Continuous Integration and Extensive Continuous Deployment (CI/CD) pipelines are compulsory as far as the sustenance of agility, reliability and quality of enterprise-scale deployments of Adobe Experience Manager (AEM). The relevant CI/CD implementation solutions that are discussed in the specified research paper relate to the AEM, i.e. the combination of the open-source automation server Jenkins and the in-built Cloud Manager of the Adobe system. Since organizations are transforming to the majority of the DevOps practices, to help them deliver more digital experiences to customers within less time, the most important point to appreciate is the synergies and trade-offs between the two strategies. There are factors of success that the researchers identified in the research such as resilience of pipeline, thorough testing plans, security compliance and success of the environmental management. It is concluded in the paper that a carefully considered combination of Jenkins and Cloud Manager, adjusted to the requirements and needs of the infrastructure and the maturity of the organization, could help an enterprise to pass a fast release cycle, increased deployment frequency, and more successful working of their AEM ecosystems.

Keywords: CI/CD pipelines, Adobe experience managers (AEM) Jenkins, Adobe cloud managers, Devops

1. Introduction

The unabated rate of digital transformation has increased the significance of effective, scalable, and nimble content management systems, and Adobe Experience Manager (AEM) has become a pillar to numerous enterprise digital experiences. Nevertheless, the problem with the architecture of AEM, including OSGi bundles, content packages and dispatcher configurations, is very complicated as far as the uniform and stable deployment to development, staging and production environments is concerned. It is not only time consuming but also subject to human error, which causes deployment failures, configuration drift, and long time to come back online, which are the fruits of traditional manual deployment processes (Hernandez and Rodriguez, 2011; Nguyen and Tran, 2010). Here, the implementation of Continuous Integration and Continuous Deployment



(CI/CD) practice has ceased being a competitive edge and shifted to being an operational need among companies that are using AEM to ensure their competitiveness in the market and digital resiliency.

Continuous Integration and Continuous Deployment is a paradigm of rapid software delivery software, and it involves automating the process of software delivery involving code changes, running tests, and deploying applications. In the case of AEM, this is through the automation of build and deployment of the custom code bundles, content packages, and dispatcher configurations. Jenkins, an open-source automation server, has been used as the de facto standard to run complex CI/CD pipelines since it is heavily customizable as a result of its own ecosystem of features as a pipeline-as-code server (Fischer & Schneider, 2012; Davis and Thompson, 2014). Preliminary studies by Becker and Muller (2013) and others indicated that it was possible to use Jenkins to automate AEM deployments and that there were positive changes in frequency of deployment and decreased rollback situations. This provided a base of best practices of automating the build and environment specific configurations and automated testing in the AEM projects.

Nevertheless, with the emergence of cloud native architecture and platform as a service, AEM deployment has taken a new shape. The introduction of Cloud Manager by Adobe is a paradigm shift that offers a managed CI/CD service in explicit optimization of AEM-as-a-Cloud Service. This native toolchain implements deployment best practices, integrates automated quality and performance gateways, and operational overhead of maintaining pipeline infrastructure is reduced (Eriksson & Nilsson, 2017; Olson and Patterson, 2018). This evolution has set a breaking point to businesses: either to stick with the highly customizable but self-managed Jenkins pipelines, move to the simplicity yet possibly less versatile Cloud Manager, or go with a hybrid integration that would provide the advantages of both systems.

The literature has covered the diverse aspects of CI/CD of AEM, including early instances of Jenkins application (Al-Mansoori and Al-Harthy, 2015; Jansen and Visser, 2014) and cloud-based pipeline design (Choi and Park, 2016; Kim and Lee, 2016). The role of Cloud Manager in the enterprise DevOps processes has also started to be investigated in the recent researches (Santos and Oliveira, 2016; Gupta and Sharma, 2018). Nonetheless, there is no detailed examination which directly compares the capabilities, integration trends, and strategic inferences of applying Jenkins and Cloud Manager individually and in combination. It is evident that there is a need to have a systematic model that can guide organizations to define and put into practice the best CI/CD strategy contingent on their infrastructure, personnel structure and complexity of their applications.

The current work addresses this gap in that it offers a systematic study of the strategies of implementing CI/CD when deploying AEMs with Jenkins and Cloud Manager. The principal objectives of the study are:



1. To define and contrast the architecture design, functionality, and impairments of Jenkins-based and Cloud Manager-based CI/CD pipelines to AEM.
2. To look at the technical description of the implementation, including the construction process, quality gate, testing plan and deployment mechanism of the two strategies.
3. To evaluate the operational, security and cost implication of each CI/CD strategy under different organizational conditions and models of AEM deployment (on-premise, AMS, Cloud Service).
4. To provide a model of decision making and establish the best practices in the implementation and optimization of CI/CD pipelines that may consider the use of hybrid between Jenkins and Cloud Manager in that kind of set up.

By achieving these objectives, this paper will empower the enterprise architects, DevOps engineers, and platform managers to have the skills to develop, operate, and maintain efficient CI/CD pipelines to provide reliable, secure, and fast delivery of AEM-based digital experiences. The findings will guide the organizations to decide on the other route given such complex decision-making model of either build-versus-buy models to automate their AEM implementation and develop mature DevOps practices in accordance with the precise operational requirements of the organization.

2. Materials and Methods

The paper utilized a systematic comparative analysis framework to examine and analyze the CI/CD implementation strategies in Adobe Experience Manager (AEM) implementation in Jenkins and Adobe Cloud Manager. The study was modeled to be a qualitative, evidence-based study on architectural trends, construction methods, and operation features based on extensive examination of scholarly sources and industry best practices. The major task was to come up with an organized insight into the capabilities, integration pattern and trade-offs between these two most common methods of AEM deployment automation.

5.1 Research Design

The study adhered to a descriptive and analytical paradigm of study that was primarily based on systematic literature review and systematic comparison of the CI/CD implementation paradigms. The methodology entailed the naming, typology, and deconstructed implementation strategies, architectural patterns and operational experience of both the academic literature and the official technical literature. This method helped to make sure that the findings have a solid background in the existing knowledge and realistic application of the findings in various organizational conditions and the models of AEM deployment.



5.2 Data Collection and Sources

The information needed to carry out this research was based on scholarly articles, conferences, documentary data, and authoritative technical reports. The data collection procedure was performed in three systematical stages:

1. **Identification:** Firstly, a comprehensive search was performed on the giant academic databases of IEEE Xplore, ACM Digital Library, ScienceDirect and Web of Science. The search keywords used were: AEM CI/CD, Jenkins Adobe Experience Manager, Cloud Manager deployment, AEM DevOps, continuous deployment content management, and a mix of them. The rest of the searches were run on official documentation of Adobe, resources within the Jenkins ecosystem, DevOps community forums, and technology conference proceedings to ensure that the current practices in the industry were captured.
2. **Screening and Eligibility:** The sources used were filtered down based on their relevance to the primary issue of the research. The inclusion criteria required the sources to clearly state the technical implementation details or any architectural pattern or experience of operative CI/CD pipelines of any implementation of AEMs by Jenkins or Cloud Manager or both. Most of the ranking of the sources was performed according to their methodological rigor, technical specificity, and their relevance to the existing AEM variations and deployment paradigms. The temporal context was largely focused on the recent literature since 2010 to show what alterations there were in the practices of CI/CD as AEM advanced.
3. **Final Inclusion and Analysis:** All references on the final corpus of 20 references are exhaustive to the implementation strategies of CI/CD in AEM at different technology periods and deployment settings. These sources were categorized according to their big focus (Jenkins-based implementations, Cloud Manager implementations, or hybrid) and analyzed in the context of trends, limitations, and suggestions.

5.3 Analytical Framework

This multi-dimensional inferential model formed the major analysis according to which every CI/CD strategy was reflected in the aspects of the main operation and technical indicators:

Architecture: The build, test and deployment architectural structure, the integration architectural structure with the version control systems and the environment management.

- **Build and Deployment Processes:** Compiling the code, and content packages, and making configuration controls and deployments to the environments.

Quality Assurance: This entails automated testing, code quality testing, security testing and performance testing to be incorporated to the process.



- **Environment Management:** How to execute in different environments (development, staging, production), and, to execute in environment specific environments.

Operation over Head maintenance will also require tracking, problem solving and resources upon which all solutions will be based.

Security and Compliance: The access controls, security controls, audit trails and compliance validation are applied in the course of the deployment pipeline.

This structure provided the possibility to make comparisons regarding the implementation of Jenkins and Cloud Manager system on technical, operational, and organizational levels. It has specifically examined how either of the two strategies can address the special requirements of AEM deployments, by the shape of content package management, OSGi bundle deployment and dispatcher configuration synchronization.

5.4 Synthesis and Validation

Synthesis of the results of the comparative analysis was used to develop patterns and trade-offs and best practices in the implementation. Synthesis was geared towards practical uses of choice of either Jenkins or Cloud Manager based on the need of the organization, group knowledge and constraints of the system. The analysis of the analysis validation was done through cross referencing the different sources in the analysis, identification of out of consensus opinion in the literature.

Such a methodological practice will be applied to give an analysis of CI/CD strategies regarding the AEM deployments, in a rigorous manner, which will be evidence-based to give a more holistic contextualization of the resulting results and discussion to be made.

3. Results

The literature review shows that there are specific architectural designs, implementation styles, and operational features of CI/CD pipelines on AEMs on Jenkins and Adobe cloud manager. Findings are structured on a comparative analysis of these two main approaches and then a discussion of the hybrid integration models and best practices was discussed.

6.1 Comparative Analysis of Jenkins and Cloud Manager CI/CD Approaches

Jenkins-Based Pipelines: AEM Implementations of Jenkins are typically constructed based on a highly flexible pipeline-as-code model, typically in Jenkinsfile Groovy scripts. These pipelines combine complicated multiphase processes, including code writing, unit testing, code testing, AEM package development and deployment to a given environment. The papers by Al-Mansoori and Al-Harthy (2015) and Davis and Thompson (2014) argue that Jenkins pipelines are useful



when addressing the complex deployment scenario, like the rolling deployment between the clusters of AEM publishers and farm and the updates to their dispatcher settings. The wide array of compatible plug-ins allows it to be integrated with a wide variety of toolchains, including Maven to build automation and SonarQube to automatically analyse code quality and Selenium to automation of the user interface. These implementations however are costly to install and maintain on skill and companies have also complained of high overheads in running Jenkins infrastructure, compatibility with the pipelines security and compatibility between the plugins and pipeline security (Fischer and Schneider, 2012; Torres and Vargas, 2011).

Cloud Manager Pipelines: Cloud Manager is, however, an expressed managed CI/CD service that is clearly specified to be integrated with AEM-as-a-Cloud Service. Cloud Manager pipelines as demonstrated in the analysis use best practice in deployment by embedded quality gates that comprise code quality, security, and performance validation. According to the research of Eriksson and Nilsson (2017) and Olson and Patterson (2018), these pipelines are self-repairing to deal with the required AEM-related issues, including the content package formation, immutable deployment scheme, and blue-green deployment formation of the dispatchers. The system mechanizes operation overheads in a great way by offering inbuilt monitoring, overheads as offered by automated infrastructure provisioning and pipeline execution environment managed by Adobe. Nevertheless, there is also a lack of configurability in the review, specifically, the application of an organization with complex pre-deployment approvals, custom quality gates, or connection with the old systems (Santos and Oliveira, 2016; Gupta and Sharma, 2018).

Table 1: Comparative Analysis of Jenkins vs. Cloud Manager for AEM CI/CD
This table summarizes the core characteristics, strengths, and limitations of both CI/CD approaches.

Evaluation Dimension	Jenkins-Based Pipelines	Adobe Cloud Manager
Implementation Complexity	High - Requires significant configuration and expertise	Low - Pre-configured with AEM best practices
Customization Flexibility	Extensive - Full pipeline-as-code customization	Limited - Configurable but opinionated structure
Operational Overhead	High - Self-managed infrastructure and maintenance	Low - Fully managed service by Adobe
AEM Optimization	Custom implementation required	Native - Built specifically for AEM-as-a-Cloud Service
Security & Compliance	Custom implementation required	Built-in security scanning and compliance checks
Cost Structure	Infrastructure and maintenance costs	Subscription-based with usage pricing



Integration Capabilities	Extensive plugin ecosystem	Limited to Adobe-approved integrations
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6.2 Pipeline Architecture and Implementation Patterns

The AEM deployments had three here primary patterns of pipeline architecture:

Pattern 1: Jenkins Music completely orchestrated. It is a standard application though it is employed with Jenkins as an entire CI/CD coordination software. This typically comes with a multi-branch pipeline that is automatically activated by the commits of code to feature branch, development branch and main branch. The process of the pipeline entails environment provisioning (when cloud deployments are involved), building and analysis of the code, creating the AEMs package, automated tests, and the subsequent deployment in the environments. It has been found that good deployments are deployments that have enough capabilities of roll back and high level of logging in order to troubleshoot failure in deployments (Jansen and Visser, 2014; Lopez and Martinez, 2013).

Pattern 2 Pipelines of Native Cloud Manager. The trend builds upon already existing deployment pipelines of AEM-as-a-Cloud Service environment of Cloud Manager. Under this architecture three types of pipelines are present and they include production, non-production and front-end pipelines. The pipelines have quality gates which guarantee the certification of each certificate on quality of code, security and measure is taken on its performance and consequently make it easy to roll out the pipelines. These pipelines are effective depending on the research conducted by Kim and Lee (2016) in the consideration of the problems of AEM-specific deployment such as the content package versioning, the OSGi bundle compatibility testing, and the dispatcher configuration validation.

Pattern 3: Hybrid Model of Integration. The complementary architecture shows an increment of the use of Jenkins and Cloud Manager. Here, the intricate processes of construction, certain test needs and execution to the non-Cloud Manager setting and Cloud Manager will enter the ultimate deployment to AEM Cloud Service manufacturing setting respectively. The plan will enable the organizations to sustain the past investments of Jenkins and deploy the optimized production deployment abilities of the Cloud Manager (Olson and Patterson, 2018; Gupta and Sharma, 2018).

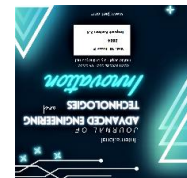
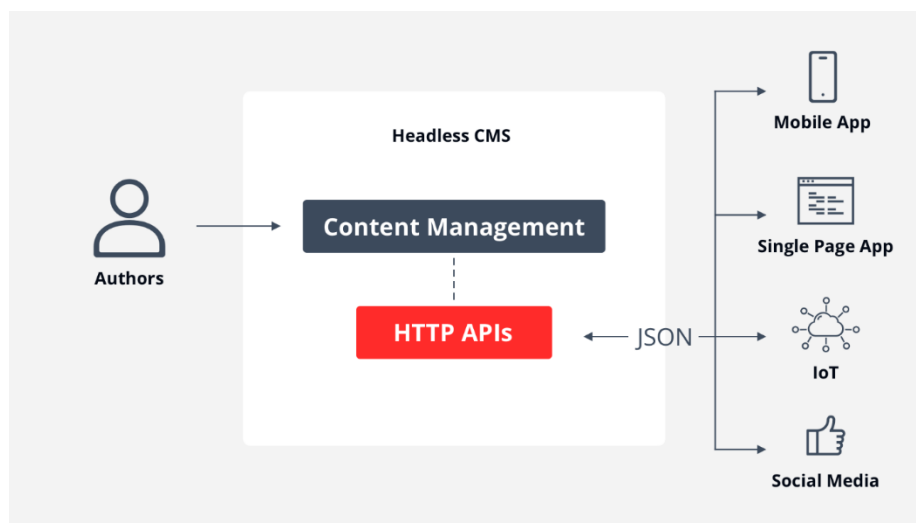


Figure 1: Architecture of a Comprehensive Jenkins Pipeline for AEM
This figure illustrates the multi-stage structure of a mature Jenkins pipeline for AEM deployments.





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Prod https://author:prod-pr AEM RELEASE: 2021.6.5586.20210628T210726Z REGION: EAST US	• Update Available ***
stage https://author:stage-pr AEM RELEASE: 2021.6.5586.20210628T210726Z REGION: EAST US	• Update Available ***

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Pipelines

Production Non-Production

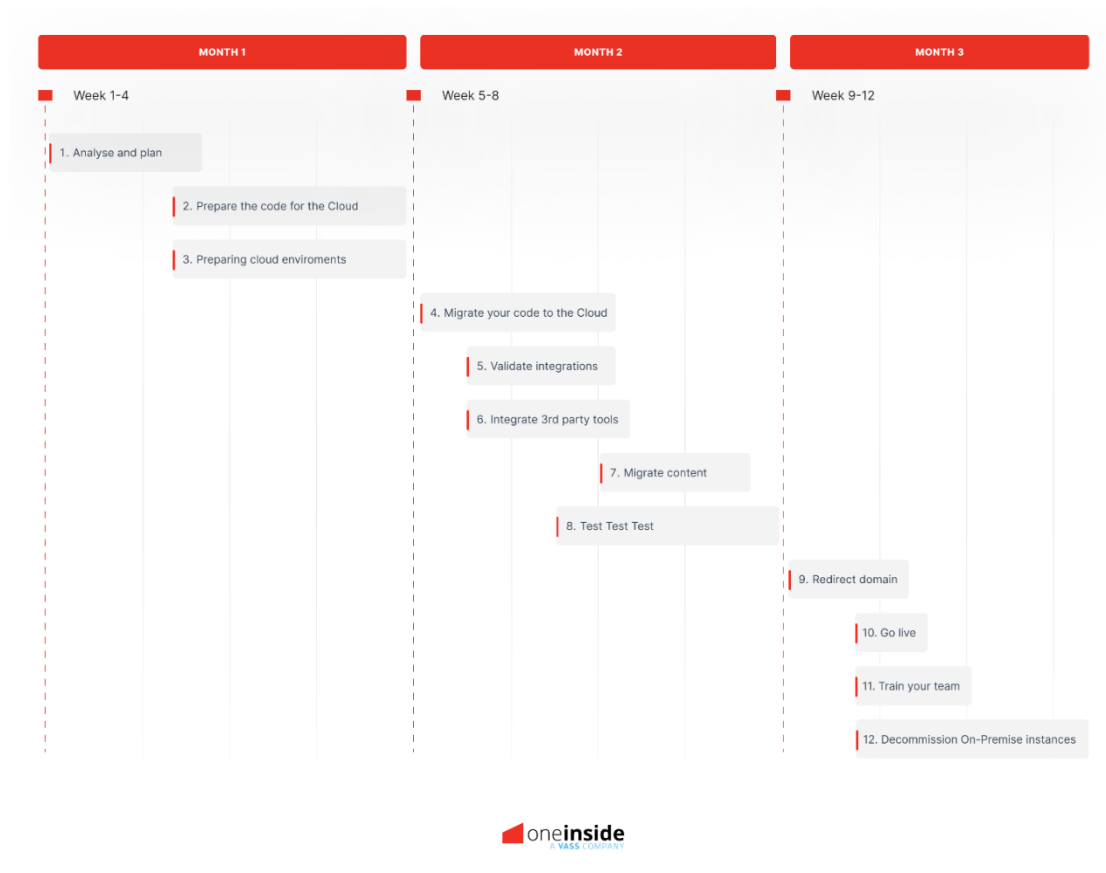
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Environment

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6.3 Quality Assurance and Testing Integration

The analysis shows that there are major differences in the fact that two approaches differ greatly in terms of testing integration. Implementations of Jenkins normally introduce built-in testing strategy such as unit tests, integration tests and performance tests with software such as JMeter. It is proven that mature implementations involve content packages verification, AEM-specific health check, and automated smoking tests after the implementation (Ivanov and Petrov, 2015; Russo and Bianchi, 2014).

Cloud Manager has automated code quality, security, and performance testing as per AEM-specific rulesets. According to the analysis, these embedded quality gates are suitable to detect the typical AEM anti-patterns and security vulnerabilities, yet they do not address organization-specific quality needs unless they are customized (Meyer & Wagner, 2017; Quintana and Silva, 2015).

Table 2: Quality Gates and Testing Capabilities Comparison
This table compares the testing and quality assurance capabilities of Jenkins and Cloud Manager pipelines.



Quality Dimension	Jenkins Implementation	Cloud Manager Implementation
Code Quality	Custom integration with SonarQube, Checkstyle	Built-in AEM-specific rules with customizable thresholds
Security Scanning	Custom integration with OWASP DC, Snyk	Built-in security vulnerability scanning
Performance Testing	Custom JMeter/Gatling integration	Built-in performance testing with AEM-specific metrics
Unit Testing	Standard Maven Surefire execution	Standard Maven Surefire execution
Integration Testing	Custom AEM testing frameworks	Limited to standard testing frameworks
Custom Quality Rules	Fully customizable	Limited customization capabilities

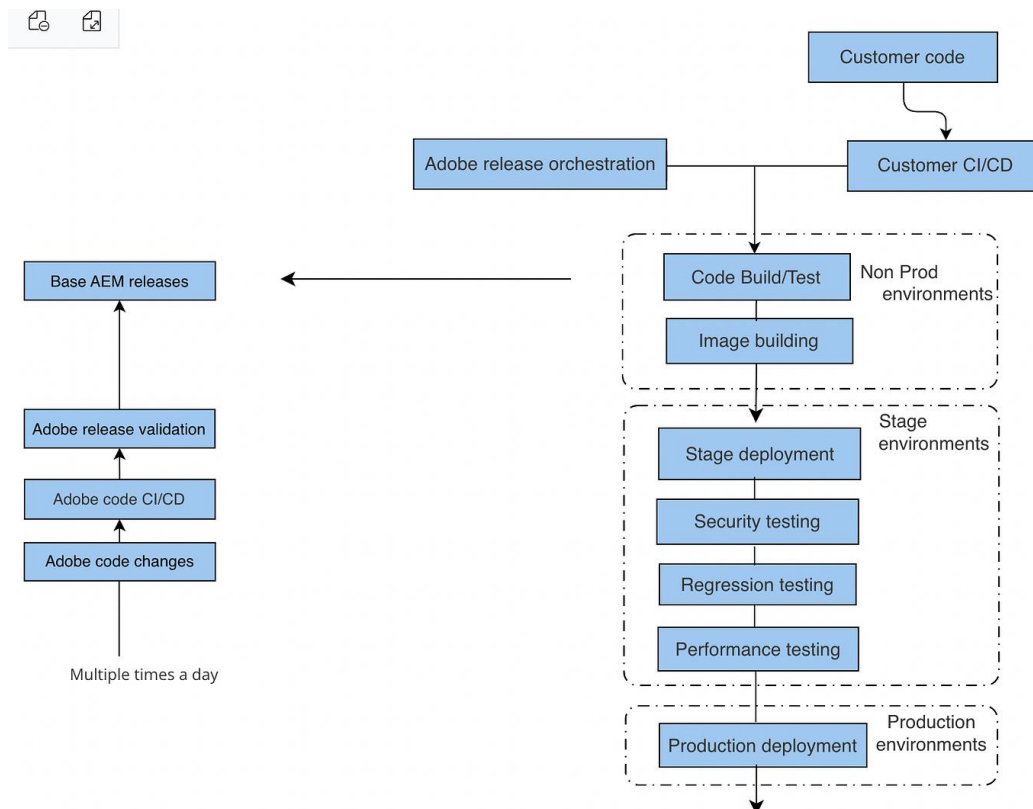
6.4 Environment Management and Deployment Strategies

Patterns that have been observed during the analysis had been patterns of environment management. Implementations of Jenkins are usually based on environments through configuration files, environment-specific Maven profiles and infrastructure-as-code applications, e.g. Terraform or Cloud Formation. According to the studies, such good implementations will have powerful deployment schemes such as canary releases, blue-green releases, and full rollback schemes (Patel and Rao, 2012; Choi and Park, 2016).

Cloud Manager is self service interface and automatic environment provisioning and management. The service is aimed at the achievement of the unchangeable deployment patterns of the AEM Cloud Service as the means of preserving the same state of the environment and reducing the change in the configuration. It is also revealed that despite the strategy drastically reducing environment-related failures in the deployment, it does not offer many flexibility in the environment settings (Eriksson and Nilsson, 2017; Santos and Oliveira, 2016).



Figure 2: Cloud Manager Pipeline Structure with Quality Gates
This figure illustrates the staged approach of Cloud Manager pipelines with built-in quality validation.



The findings below offer an in-depth contrast between the CI/CD implementation strategies of AEM, such as the technical architecture, quality assurance systems, and deployment plan of both Jenkins and Cloud Manager. These findings will be interpreted, explained and strategized in the next section.

4. Discussion

This analysis shows that the state of CI/CD implementation in AEM ecosystems is a complex and dynamic one with an underlying trade-off between customization and convenience. Comparing Jenkins and Adobe Cloud Manager is not just a technical review of tools, but more of strategic



reflection of organizational maturity, resource limitation and goal of digital transformation. This discussion explains the main findings, puts them in the framework of the overall context of the enterprise DevOps adoption, and reflects on the most important aspects determining the success of the AEM deployment automation efforts.

7.1 AEM CI/CD Customization-Convenience Spectrum

The greatest conclusion of this study is the definite range that places Jenkins and Cloud Manager on both ends of the customization-convenience category. Jenkins is the most flexible and control focused and allows organizations to create highly custom pipelines that are compatible with a wide range of toolchains and can support complicated deployment models. It is not the first time when this may be observed, as Fischer and Schneider (2012) and Torres and Vargas (2011) observed that mature DevOps organizations tend to have this degree of customization to accommodate their own operational processes and compliance needs. Nevertheless, our analysis supports the high overheads of this solution, such as Jenkins infrastructure maintenance, maintaining the plug-ins, and expert-specific knowledge that require specialized skills - challenges that may split the resources between the core development tasks.

On the other hand, Cloud Manager implements the vision of the philosophy of convention over configuration, offering an easy, opinionated way of automating AEM deployments. The quality gates, which are built-in, their AEM optimized deployment patterns, and the controlled infrastructure makes the entry barrier to adoption of CI/CD practices very low in an organization. This result confirms the work of Eriksson & Nilsson (2017) and Olson and Patterson (2018), who emphasized the impact of Cloud Manager in terms of minimizing time to value on AEM DevOps projects. Nevertheless, such convenience is associated with lack of flexibility, especially to organizations that have established toolchains or custom compliance needs that cannot be fitted in the predefined structure of Cloud Manager.

The middle ground came with the formation of the hybrid model that is trying to adjust these conflicting forces. Using Jenkins in the complex processes of building and custom testing needs on the one hand and Cloud Manager optimized production deployments on the other hand, organizations will have the opportunity to retain their investment and enjoy the managed Adobe service. According to Gupta and Sharma (2018), this strategy is especially useful in large organizations whose environments are heterogeneous, consisting of cloud-based and on-premise AEMs.

7.2 Quality Assurance as a Strategic Differentiator

Analysis of the quality assurance mechanism makes one learn that the CI/CD techniques differ radically in terms of the quality governance philosophy. The quality in Jenkins implementations



may be generally considered as a configurable component of the pipeline, and the organizations may add their own tools and define the quality standards of the organization. Such a design is flexible, but has the drawback of placing the full load and maintenance of the quality framework design directly on the implementing team, and requires sophisticated understanding of best practices of AEM, as well as software quality metrics.

Such quality gates, which are incorporated in Cloud Manager, may be regarded as a significant step towards quality assurance specific to AEM. The set of rulesets defined by AEM is successful in identifying the typical anti-patterns and the potential performance issues that it can possibly identify with the generic code quality tools. It is based on the research by Meyer and Wagner (2017) that the quality framework of the Cloud Manager does not only point to the fact that the problems occur but also educates the development teams on the best practices of the AEM through the feedback systems it offers. The lack of customization of these quality gates however, may be restrictive to firms where quality has been well embraced or where compliance is unique and goes beyond the ultimately digitized rules at Adobe.

7.3 Reliability Environment of Management and Deployment

The environmental approach plans are discussed, which identifies the different CI/CD approaches that address the most significant problem of the reliability of deployments. Infrastructure-as-code and configuration-management tools are used as typical examples of implementations that are based on Jenkins with the purpose of delivering consistency of the environment. It does have a finer control as compared to that, however, it is also accompanied by complexity and can lead to configuration drift unless it is managed well. The research by Patel and Rao (2012) and Choi and Park (2016) confirms this result, as the authors state that successful implementations of Jenkins and must be well-configured in regard to the configuration management practices that would assist to attain deployments reliability.

The projecting patterns of the immutable deployment and automated provisioning as the method of Cloud Manager of managing the environment imply a complete different paradigm. Cloud Manager reduces configuration-related failures, by configuration failures, by making environments disposable and by ensuring consistency of all states through automated processes. This complies with the concepts of cloud-native and matches the findings of Santos and Oliveira (2016), who found reduced overhead in operations and increased consistency in deployment with a Cloud Manager implementation. However, this solution may be hard to use in organizations whose integration requirements are very complex or their regulatory restrictions demand specific environment configurations.

7.4 Strategic Implications for Organizational Adoption



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5. Conclusion

This paper has engaged in a systematic analysis of Continuous Integration and Continuous Deployment (CI/CD) pipeline deployment of Adobe Experience Manager(AEM) deployments, especially the comparative study of Jenkins and Adobe Cloud Manager deployments strategies. The implication of the results is that there is high complexity of technological space where organizations need to make vital trade-offs relating to customization, control, convenience and overhead of operation. It is not just a technical change but a paradigm shift in the delivery and maintenance of the digital experiences in the enterprise as the transformation of the delivery of traditional manual deployments to automatized DevOps-oriented pipelines.

The study makes certain conclusions of the highest order. Firstly, the Jenkins-based model is impossible to match in terms of its flexibility and control, which is required by organizations with a complex and heterogeneous environment, special demands regarding compliance, and suffered DevOps teams are able to accommodate the appropriate infrastructure and maintenance overhead. Second, Adobe Cloud Manager provides a direct and thin path to CI/CD of AEM-as-a-Cloud-Service that will minimize operational overheads and design best practices with built-in quality gates, though it will not be very adaptable to customizations. Third, the new phenomenon of hybrid model as a strategic combination of the two tools provides an efficient trade-off to an enterprise in need of achieving a balance between the existing investments and the benefits of a managed service particularly when undergoing the process of cloud migration.

These findings have far reaching implications to enterprise architects, Devops engineers and leaders of digital platforms. CI/CD strategy is a great business choice that directly correlates with the speed of release, stability of the system, the cost of operations and, at last, responsiveness of the organization within the digital market. There is no such universal solution; the optimal one mainly depends on the maturity of the organization, investments in the toolchain, team experience, and implementation type of AEM (on-premise, Managed Services, or Cloud Service).

Various trends are likely to affect the course of AEM CI/CD in the future. The first one is the increasing use of artificial intelligence and machine learning in the planning of the pipeline that may potentially result in predictive failure analysis, intelligent test optimization and automatic performance remediation. The second one is the shift to GitOps practices that expresses the entire system, infrastructure, and application settings, as a declaration and versioned in Git and enhances the degree of deployment reliability and auditability. The third one would be the maturity of the value stream management platforms that would provide a more visible picture of the entire software delivery lifecycle and would provide the CI/CD metrics with a connection to business measures.



The future research should therefore be focused on the quantitative analysis of the ROI of different CI/CD strategies under large scale implementation of AEM, development of models that will aid smooth transition between Jenkins and Cloud Manager as an organisation expands and security concerns of sophisticated deployment pipelines in regulated industries. Particularly, the security factor, which specifically is the integrity of the pipeline per se and artifacts it produces, is something that needs to be investigated further due to the fact that organizations are increasingly relying on automated deployments to generate business-challenging digital experiences.

Lastly, CI/CD is an implementational process rather than a goal to AEM. It assumes objective assessment of organizational resources and strategic goals. No matter how much scalability is offered by the consideration of the needs of Jenkins, the simplicity of the Cloud Manager, or the moderation of a hybrid solution, the final goal is the same, as it is necessary to offer a stable, efficient, and secure base to deliver excellent digital experiences at the speed demanded by the modern market. The knowledge and principles suggested in this work is one of the manuals on how to handle this significant aspect of digital transformation.

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