

## Overview – Option 1 – Continuous Integration in a Growing Startup

Continuous Integration (CI) helps teams work together by automatically checking their code changes and making sure everything works as expected from one change to another. For a small startup, CI can be essential for increasing productivity. It keeps things organized and prevents issues as more people join the team and start working on the same project. CI helps developers get near instant feedback on their work through systems like pipelines and code coverage, so they can quickly fix any issues that arise. [1] With a startup, things can change quickly, and CI provides stability. It takes care of routine tasks, freeing up time for developers to focus on making the product better.

## Requirements Summary

The startup's IT team needs a Continuous Integration (CI) tool that integrates with their existing infrastructure, like GitLab.com for source code management and AWS for deployment. The tool should ensure security, with features like LDAP integration and 2-factor authentication. It should support multiple programming languages to cater to the needs of both the front-end and back-end development teams. The CI tool should be easy to configure and manage, provide audit logging capabilities, and have technical support. Budget-wise, the tool's costs, including one-time expenses, training, and annual fees, must align with the CFO's approval of up to \$300USD per developer per year. Essentially, the chosen CI tool should enhance productivity and streamline development processes.

## Tool Summary

GitLab CI is a tool that introduces continuous methodologies. It provides an easy-to-use interface, and supports many languages, including Python, Go, and React. Like the others, Gitlab has pipelines which enable CI/CD. Like many others, these pipelines contain jobs and stages, which are executed by runners [2]. Gitlab CI supports LDAP and 2-factor authentication [3]. It also supports audit logging and quick technical support [4]. GitLab CI would be a valid option considering the team is already using GitLab for version control, but since GitLab starts at \$348 USD annually, this option is off the table [5].

Travis CI is a cloud-based CI/CD platform that integrates with version control systems, providing automated build and deployment workflows for projects hosted on repository services. [6] It supports multiple programming languages, including Python, JavaScript, and Ruby, and offers customizable build environments. [7] Travis CI has security with features like 2-factor authentication, encrypted secrets, and access controls. While it offers technical support with priority support options, its subscription-based pricing model may exceed budget constraints especially since the enterprise version is required for LDAP integration [8].

Circle CI is a cloud-based CI/CD platform that integrates with version control systems, offering customizable workflows and scalable infrastructure for building and deploying software projects [9]. It supports a wide range of programming languages, including Python, Ruby, PHP, JavaScript [10]. Also offering container support for Docker-based workflows [11]. LDAP integration is possible with some configuring [12], and has support for 2-factor authentication [13]. Circle CI offers technical support with 24/7 availability, ensuring assistance is available whenever needed by the team [14]. Circle CI is a

prominent option, being user-friendly, easy to get started with, and having a competitive price of \$15/month [15].

AWS Code Pipeline is a managed CI/CD service provided by Amazon Web Services (AWS), offering integration with many repository providers and various AWS services for building, testing, and deploying software project. Security features are aligned with AWS best practices, and it integrates with AWS Identity and Access Management (IAM) for access control. AWS Code Pipelines offer technical support as part of AWS support plans, with plenty of documentation for the team to get started [16]. Costs are included as part of AWS usage on a pay-as-you-go bases, with potential for additional costs depending on usage and requirements [17]. With its flexible pricing system and deep integration with AWS services, AWS Code Pipeline is a strong competitor out of the 4 services.

## Tool Comparison

Criteria	GitLab CI	Travis CI	Circle CI	AWS Code Pipeline
General Summary	Integrated with GitLab.com, supports CI/CD pipelines, easy to configure, security features, active development	Cloud-based, integrates well with GitLab, supports multiple programming languages, provides build environments, automated deployments	Cloud-based, integrates with major version control systems, customizable workflows, scalable infrastructure, container support	Managed service on AWS, integrates with AWS services, supports multiple source providers, customizable workflows, scalable infrastructure
Company	GitLab Inc.	Idera, Inc. acquired in 2019 [18]	CircleCI	Amazon Web Services (AWS)
Years Available	12 (since 2012) [19]	13 (since 2011) [20]	13 (since 2011) [21]	9 (since 2015) [22]

current version	v16.10, depends on version used [23]	3.0.53 [24]	4.3.3 [25]	2024-02-15 [22]
release frequency	About once a month [23]	About once a month [20]	Daily [25]	About once a week [22]
LDAP Integration	Yes [3]	Yes, with enterprise upgrade [8]	Yes [12]	Yes [16]
2-Factor Authentication	Yes [3]	Yes [8]	Yes [13]	Yes [16]
Programming Language Support	Wide range, including Python, Go, and React [2]	Wide range, including Python, JavaScript, and Ruby [7]	Wide range, including Python, Java, and JavaScript [9]	Smaller range, Python, JavaScript, Go [26]
Audit Logging	Yes [4]	Yes [27]	Yes [28]	Yes [29]
Technical Support	Available with paid plans, including quick response times [2]	Available with paid plans, includes priority support [8]	Available with paid plans, includes 24/7 support [14]	AWS Support available with various plans [16]
Cost	\$348 annually, 10,000 mins [5]	\$229USD/month for more than 1 concurrent job [30]	\$15USD/month for 5 users, \$15USD for every user and minutes after, 80 jobs [15]	\$0.002 per minute of pipeline run [17]
Docker and Kubernetes Integration	Supports Docker containers and Kubernetes, includes Docker container registry [2]	Limited Docker support, Kubernetes integration possible with plugins [8]	Supports Docker containers and Kubernetes, includes Docker container registry [31]	Supports Docker containers and Kubernetes, integrates with AWS services [32]
UI testing with cypress [33]	Yes	Yes	Yes	Yes

Usability	User-friendly interface, integrates seamlessly with GitLab.com [2]	User-friendly interface, integrates well with GitLab, easy setup [8]	User-friendly interface, customizable workflows, easy to get started	User-friendly interface, integrates with AWS services, may require AWS expertise
Security	Strong emphasis on security features, including LDAP integration and 2-factor authentication [3]	Security features include 2-factor authentication, encrypted secrets, and access controls [8]	Security features include encryption at rest, role-based access control, and private builds [13]	Security features aligned with AWS best practices, integrates with AWS Identity and Access Management [16]

## Recommendation

Through a comprehensive analysis, Circle CI stood out as the most favorable choice for the startup's Continuous Integration (CI) needs due to its comprehensive features and attractive that price aligns with the startup's requirements and tight budget constraints.

AWS Code Pipeline was a close second, providing a deep integration with AWS services and a flexible pricing model. Since it charges per minute used, consideration would need to be made to reduce runtimes. This could pose challenges for the startup's small IT team and introduce uncertainty regarding overall costs, making it less attractive as a CI/CD solution.

Although GitLab CI is integrated with GitLab.com, it exceeds the budget constraints set by the CFO, ongoing annual costs will not align with the approved budget. Travis CI, while offering robust features, also exceeds budget constraints, especially since LDAP integration requires an enterprise upgrade.

## References

- [1] "What is continuous integration?," [Online]. Available: <https://www.ibm.com/topics/continuous-integration>.
- [2] "GitLab CI: Feature Overview, Tutorial and Best Practices," codefresh, [Online]. Available: <https://codefresh.io/learn/gitlab-ci/>.
- [3] "Integrate LDAP with GitLab," GitLab, [Online]. Available: <https://docs.gitlab.com/ee/administration/auth/ldap/>.
- [4] "Audit event reports," GitLab, [Online]. Available: [https://docs.gitlab.com/ee/administration/audit\\_event\\_reports.html](https://docs.gitlab.com/ee/administration/audit_event_reports.html).
- [5] "Pricing," GitLab, [Online]. Available: <https://about.gitlab.com/pricing/>.

- [6] M. Ekpang, "Travis CI, An excellent tool for continues integration," Medium, 26 September 2018. [Online]. Available: <https://medium.com/@michaelompokang/travis-ci-an-excellent-tool-for-continues-integration-28383beafc15>.
- [7] "Languages," Travis CI, [Online]. Available: <https://docs.travis-ci.com/user/languages/>.
- [8] "Travis CI Enterprise," Travis CI, [Online]. Available: <https://docs.travis-ci.com/user/enterprise/>.
- [9] P. Jain, "An Introduction to CircleCI," Medium, 13 May 2020. [Online]. Available: <https://medium.com/xebia-engineering/an-introduction-to-circleci-aa9464a86673>.
- [10] J. Schmitt, "DevOps top programming languages support engineering metrics goals," Circle CI Blog, 14 September 2022. [Online]. Available: <https://circleci.com/blog/devops-language-trends-2022/>.
- [11] "Using the Docker execution environment," Circle CI, November 2023. [Online]. Available: <https://circleci.com/docs/using-docker/>.
- [12] "CircleCI and Ldap integration," n8n, [Online]. Available: <https://n8n.io/integrations/circleci/and/ldap/>.
- [13] "Security," Circle CI, [Online]. Available: <https://circleci.com/security/>.
- [14] "Support," Circle CI, [Online]. Available: <https://support.circleci.com/hc/en-us>.
- [15] "Pricing," Circle CI, [Online]. Available: <https://circleci.com/pricing/>.
- [16] "AWS CodePipeline," AWS, [Online]. Available: <https://docs.aws.amazon.com/codepipeline/latest/userguide/welcome.html>.
- [17] "AWS CodePipeline pricing," AWS, [Online]. Available: <https://aws.amazon.com/codepipeline/pricing/>.
- [18] F. Lardinois, 23 January 2019. [Online]. Available: <https://techcrunch.com/2019/01/23/idera-acquires-travis-ci/>.
- [19] s. t. Sid Sijbrandij, "History of GitLab," GitLab, [Online]. Available: <https://handbook.gitlab.com/handbook/company/history/>.
- [20] "About," Travis CI, [Online]. Available: <https://www.travis-ci.com/about-us/>.
- [21] P. Sawers, "Continuous software integration/delivery platform CircleCI nabs \$100M," Venture Beat, [Online]. Available: <https://venturebeat.com/business/continuous-integration-and-delivery-platform-circleci-raises-100-million/>.
- [22] "AWS CodePipeline User Guide document history," AWS, [Online]. Available: <https://docs.aws.amazon.com/codepipeline/latest/userguide/history.html>.

- [23] "Get started with GitLab CI/CD," GitLab, [Online]. Available: <https://docs.gitlab.com/ee/ci/>.
- [24] "Travis CI Enterprise release notes," Travis CI, [Online]. Available: <https://enterprise-changelog.travis-ci.com/>.
- [25] "Change Log," Circle CI, [Online]. Available: <https://circleci.com/changelog/>.
- [26] "Language support for AWS CodePipeline," snyk , [Online]. Available: <https://docs.snyk.io/integrate-with-snyk/snyk-ci-cd-integrations/aws-codepipeline-integration-by-adding-a-snyk-scan-stage/language-support-for-aws-codepipeline>.
- [27] "CI/CD Security: Best Practices," Travis CI, 22 May 2023. [Online]. Available: <https://www.travis-ci.com/blog/ci-cd-security-practices/>.
- [28] "Audit Logs," Circle CI, [Online]. Available: <https://circleci.com/docs/audit-logs/>.
- [29] "Logging and monitoring in CodePipeline," AWS, [Online]. Available: <https://docs.aws.amazon.com/codepipeline/latest/userguide/incident-response.html>.
- [30] "Pricing," Travis CI, [Online]. Available: <https://www.travis-ci.com/pricing/>.
- [31] "Automate Kubernetes," Circle CI, [Online]. Available: <https://circleci.com/integrations/kubernetes/>.
- [32] C. Barclay, "Continuous Deployment to Kubernetes using AWS CodePipeline, AWS CodeCommit, AWS CodeBuild, Amazon ECR and AWS Lambda," AWS, 11 January 2018. [Online]. Available: <https://aws.amazon.com/blogs/devops/continuous-deployment-to-kubernetes-using-aws-codepipeline-aws-codecommit-aws-codebuild-amazon-ecr-and-aws-lambda/>.
- [33] "CI Provider Examples," Cypress, [Online]. Available: <https://docs.cypress.io/guides/continuous-integration/ci-provider-examples>.
- [34] "Audit logs," Circle CI, [Online]. Available: <https://circleci.com/docs/audit-logs/>.