



Fast Delivery, Continuously Build, Testing and Deployment with DevOps Pipeline Techniques on Cloud

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Abstract

Objectives: To implement the DevOps pipeline on cloud for an organization. That is designed and implemented according to the project requirements. **Methods/findings:** The results of the study are to automate everything using DevOps pipeline on cloud native with executed Continuous Integration (CI), Continuous Delivery (CD), and Monitoring required for the case project. The best practices of DevOps are for automated test execution, automated deployment on different environments, and monitoring of the application. It also maintains the application source code repository structure.

Keywords: DevOps Pipeline, Culture and Infrastructure Challenges, CI (Continues Integration), CD (Continuous Delivery) Implementation on Cloud

1. Introduction

Now days, everyone needs software applications, and its delivery quicker. DevOps helps to boost up/speed up an organization for continuous integration and continuous deployment of the software applications release in different environments inside and the automated way. DevOps was introduced for IT practices, faster delivery of the software applications which worked together as a software development team and operations team on the similar project in a more collaborative manner.

DevOps is fundamentally a combination of two words, “dev” and “ops.” Dev refer to the development and Ops refer to operations. DevOps is a culture that pursues the arrangement of practices to consolidate the DevOps and IT operation team. Its real objective is to faster delivery of software life cycles. This culture builds the organization speed to deliver the software applications and its related service.

DevOps is a culture which develops joint effort among Development and Operations teams to send the code for generation quicker in a robotized and repeatable way. The word “DevOps” is a mix of two words “advancement” and “activities.” In simple words,

DevOps can be considered as an arrangement of development and IT tasks with better correspondence and coordinated effort. DevOps is simple when you realize that your organization can embrace changes effectively and when you have the correct frame of mind to make DevOps apart in your organization.

1.1. DevOps Cycle

When the business objectives and targets have been obviously recognized and resource planning and improvement is done, the DevOps technique travels through the accompanying stages. The organization need and follow the DevOps Cycle [1,2]. The DevOps cycle based on as shows in Figure 1 DevOps cycle process. The organization need and follow the DevOps Cycle.

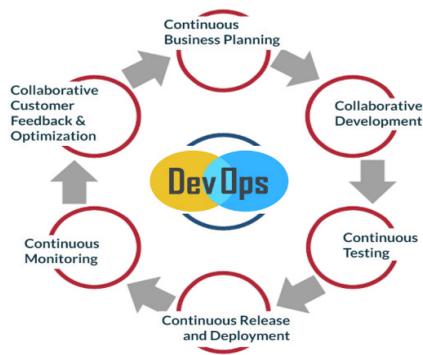


FIGURE 1. DevOps cycle DZone.

1.1.1. Collaborative Development

This is the absolute first stage, which includes the planning technique of your application. The development based on the requirements and objective that are to be accomplished through the application you need to make. When you close in and accept a last approach of the targets, you are prepared to take over to the development of your project. This establishes the techniques of creating the applicable codes and preparing them for the following stage. Since DevOps is a reliable system, existing code can likewise be utilized for further upgrades by taking consistent input on the development.

1.1.2. Continuous Testing

Testing is the phase that has use for the application under DevOps gets converged into. A tester checks and makes an effort to guarantee that the application is made sufficiently capable to yield conceivable outcomes that are practical in reality. Testing gives more profound bits of knowledge with respect to different parts of the application. This is an extraordinary positive as any progressions to be made are straightaway sent to the improvement procedure once more. Testing empowers steady enhancements in the general working of an application and sets it up for dispatch in reality [2].

1.1.3. Continuous Integration

Continuous Integration is a product advancement practice in which you manufacture/build and unit-test programming each time an engineer checks in new code. This gives Agile programming team the fast criticism they have to react to showcase requests and dispense with issues rapidly.

1.1.4. Continuous Delivery

Continuous Delivery (CD) is a product improvement practice in which continuous integration (CI), the testing mechanism uses automated testing, and release deployment automatically. The capabilities of software to develop the high level quality of software and deployed quickly, dependably and more than once with insignificant manual overhead.

1.1.5. Continuous Release and Deployment

Continuous Deployment is a product development practice in which each code change experiences the whole pipeline and releases into a production environment automatically. The Continuous Deployment is consequently, bringing about numerous creation arrangements consistently [3]. The continuous release and deployment is based on Figure 2 as shows Continuous Delivery and Deployment process.

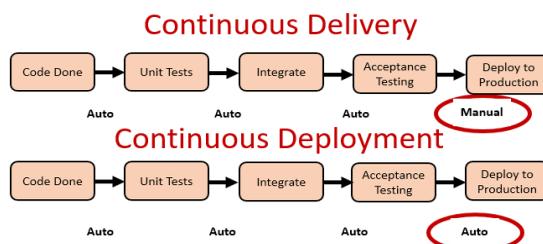


FIGURE 2. Continuous delivery and deployment.

With the help of Continuous Delivery, your product is ready to Deployment the release, yet the planning of when to push the code into production branch is a business choice, thus the last sending is a manual advance. With Continuous Deployment, any refreshed working adaptation of the application is consequently pushed to production. Nonstop Deployment commands Continuous Delivery, however, the inverse is not required.

1.1.6. Continuous Monitoring

Continuous Monitoring is a stage which includes the operational variables of the whole DevOps process. This is the place where a great deal of critical data about the application use is spared and complicatedly prepared with the goal of discovering the regions of errors and observe the present patterns that include the application. This checking and monitoring is as a rule, incorporated appropriately inside the product that can be recorded or even

produce information about specific benchmarks when the software is on production or active.

1.1.7. Customer Feedback and Optimization

This takes into consideration a quick feedback from your clients for a product and its highlights and causes you to change likewise. Dealing with these six phases will make you a decent DevOps organization. This is anything but an absolute necessity that has displayed yet it is one of the more complex models. This will give you a reasonable thought on the apparatuses to use at various stages to make this procedure progressively rewarding for a product controlled organization.

Continuous deployment pipelines and Continuous Integration tool make things simple. When you need to rehearse DevOps, having a micro services design bodes well.

1.1.8. Release Automation and Deploy Automation

Release pipeline is the entire procedure from engineer's registration completely through Production. As a component of that procedure, arrangements occur in different stages and in different situations. Figure 3 as shows Release and Deployment Automation process.

Example, after CI you have to deploy the different conditions in QA process, following an arrangement into staging servers and afterwards into production [3-4].

1.2. DevOps Stage

DevOps is the connection of people, process, and products which empower Continuous Delivery of significant worth to end clients. The results are firmly associated with the capacity for frequent releases to happen and in the meantime to the capacity to keep a similar dimension of value. DevOps has three communication stages as shows in Figure 4.

1.2.1. People

Considering DevOps at an actual high level, first it is all about the people. DevOps business, everyone that is included who needs to deliver the business working in all respects firmly

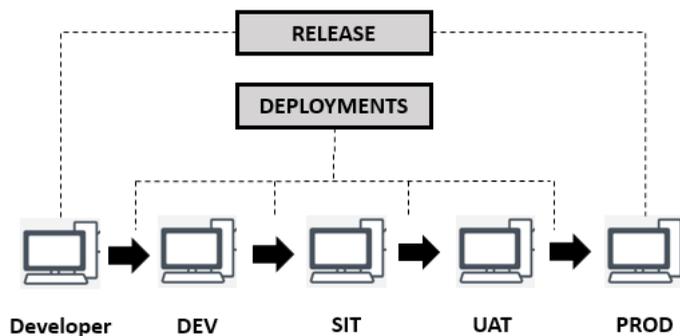


FIGURE 3. Release and deployment automation process.

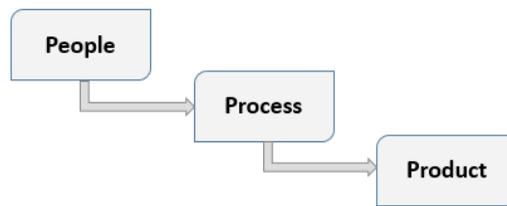


FIGURE 4. DevOps stages.

together with the shared objective of increasing the value of the client. The most recent investigation by Gartner group, which included 367 leading IT organizations (113 of which were utilizing DevOps). This research by Gartner group likewise uncovered that the offer of procedure and IT issues is on a lower level than the general people issue. Along these lines, we can believe that having profoundly energetic individuals with great joint effort between teams is vital

1.2.2. Process

DevOps is about procedure in light of the fact that regardless of whether you have individuals who are greatly cooperating, you have a business procedure that squares development (for example, having long chain warning sheets before your kin can accomplish something or limiting individuals to getting things done with a particular goal in mind). The way toward planning, building, and testing, programming ought to be top notch to every individual teammate to make each teammate mindful of all pieces of the advancement procedure. The execution of a DevOps procedure into an organization is a diligent work, as it totally changes the organization's structure all in all. This is a piece of a greater picture of DevOps: empowering the productive stream of individuals cooperating and not having forms act as a burden, yet having procedures and practices that assistance empower an incentive to convey to your clients.

1.2.3. Products

DevOps is not any tool or software product. One cannot purchase DevOps, as DevOps is not a product, device, procedure, organization, or individual; it is a system and methodology utilized particularly by IT experts. Be that as it may, there is product, tools, and software service that truly helps empower distinctive DevOps rehearses that groups can use to make things simpler. From the exceptionally high level, these tools are Microsoft Azure, which offers a variety of items, product and software services, for example, Microsoft Azure Stack and Microsoft Azure. Other than Microsoft Azure, there are additionally different products identified with DevOps practices, for example, Visual Studio Team Services (VSTS) and Team Foundation Server (TFS).

1.2.4. Agile to DevOps to Continuous Delivery

Several IT organizations have success stories in implementing agile methodologies to deliver the software applications faster. Agile methodologies working effectively in the

development organization. Groups, at that point groups of groups, have streamlined procedures, improved criticism circles, and driven on a lot faster pace of development into IT departments, which have affected the whole organization. To expand on this achievement, DevOps and continuous delivery (CD) has moved to help development improvement with IT operations. (Mostly through the presentation of automation) to help and develop agility, responsiveness, and quicker time to showcase all through the product delivery lifecycle [5].

The motivation behind this section is to present the idea of DevOps just as its appropriation, execution and implementation, benefits and challenges in software programming concentrated organizations dependent on existing writing. The studies about the DevOps pipeline techniques of Cloud native of DevOps were distributed in parallel or in the wake of distributing the findings of the proposition, and accordingly, they are viewed as related work [6].

1.2.5. DevOps Continuous Integration/Continuous Deployment

DevOps, development and operations introduce the organizational structure, practices, and culture expected to empower fast spry development and scalability, reliability operations. DevOps is collaborative practices, culture, and automation that lines up the development and operations team. They have a solitary mentality on improving client experiences, reacting quicker to business needs, and assuring that development is offset with security and operational needs. The organizations have to trust in combining of development and operational people duties so one DevOps group perform the both duties. In that manner, you simply have one group who assumes the liability of software development, software deployment on different environments and running the software in production environments [7]. Figure 5 shows continuous integration and continuous deployment process on Application Environments

Continuous integration (CI) and continuous delivery (CD) have a lot of working rules that empower product development teams to push code changes all the more every now and again and dependably. The specialized objective of CI is to set up a reliable and automated approach to manufacture, bundle, and test applications. With consistency in the combine procedure set up, teams are bound to submit code changes all the more habitually, which prompts better cooperation and programming quality of software.

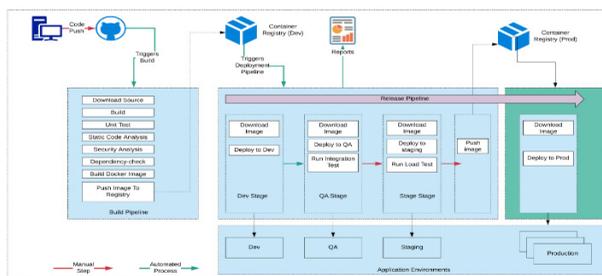


FIGURE 5. CI and CD process.

In DevOps, Continuous delivery catches where continuous integration closes. Continuous delivery automates the application delivery chose as environments. It catches the build worked by CI. The build deploys into different and multiples environments like Dev, QA, Performance, Staging runs different tests like reconciliation tests, execution tests and so forth lastly deploys into production. Normally Continuous delivery has some few steps to manual in the pipeline. The continuous deployment is automated pipeline which completely automates the entire deployment process from code check in to deployment production.

2. Objective of Study

The study on the DevOps pipeline techniques implementation helps to design the structures and strategies for successful fast deployment of the software on multiple environments. This structure has also to continuous delivery of the software to client. The study also covers the issues and infrastructure challenges during the implementation on cloud. To provide the best possible solutions for these issues and infrastructure challenges.

The result and finding of the study provide comprehensive knowledge and information of DevOps pipeline on a cloud to the rest of the organization and help to understand the project requirement to achieve the goals accurately and efficiently.

The systems have implemented of Code Review System. In [8], Figure 6 shows the DevOps CI and CD pipeline.

- The DevOps Automate Build on Cloud.
- The DevOps Automate Testing on Cloud.
- The DevOps Automate Deployment on Cloud.
- The DevOps Automate Monitoring on Cloud.
- The DevOps Automate Issue Tracking.
- The DevOps Automate Feedbacks.

DevOps pipeline goal should be achieved by implementing and configuring the DevOps continuous integration pipeline and continuous deployment/delivery on cloud. The post-delivery, a procedure for Continuous Monitoring is configuring up.

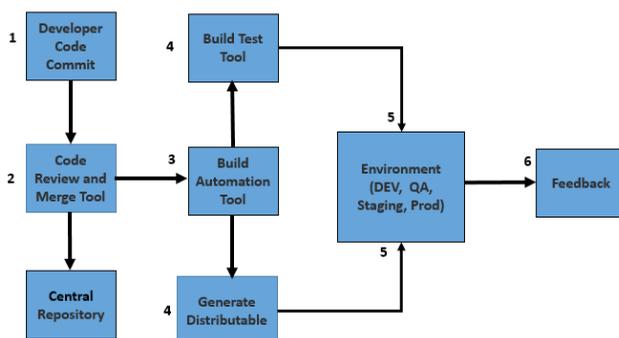


FIGURE 6. CI and CD pipeline.

- Implementation and Configure up CI and CD pipeline:
- Lot of code push (many commits), every developer has push code on many braches.
- Once the code have commit a build automatically triggered.
- Automate tests cases run, in production clone environment the automated test run.
- Software build deploy fast.
- Everyone has feedbacks (tester, developer, admin and etc.)
- Deploy latest build on different environments.
- Build should be deploying on different environments.
- The process of Continuous deployment should be dependable and secure.
- A single click build should be deploying.

3. Conceptual Framework

3.1. Statement of the Problem

We need to understand that, once we start implementing the DevOps, challenges are go to their. Each organization has different environment, procedures and each organization is go to have different challenges implementing DevOps within the organization.

This is very important that, what are the challenges which organization is facing, and how they try to solve it. What is the best practice to they can embed in the organization. So they can bypass these challenges and start successfully implements DevOps within the organization.

Few of the challenges that normal organization face.

3.1.1. Cultural Challenges

Each organization has a different way of functioning. Each organization has different departments and different processes, they follow and streamlining all these organizations and all these teams together in one process and best practice which come big challenge and we look it to how we trying to solve this particular problem. Roles and Responsibility – A developer just right a code, and says that this is not my job to deploy the code on production. Application security issues – Everybody is scare, so DevOps we are talking about increasing the speed of deployment if we are a go to deploy things in a fast way security and compliance will raise all bad flax and all defected areas. We can take care that we are deploying the code and security defined by the organization. Right Skills Set – The People don't have right skills which are needed to implement. Tools Issues – The People do not have skills of tools picking to implement DevOps process and pipeline. Business Impact – The code is deploy on production, it is not deployed fully code. Legacy knowledge of DevOps Pipeline on cloud – The people do not have knowledge that how can implement DevOps pipeline on cloud. Automated testing Issues – The tester don't know how can write automate test script and test the process based on automation.

3.1.2. Infrastructure Challenges

Manual and Repetitive – In manual base, there are multiple server, multiple instance, and the business never can grow. Change not Tracked – How we do track the changes, we need

to understand what change of the last version. In manual way it is very difficult to track the changes. Configuration values not externalized – we need the things which we have configured the things in a centralized way. Infrastructure is not tested – Infrastructure is a key for the security compliance and even the health of product which we are trying to push to the customers. Not easily accessible for developer, the developer does not look at what the operation team is doing, or does not have the production access. Difficult to automate, current organization does not do automation. That's a big challenge.

4. Review of Related Works

In [9] the case study of a Dutch IT organization, who uses Agile methodology, Agile team is engaged in requirement analysis and requirement gathering. DevOps is enhancement of the IT service of an organization by making improvement in the performance of the organizations. DevOps focuses on the scope of project and fast delivery of software releases and deployment. In this literature, the agile methodology uses Scrum. The project implements into Scrum and the Scrum can define the weekly sprints. The problem area of the case study is DevOps implementation practice. They have described that how DevOps implementation are helping the organization for IT activities.

In [10] a research by Martin Nordsletten, before moving towards the DevOps continuous integration pipeline, first check the IT operation how is it work. Now the continuous integration is support for the continuous delivery of the product. This implementation is helping automated deploying and improving testing pipeline. The continuous integration pipeline support and help the multiple versions of code and build. Continuous integration pipeline maintained the versions of every release. The goal of the organization is to deliver its product quicker to the customer and as well as in a satisfied manner. The DevOps pipeline is very helpful for an organization to continuously delivery.

The DevOps and implementation in a software development organization to deploy the short release cycle of software. The software release has short time to deploy the software. The adoption of the DevOps has affected all the IT operations and activities of an organization during the implementation of DevOps process it has facing many challenges on cloud. The purpose of DevOps to automated software release deployment techniques and focusing on continuous delivery of the software release and any changes that came in software the DevOps can automate management of operational infrastructure changes. The Development team and operation team are working together on IT operations.

In Ref. [11], the study shows to introduce agile and the SDLC techniques. It increases the quality of software and quality of software delivery. In this literature review, they have described the experience of DevOps implementation in the organization. That was an interview-based study and six or more organizations involving, most of the organizations are working on DevOps and to observe that the feedback of organization is positive about their experiences and expertise.

In Ref. [12], the DevOps is an organization culture and it is new technology for software delivery. They have adopted DevOps for improvement of the software delivery cycle and

also attempts to solve many problems and challenges in adoption. The purpose of DevOps research is working together development and operation team on agility. How it will work in the organization, which tools to use for implementation of DevOps and how it will tested the code and different types of testing as an international level.

In [13], this literature review is related with DevOps project management, the research methodology on the agile. DevOps methodology involvement in project management of software development and its related implementation. They have experience of agile methodology by developing a project. They have a team with worked on the project implement and define its relevant sprints and backlog. The project management creates the planning, execution, performance monitoring the project with DevOps (Agile) in the project management field.

In Ref. [14], the organization on daily basis operations performs in different software environments, operations perform to meet the new change request and security criteria. The system builds have changed the requirements, they used agile and DevOps to faster in development and deployment the software. This literature review has changed the management and changing the digital environment. The change has an effect on the working environment. The organization has support to employees to be prepared for it. The objective of this literature review, the past and current state of development and benefits of DevOps.

They [15] have worked on case studies, how can shorten time to deliver the new software features and reduce error, bugs and deployment issues, they have also worked on the security issues of the DevOps practices, they have introduced DevOps automation pipeline using different deployment tools and code infrastructure deployed in the specify environment. They have recognized the software change of an organization and moves from manual deployment to automated deployment with DevOps processes.

In [16] this literature view related to DevOps grow in the organization. How to improve the software delivery and how to implement and adopt DevOps in the organization? This study based on interview and many companies has adopted the DevOps based on interview.

In [17] this study based on faster delivery of the product, define infrastructure, new approach automation apply. They can define the automated pipeline and monitor the process required by the Sever less approach case project for testing, deployment, and monitoring the application.

In [18–20] today's world of computing the organizations frequently facing the changes in the requirements to run their business operation and procedures. To meet this situation and make quick delivery of the software solutions, the organizations are moving towards a third generation Software Development approach which known in the IT markets as DevOps. The DevOps approach for the development of different software applications for the organizations break down the barriers, restrictions and walls between the different teams so the development and delivery of the software is possible in faster and efficient manner.

Now [21] a day's, DevOps use for faster release of the software application, enhancement in the communication and integration between the teams of developers and operation. The main purpose to adopt the DevOps in an organization is to get the most out of the

return of investment and enhance the satisfaction of all the stakeholder of the organization through continuously giving them the features and as well as improved the service quality of the organization.

In [22] a case study, DevOps is an approach where the traditional software development procedures and roles are become together. The communication between the development and operation team and as well as between the individuals is also become more efficient which improve the production release frequency and maintain software quality and its features.

The [23] DevOps software development approach has become a significant part of the culture of several different organizations. "Large influence on DevOps was done by wide adoption of micro services, containers and cloud computing". On the future development of cloud based and micro services architecture is performed on server less framework of the computing in which the cloud service provider takes the complete responsibilities of operating system and other hardware infrastructure. The server less and cloud-based computing will make simpler the DevOps operations and procedures. Similarly, Shaikh et al. [25] have enhanced the technology tool using software approaches. So student or anyone can easily access their desired data. Likewise, the author [26] used the software approach to enhance the Web Application of WhatsApp where anyone can delete their MSG with the passage of time. On the other hand, the author [27] using software approach to implement the tool inside the Microsoft office where people can easily send the image to mobile using Bluetooth without any internet.

5. Methodology

The purpose for research of DevOps pipeline cloud techniques is to find out the cultural challenges and infrastructure challenges of the process for fast delivery of the software. In this research, the method is using the qualitative research approach. The research approach is to find out the cultural challenges and infrastructure challenges about the implementation of DevOps pipeline on a cloud in an organization.

The research is conducted to find out a new approach which deals with software development and fast delivery in the field of Information Technology. The qualitative research is an investigation approach which is performed with the assistance of printed or spellbinding data to discover the ideas or solutions for the issues in regards to subject study. The procedure of statistical or numerical information collection not performed in subjective research. The research to discover the problems in cultural and infrastructure challenges, during implementation of DevOps does not take any primary data. The information examined and analyze for the research from the secondary data which is gather through the sources like research journals, books and online sources that have inquired about or have best works on with respect to the procedure of DevOps usage in organization.

Below is the model for qualitative research to discover the issues about cultural and infrastructure throughout the DevOps pipeline implementation process are appeared. Figure 7 shows the structure of qualitative research.

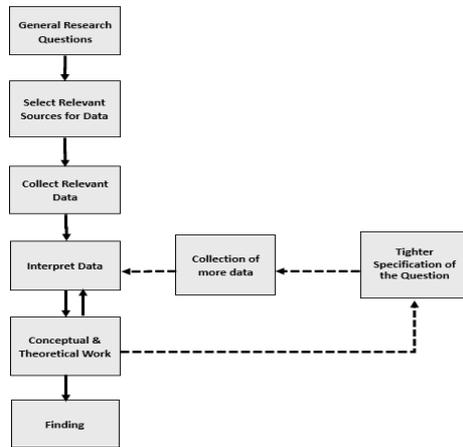


FIGURE 7. Qualitative research structure.

Figure 7 above is the process structure of qualitative research.

Follow the qualitative research for the implementation of DevOps pipeline and discover the issues about cultural and infrastructure throughout of the DevOps pipeline implementation process are appeared. Figure 8 shows the structure of qualitative research for DevOps pipeline plan.

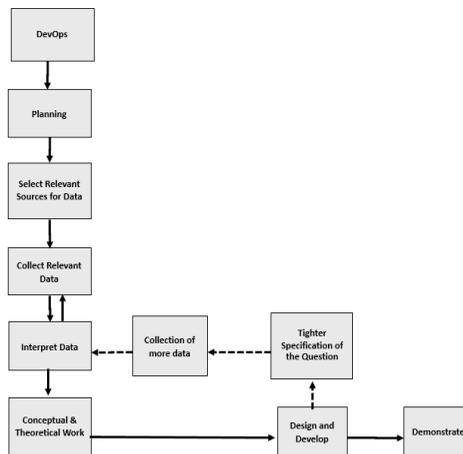


FIGURE 8. Qualitative research structure for DevOps pipeline plan.

6. Results and Discussion

The research emphasizes on the DevOps pipeline implementation on a cloud in the organization, the respondents ought to have information on DevOps, which makes their involvement with DevOps an imperative factor to be considered. The study is focused on the technical and functional issue during the implementation process of DevOps pipeline

on a cloud in an organization. The most important part which plays a major role in the successful implementation of DevOps process is Cultural and Infrastructure Challenges.

First, we have started the implementation of DevOps within the organization, what are we trying to do, it is very important to ask before you start the implementation process of DevOps within the organization.

DevOps, introducing new skills, new tools, and new process which is trying to automate everything through automation [28]. These are the changes with the organization. Big changes are to big challenges within the organization, change is not bad but it just needs to be well planned, how we are going to bring this change.

6.1. DevOps Cultural Transformation

For successful implementation of DevOps, we need DevOps cultural transformation changes and DevOps cultural organization changes. In DevOps, we are concentrating particular areas Cultural and the Infrastructure Transformation. Figure 9 shows the DevOps cultural transformation and cultural transformation helping in DevOps pipeline.

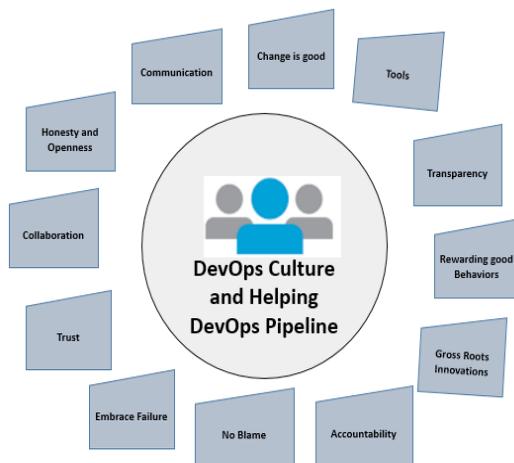


FIGURE 9. DevOps cultural transformation.

Now we start how we can plan and bring the DevOps Cultural Transformation. Bringing the transformation or change is needed change is good we can repeat that and we can embed that to our team, so people start the change, how we do make these changes we need to bring this change with in the work culture the part, organization the part and process the part so all these thing to be implemented we are trying to Transform which talking about in DevOps [29–30].

6.1.1. DevOps Cultural Change

It is important to understand that DevOps start with introducing changes in people culture which plays a vital role for successful implementation of DevOps. What is the feature to bring this DevOps Culture? We bring the concept of trust, we are seeing, trust the team

which can work you can better collaborate, better communicate, honest and how to communicate with the people and the same thing which we talk earlier, change is good. So other things there are lots of tools which have helped us in this particular implementation. There are cases of people do not have the skill set, we help them, train them and maybe there are tools help them its embedding part of easy way to implement [31–32]. We have transformed the business goals, challenges, service level agreement (SLA) everything can transform and share their work across their team and everybody works the business goals. DevOps talk about how you convert your idea into your product or a software services in a best possible way or a fastest way which you can do.

Let's talk about one expect, the culture which is normally missing in most of the organization, rewarding the good behavior inserting devising the people so it is the major object which is currently missing in most of the organization. Several people feel that they are not motivated, they are not the recognition the kind of work, they are trying to bring the change but it is not recognized that is something which we need to concentrate so we trying to DevOps culture within the organization.

6.1.2. Roles and Responsibility

Lot of freedom of developer: Developer is anybody who is working on a business goal, it is very imperative that we add the accountability to that particular person, so each person is accountable for their role and responsibilities which have assigned to them, for example, the developer developing the features, is accountable for that particular feature to be hosted in the production. He may also support on the production once the feature is live, that is very important with the flexibility and lot of transparency, lot of empowerment.

6.1.3. Process Changes

What kind of process change we get it. Agile is the backbone of DevOps implementation. Agile is the internal part how we go to start bringing the idea of agility, so it is very important that we actually understand all the ceremony of the agile of scrum forces and we followed it regency. People concept has been same that we are following hybrid scrum. We have no idea what it means. We have one well define process and we need to stick to it. We understand each project have different requirements in the organizational way for it. But it is very important that we understand that why this particular process have been done? What is the advantage we get from it then make customization? Figure 10 shows the DevOps process Development (process changes)

We can differentially understand small customization needs to be done because every organization works in a different way and they have different challenges, but we need to follow all the ceremonies and the right ways so once we have IT agility is very imperative than we need to bring the continuous release process with Automation.

6.1.4. Continuous Incremental Delivery

Continuous incremental delivery is a procedure by which highlights deployed features into different environment, “released incrementally on production or immediately to

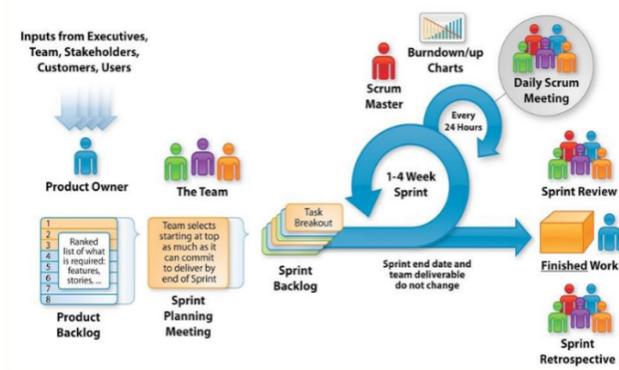


FIGURE 10. DevOps process development [24].

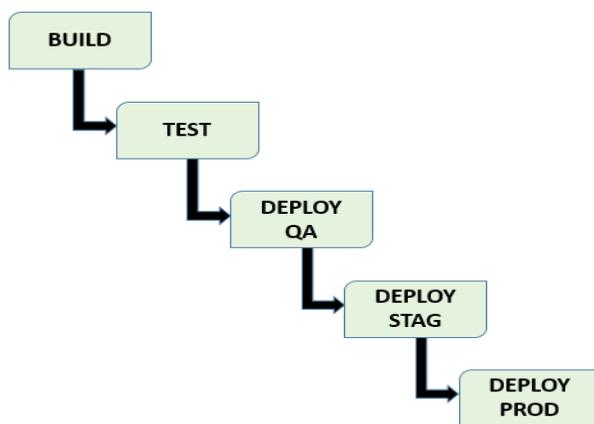


FIGURE 11. Continuous incremental delivery.

customer based on market demand”. Figure 11 shows continuous incremental delivery process

The agile team supports an incremental delivery technique and strategy. In an Agile setting, this implies each progressive version of the product is usable, and every builds past rendition by including clients obvious usefulness.

6.1.5. Continuous Release Process with Automation

So what we do is, we are talking about how we need to bringing continuous integration, continuous deployment into the whole process. We have the source code once its check-in, we have a quality to done it, we have an integration test to done it, then we have the option of promoting various autonomous like a different organization follow the different promotion models to move the QA, Staging, some quality of the user acceptance phase and then have a deployment life cycle defines where they can have the deployment done successfully on the target. Figure 12 shows DevOps Release Process Automation.

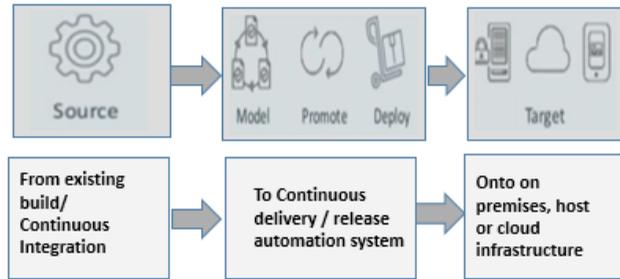


FIGURE 12. DevOps release process automation.

When the target is changing, you need to signal the application which is running on the server from the cloud. There is different deployment strategy which you can look at base on the different targets to the business needs to the particular processes.

6.1.6. Continuous Testing – Automation

In DevOps, testing play most significant role among all these things so we need to bring continuous testing with the process and talk about testing service. It is very important. We started three major parts of testing, first is unit testing, and then we look at test development driven testing and behavior driven testing aspect from it. These are the most significant testing and most of the organizations are following these testing service processes. The test development testing is embedded in the team which becomes the culture and many people face the challenges. Developer says that he had finished the code by the end of tomorrow he does not have time to do it. It is very important that people also understand that it is not integrated with the process. Just need the current build. It is important that we are not a short sided. Figure 13 shows testing automation strategy.

We start looking into the bigger advantages of the business goals which you are trying to get through the team. Other things are that you can start your regression testing and also start emphasize on the user acceptance testing. Make necessary arrangements to perform the performance and load testing when and where it needed. Researchers disagree with



FIGURE 13. Testing – automation.

that performance testing and load testing is needed to be bring the regular deployment pipeline. Where in actually do the testing and identify the issues before it actually happens not after it occurred and start fixing the issue where it happened, why it has happened. Performance and load testing is very important into the continuous deployment life cycle it is followed as regress which you release have deployed.

6.2. Changed IT Infrastructure Landscape

There is new technology to change the IT infrastructure in the organization. This is to summarize what are the areas which the infrastructure landscape is evolving and who are the leader for that. Differentially from the cloud, platform point of view AWS, AZURE, and Google cloud are superior to changing the way of delivery of products. From the process point of view, DevOps is going everywhere, everything, its bringing concept of continuous integration, continuous delivery. Figure 14 shows IT infrastructure tools.



FIGURE 14. Changed IT Infrastructure.

Even the product base company is totally changing the strategy and how they contain wise product and scale is to the business needs to it that the kind of IT infrastructure landscape changes the infrastructure looking like that.

6.3. Infrastructure as Code

The transformation is a giant part of Infrastructure as Code, so what is the Infrastructure as Code? We are trying to create a Reusable, Maintainable, Extensible and Testable Infrastructure. What kind of advantages it has? We are getting that, so we are getting the continuous integration and delivery process. It is just not software it is the delivery of Infrastructure for continuously development. Figure 15 shows Infrastructure as Code.

Now develop and modularize the Building Blocks of Infrastructure, quality is getting embedded into the infrastructure directly in the sense when we are developing the codes we are developing the checks for the particular implementation.

Version Control Changes, it's really helps in tracking the changes, tracking the users were making changes and its helps in issue and compliance. We have a Share Module across teams is the concept of reusable components. That is a great objective in DevOps is to reduce the time of delivery for the market therefore, the infrastructure plays vital role

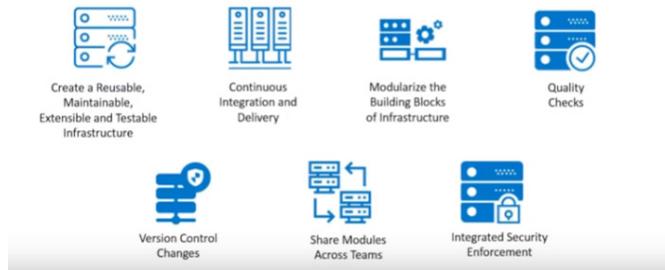


FIGURE 15. Infrastructure as code.

in the completion of the task in time. The precise key feature is security. It is integrated directly to the infrastructure.

6.4. DevOps Continuous integration, Continuous Testing, and Continuous Deployment Tools

Several IT organizations develop the enterprise application and establish the DevOps Process. By utilizing right heap of tools and technologies. Figure 16 shows the integration, Testing and Continuous Deployment Tools.

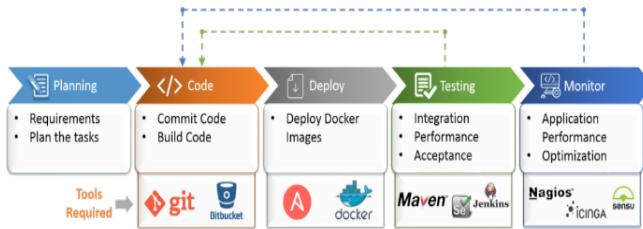


FIGURE 16. Continuous integration, testing, and deployment tools.

6.5. Start DevOps Pipeline Using Microsoft Azure Cloud

Start CI and CD implementation of DevOps using Microsoft Azure Cloud techniques. Below is the implementation process flow for fast delivery, Continuous Build, Testing and Deployment pipeline on Microsoft Azure Cloud. Figure 17 shows DevOps Pipeline-Microsoft Azure Cloud.

Microsoft Azure DevOps Portal gives Repos to source code control. DevOps Pipelines for CI or CD, Artifacts to have construct antiquities, and Boards for designer joint effort and coordination. Azure App Service gives the support to deployment the “application swapping to/from production” [33–34]. Utilized together, they give a viable way to deal with taking off continuous updates with no downtime of application.

Beginning at the lower left, Azure Boards gives “backlogs”, tracking the work item, “Kanban boards”, and help the other tools to development teams organize their work. This outcome in code refreshes that are “pushed to Azure Repos giving source code control”.

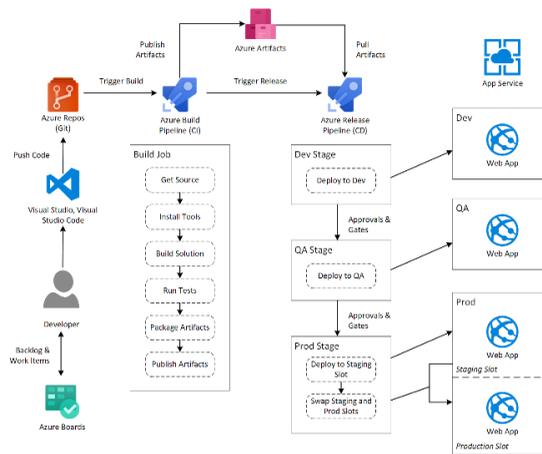


FIGURE 17. DevOps pipeline-Microsoft Azure cloud.

“After getting a ‘git push’, Azure Repos fires a trigger to dispatch a Build Pipeline. The Build pipeline incorporates different tasks and job that clone the repos, tools install, “build the solution” and afterward bundle and distribute ancient rarities to Azure Artifacts. Upon finish, the Build Pipeline triggers the software release pipeline [35].

While the Build Pipeline is an application building responsible and distributing artifacts. A responsible Release pipeline required for deploying the application artifacts for the different environments, e.g. development, QA, and production environments. The Build Pipeline normally gives Continuous Integration (CI) though the Release Pipeline gives Continuous Delivery (CD). Together, they empower CI/CD pipelines [36].

The Release Pipeline can be sorted out into stages which, albeit executed successively, act freely of one another. In this situation, the Dev deploys the application to a Dev domain. This condition is normally facilitated in a non- production “Subscription and may share an App Service Plan with other non-production situations”, for example, QA.

Stage between; use the approvals and gates in pipeline to control when the following stage is executed. This enables your team to perform testing and approval in each phase before moving onto the next.

The stage of Prod deploys the application to a “staging slot in Azure App Service” [37]. The case of Blue-Green Deployment, the staging is representing the “green” deployment. The production represents “blue” deployment. When you approve that everything has been effectively “Deployed to the staging” (for example, green), the Prod organize plays out a swap of green and blue.

The green deployment live make for the end user and blue deployment move to the staging where it stays until you remove it. On the off chance that issues emerge with the new green deployment, at that point you can swap again to move blue back to production.”

Below is the Microsoft DevOps Azure Portal Dashboard Screen. We have acquired the Microsoft Azure Cloud for implementation of DevOps Pipeline. In DevOps Azure portal, we have to implement the Software fast delivery pipeline, Testing pipeline, CI and CD pipeline. And also track the number of release version and monitors the logs and issues on multiple environments. Figure 18 shows DevOps Microsoft Azure Cloud.

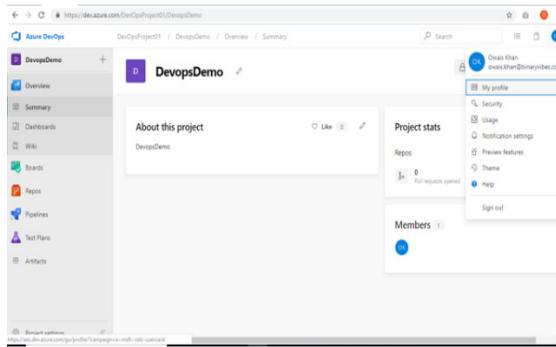


FIGURE 18. DevOps Microsoft Azure cloud.

In below Screenshot the pipeline slots define, there are multiple environments to deploy the release on Dev, QA and Prod through by Approvals (Figure 19).

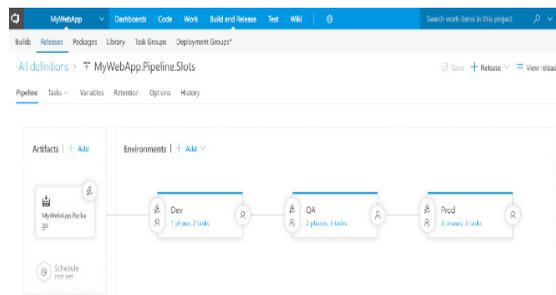


FIGURE 19. DevOps multiples env. on Microsoft Azure cloud.

6.6. DevOps is an Enterprise Success Differentiator

Why are people getting the DevOps, so what the differences are? How the DevOps really help the enterprise once they started implementation of DevOps in the organization.

- Agility: More frequent deployment with the (Short lead time).
- Efficiency: Less time on unplanned work and rework.
- Customer satisfaction: Employees more likely to recommend their organization as a great place to work.
- Stability: Faster recovery time for failure, option of roll back.
- Security: It is coming into the implementation and deployment of the product. We are seeing 50% less time is taken to remediation the security issues which are being raised.
- Quality: We are seeing 3 times lesser changes fail rate, which are seen in the organization.

6.7. Technical Benefits of DevOps

- Continuously faster delivery of software.
- Rapidly deliver the software releases.
- Fastest of problems resolution.

6.8. Cultural Benefits of DevOps

- Follow the software delivery standard.
- Management levels people engagement.
- Productive teams work with CI and CD

6.9. Business Benefits

- Faster delivery of new features.
- Operating environments is stable Dev, QA, Staging and Production.
- Better collaboration and communication.

6.10. Survey Findings

During the research, a survey was conducted to find out the issues and challenges for the implementation of DevOps process. Results mentioned in Table 1 are prepared from the answers for the questionnaire which was given to the respondent during the survey.

For the survey regarding the issues and challenges during the process of Implementation of the DevOps pipeline on cloud, we have visited the live environment and found the following results.

During the survey majority of the respondent recognize (100%) that DevOps culture is most important for an organization to deliver the fastest and high quality of the product. In response for the question regarding team selection for DevOps CI and CD implementation, it is found that (85%) members agreed and recognize the team selection as a significant factor. Majority of the respondent of the survey (93%) recognize that automated testing is better than manual testing.

7. Conclusion and Recommendation

Study for the DevOps implementation is focused to find out the culture and infrastructure issues during implementation of DevOps pipeline on cloud. The study is also conducted to

TABLE 1. Illustrate survey findings

Survey findings			
Description	Agreed	Not agreed	Neutral
DevOps culture selection	100%		
Selection of the team	85%	3%	12%
Finding the expert consultants	85%	2%	13%
Creation of a thumb rule	87%	3%	10%
Version controlling	88%	0%	12%
Infrastructure is a key for the security compliance	88%	0%	12%
Organization has management consent and clear strategy in place to implement DevOps	73%	7%	20%
DevOps is responsible for deployment of application	71%	18%	11%
Does organization have research based decision for strategic choice of tools for implementing CI/CD pipelines	74%	13%	13%
Automated testing better than manual testing?	93%	2%	5%

discuss the strategies, structural changes, cultural transformation changes, infrastructure changes, procedures, and role of the different teams of experts in the successful completion of a DevOps implementation project in an organization. During the study for the implementing of DevOps, the researcher has studied best practices available and has discussed different important strategies which are necessary for the implementation process. For example, DevOps culture selection, selection of the team, finding the expert consultants, budget control, change in the strategies, cultural aspects, trainings and guidelines for the staff, etc.

It is found that the planning phase plays a vital role in the DevOps deployment for an organization. It is the earliest phase of a project when an organization is seeking to adopt DevOps. Soon after the planning phase it is necessary to make changes in the management which is essential for the successful completion of the project. Another major factor is selection of the right DevOps culture which plays major role for the success of the implementation plan. It also has a great impact on other phases of the project. In the modern computing and business world the DevOps available for the organizations are improving the software faster delivery in an automated way. The implementation of the DevOps is time consuming process and requires extraordinary efforts, multiple teams of experts and consultant. To achieve success for deployment of DevOps in any organization, the top management has to recognize DevOps culture and execute best practices during the DevOps implementation process.

8. Recommendation

The DevOps' best practices are to change the culture of the organization and also bring a change in the infrastructure of the organization. To improve the software delivery process, it is very important to change the culture and work in a quicker way, use new technology, techniques and tools for delivery of the product.

The most important part of this study is planning. Everything depends on planning; before implementation, the DevOps Pipeline should have well planned as per requirement of the project. Security is the main part of DevOps, security base on infrastructure or a build process this platform has used for deploying the software release. Change is good in the organization but before bringing change in the organization management should acquire sound knowledge and information regarding the change which they want to implement in the organization.

In IT Organization, Successful story and successful implementation should be based on research. It is also necessary that top management of the organization have to gather the experience resources, provide trainings to the workforce and work as a one team in a collaboration and communication for the success of the implementation process of DevOps in an organization.

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