**Challenges and limitations in organizations adopting DevOps**

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**Final Project**

Submitted to

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# Abstract

The ability of the DevOps software development process to increase an organization's agility and speed is causing it to gain favor. Utilizing DevOps methodologies does provide A few obstacles though. Businesses frequently run across resistance to change, a lack of skilled staff, cultural issues, and a dearth of automated solutions when attempting to implement DevOps. To overcome these challenges, businesses must create a well-organized strategy and plan for implementing DevOps, engage in staff training and development, promote a culture of experimentation and cooperation, and leverage automation tools to speed up procedures. By efficiently utilizing DevOps methodologies, businesses can boost the effectiveness and rapidity of their software development, giving them a competitive advantage in the markets in which they compete.

# Introduction

Software project development projects now support higher consistency and better teamwork thanks to a shift in the methodology utilized in the field. While presenting considerable obstacles, the introduction of new digital technologies opens new economic opportunities. Developers can deliver functional hardware and software to clients as quickly as feasible thanks to DevOps and software deployment. DevOps is responsible for ensuring that the product is delivered on schedule and with better quality. A collection of cultural norms and practices aimed at integrating the software sector is referred to as "DevOps" in this context [1]. It also makes it easier to remove the development and operational teams, removing obstacles and fostering greater interaction and cooperation. A mix of paradigms provided by DevOps improves the company's engagement with its IT staff.

2.1 Definition of Dev Ops

Software development (Dev) and IT operations (Ops) teams collaborate throughout the software development lifecycle thanks to a set of principles called DevOps [2]. DevOps aims to improve software delivery quality, speed, and efficiency by promoting collaboration, communication, and automation between development and operations teams. By dismantling conventional silos, this strategy hopes to enable continuous delivery, continuous integration, and continuous monitoring—all of which will eventually result in software releases that are quicker and more dependable.

2.2 Importance of DevOps in Modern Organizations

DevOps is critical to today's businesses because it facilitates communication between the development and operations teams, accelerates the supply of software, enhances quality through continuous testing and feedback, and enables automated deployment for practical use. Through the alignment of development objectives with business goals for sustained performance, this integrated approach promotes adaptability, innovation, and consistent product releases.

## 2.3 Research question

The research questions include

* What challenges do companies face when striving to implement continuous production and continuous deployment within the framework of DevOps?
* How can businesses effectively surmount the hindrances associated with integrating DevOps into a rapid methodology?

# Literature review

"DevOps, a collaborative approach integrating operations and software development, fosters close teamwork between these two domains. It aims to enable swift software feature releases and effective post-release user education. DevOps, as According to the study conducted by Lwakatare and colleagues in 2019, DevOps is a mindset that fosters collaborative efforts across different functions within IT operations and software development [3], promoting their expansion and enhancement. It extends the principles of the agile software development methodology, emphasizing continuous integration, development, and software delivery. Automation is a pivotal component of DevOps, essential for reducing product release delays. Furthermore, DevOps fosters enhanced communication and collaboration, ensuring the rapid and uninterrupted delivery of software solutions. This approach leads to frequent updates and heightened reliability, ultimately resulting in quicker time to market and improved product development, aligning with the advantages of continuous delivery, as suggested by (Ebert, Gorka Gallardo, and Josune Hernantes in 2016.”) [4] Furthermore, it leads to heightened efficiency and productivity, along with improved product quality and reliability, resulting in heightened client satisfaction. Before the advent of DevOps, employees within a company used to work in silos, creating an environment that caused delays in the delivery process due to extended integration times resulting from a lack of shared infrastructure for program development. DevOps also ensures seamless integration across all stages of product development and promotes a unified team approach throughout the entire cycle (Gokarna & Singh, 2021)[5]. It encourages software organizations to deliver more features and continually enhance their products based on feedback within shorter time frames, emphasizing the need to integrate teams and tools across various software development levels.

3.1 Evolution and History of DevOps

A combination of the words "development" and "operations," "DevOps" stands for a collaborative and cultural approach to IT operations and software development [6]. To improve communication, cooperation, and efficiency across the software development lifecycle, it arose as a reaction to the conventionally divided organizational structure between the development and operations teams.

The Agile methodology and the demand for more rapid and dependable software delivery drove the development of DevOps in the early 2000s. As companies looked to solve issues including frequent software releases, scalable infrastructure, and the need for continuous integration and delivery (CI/CD), the adoption of DevOps principles accelerated. The release of "The Phoenix Project" in 2013[7], which popularized DevOps principles, and the rise of numerous tools and frameworks facilitating automation, monitoring, and collaboration are significant turning points in the history of DevOps. The goals of DevOps are to decrease time to market, improve software quality, and shorten development cycles through the use of automation, continuous testing, and continuous deployment.

3.2 Major DevOps Challenges

There are challenges involved in implementing the day box throughout the firm. Among these include encouraging collaboration across various functional boundaries and aligning the organization's priorities with its goals. Another challenge is the evolution of the infrastructure paradigm, which has been in use for more than 10 years. The business must be aware of any potential challenges and know how to address them before implementing the plan (Azad & Hyrynsalami, 2022)[8]. A lack of team communication and a preference for progress over risk may be to blame for the problems. Additionally, it has to do with the team members' knowledge levels and their contempt for developmental disparities. Additional challenges include the production and testing environments, poorly specified functional and technical requirements, and more. Along with the integration of tools, it also must deal with the issues that people have with thinking in silos. There are additional problems that are related to the difficulties with remote project execution and feature release. Knowledge barriers and accountability for distribution issues are also shared using DevOps.

The devices that cause problems are also given far too much attention. DevOps employs a variety of tools to promote better pipeline creation during the process of developing software. Ghantous and Gill (2017)[9] assert that the integration of the tool is what makes it possible for the issues to be differentiated and integrated following the times. The tool integration is highly difficult and difficult to maintain a deadline. It has to do with the technological decision to add quality assurance and a flexible management system to its product. The tools are also associated with the automation of managing a warehouse to write a script and perfect the operation. Along with virtual computers, Nigeria's location in Africa, continuous integration and operation tools, automated testing, and continuous development are all covered by the tools. Using a variety of technologies, such as those used for continuous integration and testing like Jenkins and Code ship, Bit buts, and GitHub, among others, can make it challenging to manage a large amount of work and complete it on schedule (Pingrong, Xiaoguang, & Junqin, 2021)[11]. To guarantee a better grasp of the problems, whole separate tool collections, & the use of metrics that give obstacles, this toolset comes into contact with the tools used in the manufacturing of the problems by Dev and Ops.

3.2 Migrating the DevOps integration challenges.

In order to tackle these issues, companies have to start a gradual transition towards DevOps, ensuring alignment among key stakeholders concerning their goals and objectives. It's imperative to allocate the necessary resources, including personnel and technology, to facilitate this transformation. Furthermore, organizations can benefit from the guidance and assistance of a DevOps consultant during this migration. Before embracing DevOps, thorough assessments of their existing technological infrastructure and internal landscape are vital. They should also scrutinize the cost-effectiveness of DevOps implementation. A clear understanding of the current organizational practices, processes, and tools in use is essential. Additionally, organizations should carefully deliberate their motivations and objectives for embracing DevOps before proceeding with the transition.

To optimize organizational operations, it is imperative to wholeheartedly embrace the DevOps operational model. This entails fostering efficiency through collaborative, cross-functional partnerships and seamlessly integrating the complete DevOps lifecycle, from developers to operations. This integration must also encompass considerations for governance and a strong grasp of fundamental concepts. Additionally, team members need to undergo basic security training, and developers should be strongly encouraged to swiftly adopt automated code checks and testing procedures, as emphasized by Battina in 2021. Furthermore, exploring the potential to incorporate infrastructure-related responsibilities into the development team's purview can be achieved by implementing automated infrastructure monitoring using appropriate tools.

# 4. Methodology

The research methodology adopted for this study is characterized by a thoughtful integration of both “qualitative and quantitative” data collection techniques. As highlighted by Hafsa (2019)[10], this strategic combination serves to harness the strengths of each method while offsetting their limitations. To capture qualitative insights, a survey strategy is employed, providing a nuanced understanding of the subject under investigation. Concurrently, quantitative data is garnered through the insightful lens of case studies. This dual approach proves particularly advantageous when delving into the real-time implementation of DevOps in organizational settings, allowing for a comprehensive examination. The use of case studies enhances the depth of exploration, enabling meaningful comparisons with the qualitative findings and contributing to a more robust analysis.

## 4.1Research Design

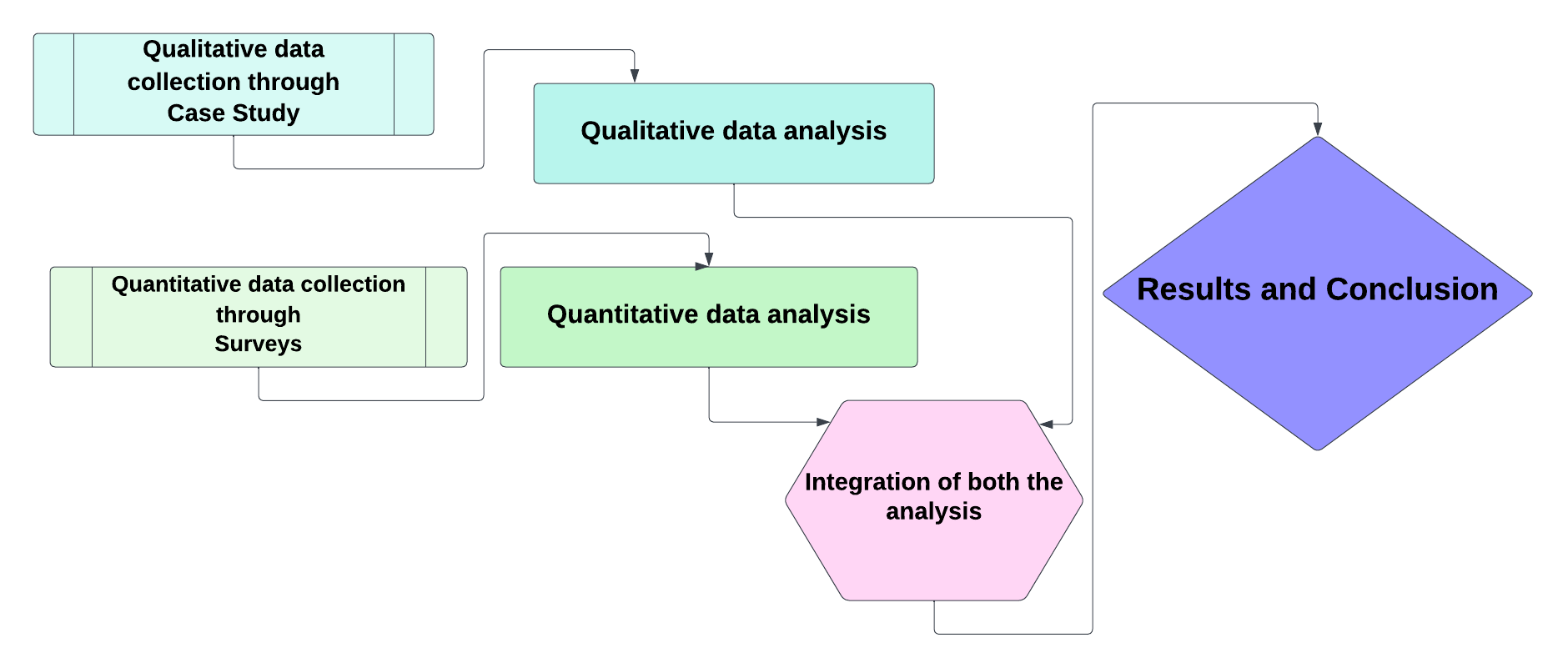


Fig 1

The Fig above clearly illustrates the steps that have been taken throughout the Procedure.

4.2 Research Procedure

4.2.1 Data Collection

Data acquisition employs both numerical and qualitative methodologies. The quantitative approach, in this case, utilized a survey to gather information. The questionnaire, strategically designed to address challenges and solutions in DevOps deployment, was administered online. This survey proved instrumental in comprehending strategies to overcome obstacles in the deployment of DevOps. To quantify the collected data, a set of closed-ended survey questions was employed. The data collection process adhered to a 5-scale Likert scale, providing a structured framework to assess and measure the gathered insights.

The Survey Link: <https://forms.office.com/r/PXZKUvbe34>

Case studies served as the means of gathering qualitative data. The two instances that were chosen. Within one of the scenario studies, a PSL company discusses its DevOps difficulties.

The case study, which can be seen at **https://acris.aalto.fi/ws/portalfiles/portal/35440471/SCI\_Lwakatare\_DevOps\_in\_practice\_INFSOF6157.pdf,** includes several examples of how DevOps is being used in the procedure within.

**Sampling and population size:**

It was strategically decided to use a convenience sampling technique for the survey, which involved selecting participants who were easily reachable. This approach was selected to maximize information-gathering efficiency because it was both highly efficient and cost-effective in terms of the amount of time needed to collect data. The research team sought to improve the overall feasibility and usefulness of the study by streamlining the survey process and explicitly selecting individuals who were more accessible. The size of the population that was around 45.

4.2.2 Data Evaluation

The application of statistical techniques was essential to the evaluation of the collected quantitative data. To further explore the subtleties of numerical data, customized graphs were carefully created for every inquiry. A thorough examination of the produced responses made it easier to synthesize these graphs and allowed for a more in-depth and perceptive examination of the quantitative dataset.

In the case study, the data analysis procedure went beyond simple numerical examination. It entailed a careful examination of the difficulties that DevOps and different businesses faced. This in-depth analysis sought to uncover the complex challenges present in these domains. Moreover, the examination expertly combined a range of options designed to deal with and settle the problems found. Essentially, the data analysis explored the qualitative aspects in addition to the quantitative ones, promoting a comprehensive comprehension of the issues and their solutions related to enterprise dynamics and DevOps.

4.2.3 Data Integration

The collective efforts culminated in a cooperative success as we were able to smoothly merge two sets of well-analyzed data. This seamless integration not only made for a deeper comprehension but also revealed the best practices that companies can adopt to successfully integrate DevOps into their daily operations. Through the collaborative integration of these datasets, we were able to extract important insights that may be used as a roadmap by enterprises looking to improve the efficiency of their software development initiatives. Along with streamlining the assimilation process, the integrated data gave businesses a nuanced perspective on best practices, enabling them to successfully navigate the complex DevOps implementation landscape.

5. Challenges in Adopting DevOps

5.1 Cultural Challenges

DevOps frequently faces cultural obstacles stemming from the requirement for a change in organizational culture and heightened teamwork. Outdated and silted organizational structures, together with opposition to change, might impede the smooth integration of development and operations teams. Established departmental and hierarchical conventions may not align with the key principles of DevOps, which emphasize transparency, continuous communication, and common ownership for the whole software delivery lifecycle. Building a foundation of trust, supporting cross-functional cooperation, and cultivating an attitude that prioritizes flexibility, innovation, and learning from mistakes above placing blame are all necessary to overcome cultural boundaries. The foundation of a successful DevOps environment is building a culture where people and teams are empowered to accept change and collaborate to achieve shared objectives.

5.2 Technical Challenges

DevOps has several benefits, such as accelerating software development and deployment processes, but it also has some technical drawbacks. Automating and smoothly integrating different tools and technologies throughout the whole development lifecycle is one of the main challenges. Because development and operations teams frequently utilize different tool sets and workflows, it becomes critical to resolve compatibility concerns and maintain consistent communication to foster efficient collaboration. Further complexity arises from managing infrastructure as code since it might be difficult to maintain version control and uniformity of configuration across many settings. Pipelines for continuous integration and delivery, or CI/CD, must be scalable, dependable, and adaptable enough to change course as project needs do. To do this, careful planning and execution are needed.

5.3 Process challenges

DevOps has many benefits, such as promoting cooperation and optimizing software development and delivery procedures. It does, however, also have certain inherent difficulties. One major obstacle is cultural resistance since companies frequently find it difficult to foster a common perspective of cooperation and communication across the formerly divided development and operations teams. Furthermore, choosing the right technologies and guaranteeing smooth compatibility present difficulties when implementing necessary automation tools to accomplish continuous integration and deployment. Another difficult task is setting up efficient continuous monitoring and feedback loops. This requires striking a careful balance between obtaining real-time insights and avoiding information overload. In summary, the continuous difficulty in maintaining security in the DevOps pipeline results from the possibility of vulnerabilities being introduced as a result of quick development cycles. Overcoming these challenges is crucial.

6. Limitations in adopting to DevOps

Although DevOps has a revolutionary effect on how development and operations teams collaborate, it nevertheless faces obstacles like organizational inertia, cultural opposition, and the complexity of legacy systems. Organizations frequently struggle with change resistance, which makes a culture transformation necessary to achieve seamless integration and continuous delivery. Furthermore, it might be logistically challenging to manage several toolchains and ensure compatibility across different contexts. DevOps installation has advantages, but to fully achieve its potential in speeding software development and delivery, careful navigation of these hurdles is required.

7. Results

The qualitative data represented here was created using the survey which was conducted on many participants.

Fig 2

The inquiry focuses on demographics to assess the research findings' feasibility. According to the statistics, 94% of individuals possess experience working for a software company, with only 6% lacking such background.

Fig 3

Examining the composition of the software development team reveals that a substantial 92% of individuals are actively engaged in employment within the software development industry.

Fig 4

The investigation is centered on evaluating how much DevOps emphasizes continuous development and software delivery. The results show a high degree of agreement, with 92% of respondents strongly agreeing or agreeing with the idea, and only 6% disagreeing. This suggests that the DevOps community as a whole recognizes and embraces the importance of software delivery and continuous development.

Fig 5

The survey, aimed at assessing the impact of DevOps on quality and feedback, reveals overwhelmingly positive sentiments among respondents. A striking 94% express agreement or strong agreement with the notion that the rise of DevOps ensures enhanced quality and prompt feedback. In contrast, only a mere 2% of participants indicated disagreement with the statement.

Fig 6

The inquiry aims to understand the difficulties associated with deployment, goal alignment, and prioritizing. The findings show that a significant 72% of people strongly agree or agree with the statement, while 20% of respondents disagree.

Fig 7

The assertion suggests a dependence on a diverse set of tools efficacy in fostering advancements throughout the pipeline. A significant majority, comprising 80% of respondents, express concurrence or strong agreement with this notion, underscoring the widespread acknowledgment of the instrumental role played by these tools in ensuring robust development. Conversely, a minority, constituting 16%, holds a differing perspective.

Fig 8

The survey findings reveal that DevOps plays a crucial role in providing guidance and support throughout the project migration process. A majority of respondents, comprising 58%, express strong agreement or agreement with this assertion, emphasizing the perceived value of DevOps in facilitating smooth transitions. However, it is notable that 38% strongly disagree or disagree with the statement, indicating a substantial portion of respondents may not perceive DevOps as significantly beneficial in the context of project migration.

Fig 9

Before embracing any technological changes, it is crucial for the company to thoroughly understand the question at hand and carefully consider the implications of the new technology. According to observations, a significant majority of respondents, comprising 84%, strongly agreed or agreed with the statement, indicating a high level of approval. In contrast, only a minority of 12% expressed disapproval. This suggests a prevailing positive sentiment among the respondents regarding the company's need to comprehend and incorporate technology into its operations.

Fig 10

Before implementing DevOps, the company must conduct a comprehensive evaluation of the associated costs and benefits. A substantial majority, comprising 76% of individuals, concurs with this notion, emphasizing the importance of a strategic assessment. In contrast, a smaller proportion, specifically 12%, holds a differing opinion on the matter. This underscores the significance of careful consideration of the implications and merits of adopting DevOps practices within the organizational context. To guarantee successful DevOps deployment, comprehension is required. Is that of the current work environment, the relevant procedures, methods, and instruments that are employed.

Fig 11

Understanding the current organizational landscape is crucial for ensuring a successful implementation date. Analysis of the survey results reveals that 28% of respondents agree with the given statement, while a significant 50% strongly agree. Additionally, 6% of participants remain neutral on the matter. These findings underscore the importance of comprehending the organization's current state to effectively plan and execute the proposed changes.

Case Study Analysis

This case study explores the difficulties of deploying DevOps in a worldwide geolocation company that provides location services with definitional maps in more than 50 countries (PSL, 2016) [11]. The customer had trouble encouraging creativity in their extensive location services and intricate data layers. After it was realized that improved teamwork and productivity at work were necessary, DevOps had to be used for data upgrades. Maximizing output, streamlining procedures, and guaranteeing quick project rollout were the objectives, with the end goal being to enhance staff competencies and knowledge of the complex terrain of location-based services.

This case study must highlight automation techniques and guarantee improved cooperation between the creation of software and its use. According to Lwakatare et al[10]. (DevOps in practice, 2019), the case study's implementation guarantees a thorough description of the apps and demonstrates how it gives software teams the capacity to take ownership and responsibility for their development. It contributes to better time-saving corporations and the ability to come up with new talents related to operation-related duties. It is necessary to address long-term activities, which call for technological techniques in addition to a supportive culture and mindset.

8. Discussion

The company commits to achieving continuous delivery and continuous deployment, overcoming various challenges in the DevOps implementation process. The deployment and organizational goals, which demand high performance, are interconnected in addressing the DevOps challenge. These challenges contribute to fostering team cohesion and enhancing the adept handling of technological obstacles, thereby necessitating the adoption of a DevOps philosophy and instigating a cultural shift within the organization. Emphasis is placed on ensuring improved approval processes, thorough documentation, and integration considerations. This approach is not only employed to streamline the low-cost processing line but also to amalgamate high infrastructure costs and replace traditional, less efficient pipelines.

Careful evaluation of technology and the internal context of the firm is necessary to ensure efficacy and overcome obstacles in integrating theft into the agile process. The implementation of DevOps is essential for offering direction and assistance. A comprehensive cost-benefit analysis must be carried out by the company before using DevOps. Ensuring the effectiveness of DevOps deployment in the existing environment is crucial, considering both the procedure and the technologies that will be employed. This contributes to ensuring that organizations use agile methods to overcome difficulties and achieve greater effectiveness.

9. Conclusion

DevOps approach implementation in enterprises is a challenging endeavor that calls for a significant change in technology, procedures, and culture. During the implementation phase, issues like cultural obstacles, resistance to change, a lack of experienced workers, and a lack of automated solutions could come up. Organizations can begin addressing these problems by creating a clear plan and strategy for DevOps adoption and highlighting its advantages to pertinent stakeholders[12]. It's imperative to spend money on employee upskilling and training to make sure workers can apply DevOps techniques efficiently. In addition, a DevOps methodology cannot be successfully implemented without cultivating a culture of experimentation, continuous development, and cooperation. Finally, using automation tools can improve overall productivity and streamline procedures.

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