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## Assessing DevOps Adoption in Saudi Software Teams

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#### Abstract

The global adoption of DevOps principles has transformed software development through enhanced collabo- ration, automation, and continuous improvement. However, empirical research on DevOps adoption in the Middle East, particularly Saudi Arabia, is limited. This study examines the understanding and implementation of DevOps practices among software development teams in Saudi Arabia, highlighting challenges faced. A survey of 308 team members assesses their knowledge, comprehension, and application of DevOps methodologies. Results indicate that while many respondents grasp core DevOps concepts, adoption is hindered by barriers such as inadequate knowledge, resistance to change, and insufficient training. Approximately (50)% of organizations have adopted DevOps practices, yet many participants are uncertain about their organization's status, indicating a need for better communication and awareness. The study identifies benefits like faster software delivery and improved collaboration but emphasizes the necessity for expertise development and cultural shifts. Findings suggest that to enhance DevOps adoption in Saudi Arabia, focused efforts in training, change management, and leadership engagement are crucial. This research offers insights for policymakers, industry leaders, and software teams to boost competitiveness and efficiency in the region, with future studies recommended exploring the long-term impacts of DevOps on business performance and strategies to address identified challenges.

Keywords: DevOps Adoption, Software Development Teams, Saudi Arabia, Digital Transformation, DevOps Barriers.

## Introduction

The increasing demand for rapid and reliable software delivery has led to the widespread adoption of DevOps practices globally (Mishra & Otaiwi, 2020; Grande, Vizcaíno, & García, 2024). As a cultural and philosophical movement, DevOps aims to bridge the gap between software development and operations teams, fostering a culture of collaboration, automation, and continuous improvement (Faustino et al., 2022; Jha et al., 2023). The integration of development and operations practices enables organizations to respond quickly to changing market conditions, improve product quality, and reduce time-to-market (El Aouni et al., 2024). However, the adoption and understanding of DevOps practices can vary significantly across different regions and industries, influenced by factors such as organizational culture, technological infrastructure, and human capital (Jayakody & Wijayanayake, 2023; Pérez-Sánchez et al., 2024). DevOps adoption in software teams is a growing trend that aims to improve collaboration between development and operations, leading to faster delivery and higher quality software (Trigo, Varajão, & Sousa, 2022). Research has identified various team structures emerging in DevOps environments, ranging from emerging to consolidated product teams, often supported by horizontal teams providing technical capabilities and mentoring (López-Fernández et al., 2021). Key practices in DevOps include continuous delivery and

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integration, with benefits such as improved software quality and faster delivery (Trigo, Varajão, & Sousa, 2022). However, organizations face challenges in adopting DevOps, including resistance to change and lack of guidance (Muñoz & Rodríguez, 2024). To address these challenges, researchers have proposed frameworks for implementing DevOps in small organizations and automated assessment processes for team-coding assignments in educational settings (Muñoz & Rodríguez, 2024; Fernandez-Gauna, Rojo, & Graña, 2023). These approaches aim to facilitate DevOps adoption and provide valuable feedback to teams and individuals.

In recent years, Saudi Arabia has been undergoing rapid digital transformation, driven by its Vision 2030 initiative, which aims to diversify the economy, promote innovation, and enhance the quality of life for its citizens (Asem, Mohammad, & Ziyad, 2024). The kingdom's software industry has been experiencing significant growth, with many organizations investing heavily in digital technologies to improve their competitiveness and efficiency. As a result, there is a growing need to understand the extent to which software teams in Saudi Arabia comprehend and adopt DevOps practices, as well as the challenges and barriers they face in implementing these practices.

Despite the growing importance of DevOps in the software industry, there is a lack of empirical research on its adoption and understanding in the Saudi Arabian context. Most existing studies on DevOps adoption have focused on Western countries, with limited attention paid to the experiences of software teams in the Middle East and North Africa (MENA) region. This knowledge gap highlights the need for a study that investigates the comprehension and implementation of DevOps practices among software teams in Saudi Arabia, taking into account the unique cultural, organizational, and technological factors that shape their experiences.

This study aims to address the knowledge gap by exploring the extent to which software teams in Saudi Arabia comprehend and adopt DevOps practices. Specifically, it seeks to answer two research questions: ((Mishra & Otaiwi, 2020)) To what extent do software teams in Saudi Arabia comprehend and adopt DevOps practices? and ((Grande et al., 2024)) What are the primary challenges and barriers that software teams in Saudi Arabia face in implementing DevOps practices? By answering these questions, this study aims to provide insights into the current state of DevOps adoption in Saudi Arabia and identify areas for improvement.

The findings of this study will contribute to the existing body of knowledge on DevOps adoption and provide practical recommendations for software teams in Saudi Arabia seeking to improve their DevOps practices. Moreover, the study's results will inform policymakers and industry leaders about the challenges and opportunities facing the software industry in Saudi Arabia, enabling them to develop targeted initiatives to support the growth and development of the sector.

This study will employ a survey-based approach to collect data from software teams in Saudi Arabia. The survey will be designed to gather information about the respondents' understanding of DevOps practices, their level of adoption, and the challenges they face in implementing these practices. The data collected will be analyzed using statistical methods to identify trends, patterns, and correlations, providing a comprehensive understanding of the current state of DevOps adoption in Saudi Arabia. The study's methodology and findings will be presented in the following sections, providing a detailed account of the research design, data collection, and data analysis procedures employed in this study.

## **Research Questions**

1. To what extent do software teams in Saudi Arabia comprehend and adopt DevOps practices?

2. What are the primary challenges and barriers that software teams in Saudi Arabia face in implementing DevOps practices?

## **Related Work**

The adoption of DevOps has been widely studied in recent years, primarily focusing on how this practice enhances collaboration between development and operations teams to improve software quality and accelerate delivery (Senapathi, Buchan, & Osman, 2018; Lwakatare et al., 2019; Muñoz & Rodríguez, 2024; El Aouni et al., 2024). The following studies provide a comprehensive understanding of the benefits, challenges, and factors influencing the success of DevOps adoption in various organizational contexts.

(Riungu-Kalliosaari et al., 2016) highlights DevOps as an approach that merges traditional software engineering roles and fosters enhanced communication, ultimately improving the frequency of production releases while maintaining software quality. In a qualitative multi-case study involving software development organizations in Finland, the findings suggest that DevOps can lead to an increase in release frequency and improved test automation practices. More importantly, the study emphasized how DevOps encourages cross-department collaboration, which enhances communication and employee satisfaction. However, significant challenges were noted, such as communication structures that hinder collaboration across departments and the cultural shift required for DevOps adoption. Technical barriers, such as discrepancies between development and production environments, were also mentioned. The study further raised concerns about the ambiguity in defining DevOps, making adoption difficult for organizations unsure of which practices to implement.

(Luz, Pinto, & Bonifácio, 2019) underscores the cultural and practical components of DevOps by exploring its adoption across various industries. Using Grounded Theory, the paper presents a model and theory based on (Riungu-Kalliosaari et al., 2016) real-world scenarios of successful DevOps adoption from five different countries. A case study conducted at a Brazilian government institution provided empirical support for the proposed model, which emphasized that collaboration, rather than automation or tooling, is the heart of DevOps. The study's contributions lie in offering a detailed explanation of the practical steps and cultural shifts necessary for DevOps adoption, thus helping organizations better understand the path toward successful implementation. The research challenges the prevailing notion that DevOps success can be achieved solely through automation, arguing instead that collaboration is the core tenet that drives DevOps transformation.

(Krey, 2022) explores the widespread acceptance of DevOps in modern software engineering as a response to the dynamic demands of software delivery. While DevOps has become increasingly popular, the study identifies a gap in understanding the adoption process, specifically how organizations can overcome ambiguities in definitions and conceptual inconsistencies. The paper synthesizes existing academic and practitioner research to offer a clearer roadmap for DevOps adoption. One key contribution is the identification of common challenges, such as resistance to organizational change, technical barriers, and unclear definitions of DevOps practices. This paper calls for further research that bridges theoretical frameworks with practical implementation strategies, providing insights that can guide both

# 728 Assessing DevOps Adoption in Saudi Software Teams academic inquiry and real-world adoption.

(Trigo, Varajão, & Sousa, 2022) focuses on a case study conducted within a large telecommunications company undergoing a DevOps transformation. The study provides a holistic view of the DevOps adoption process, covering pre-adoption, adoption, and post-adoption phases. Key findings include the identification of continuous delivery and continuous integration as the most critical DevOps practices within the organization. The study highlights several benefits, including improvements in software quality, faster delivery, and a reduction in production failures. However, resistance to change emerged as a significant barrier, particularly in the cultural and organizational dimensions. The study identifies several success factors, such as top management support, the implementation process, and applied technology. Overall, the results offer a comprehensive view of the factors influencing DevOps adoption, providing both academics and practitioners with actionable insights into the conditions necessary for successful implementation.

(Zarour et al., 2020; Zarour et al., 2019) shifts the focus to the adoption of DevOps in Saudi Arabia, with a particular emphasis on assessing the maturity of DevOps practices in local organizations. Using the Bucena DevOps maturity model, the study evaluates the DevOps adoption levels of seven Saudi organizations. The findings indicate that while DevOps adoption is promising, several factors—particularly those related to culture, process, and technology remain underdeveloped. The research highlights the need for organizations to focus on these areas to achieve higher levels of DevOps maturity and improve performance. This study contributes to the growing body of knowledge on DevOps adoption in non-Western contexts, offering valuable insights into the specific challenges faced by organizations in the Middle East.

In addition to these case studies, several other researchers have explored the broader challenges and opportunities associated with DevOps adoption. (López-Fernández et al., 2021) suggest that DevOps adoption is increasingly linked to the use of microservices, which, while beneficial for scalability, can also introduce complexity. Similarly, Pallis et al. argue that the integration of microservices into DevOps practices can lead to increased architectural complexity, which organizations must carefully manage. (Muñoz & Rodríguez, 2024) highlight the particular difficulties faced by small organizations in adopting DevOps, often due to a lack of guidance and misunderstandings about what constitutes DevOps. They propose actionable implementation guides to help overcome these challenges. Khan et al. further elaborate on the critical challenges to DevOps adoption, such as a lack of collaboration, insufficient skills, and limited management support. Their work emphasizes the importance of addressing these cultural and organizational barriers to ensure successful DevOps adoption.

Despite these challenges, the potential benefits of DevOps are well-documented. (Khan et al., 2022) argue that DevOps can significantly reduce production times and increase the reliability of software systems. In response to the cultural and technical challenges identified in previous studies, researchers have developed taxonomies of team structures and implementation guides to assist organizations in their DevOps journey. These efforts aim to provide a clearer understanding of the adoption process and help organizations navigate the complexities associated with implementing DevOps practices.

Overall, the existing body of research highlights both the promises and obstacles of DevOps adoption. While the cultural and technical challenges are significant, the potential benefits—such as faster production cycles, improved collaboration, and enhanced software quality—make DevOps a compelling framework for modern software development teams. Understanding these

challenges and implementing appropriate strategies is crucial for organizations aiming to successfully integrate DevOps into their workflows.

## Methodology

This section outlines the methodological framework utilized to examine the adoption and comprehension of DevOps practices among software teams in Saudi Arabia. The approach integrates research design, population and sampling strategies, survey development, data collection procedures, and data analysis techniques, ensuring a comprehensive and robust investigation. Ethical considerations and measures to ensure validity and reliability are also detailed to uphold the study's integrity. An overview of the methodology is depicted in Figure 1.



FIGURE1. Research Methodology

## **Research Design and Population**

A quantitative research methodology was employed, leveraging structured surveys to gather measurable and comparable data from software team members across various technology companies(Creswell & Creswell, 2017). This approach facilitates an objective assessment of DevOps adoption levels, comprehension, and associated challenges, while enabling the identification of trends and correlations within the data. The study adopted a cross-sectional survey design, capturing a snapshot of DevOps practices during a period of significant digital transformation driven by Saudi Arabia's Vision 2030 initiative.

The target population included professionals involved in the software development lifecycle, such as developers, system administrators, DevOps engineers, QA engineers, and project managers. A convenience sampling method was utilized to recruit 308 respondents, chosen for their accessibility and willingness to participate. Although non-probability sampling may limit generalizability, it was selected due to practical constraints related to time, resources, and participant accessibility (Dillman, Smyth, & Christian, 2014).

## **Survey Instrument Development**

The survey instrument was meticulously designed to capture various dimensions of DevOps adoption and understanding. The development process began with an extensive literature review to identify key constructs and validated measurements related to DevOps methodologies, familiarity, benefits, and obstacles . The final survey comprised five main sections:

- 1. Demographic Information: Captured background characteristics such as age, gender, education level, professional role, and years of experience.
- 2. General Understanding of DevOps: Assessed theoretical knowledge and recognition of DevOps principles.
- 3. Practical Experience with DevOps: Evaluated the implementation and personal involvement in DevOps practices.
- 4. Perception and Challenges: Investigated perceived benefits and obstacles related to DevOps adoption.
- 5. Open Feedback: Allowed respondents to share additional insights or experiences.

The survey included both closed-ended questions (using Likert scales, multiple-choice options, and checklists) for quantitative analysis and open-ended questions to capture qualitative insights. To ensure validity and reliability, the survey underwent a two-phase pretesting process: expert review for content validity and a pilot test with (Khan et al., 2022) software professionals to refine question clarity and response consistency. Internal consistency was confirmed using Cronbach's alpha, with all multi-item scales exceeding the acceptable threshold of (0) (Bujang, Omar, & Baharum, 2018).

## **Data Collection Procedures**

Data was collected online using a reputable survey platform that ensured confidentiality and participant anonymity. The survey link was disseminated through various channels, including professional networks, online forums, social media platforms (e.g., LinkedIn, Twitter), and direct outreach to technology firms and software development communities in Saudi Arabia. Participants were invited voluntarily, with assurances of data security and the option to withdraw at any time without repercussions.

Ethical approval was obtained from the relevant institutional review board (IRB) prior to data collection. Informed consent was secured from all participants, detailing the study's purpose, procedures, potential risks, and benefits. Compliance with data protection regulations was maintained throughout the study (Wiles, 2012).

## **Data Analysis Techniques**

The collected data was analyzed using both descriptive and inferential statistical methods to provide a comprehensive understanding of DevOps adoption and comprehension.

Descriptive Statistics: Summarized the main features of the data, including frequencies, percentages, means, and standard deviations for demographic variables and responses related to DevOps practices. These metrics offered an overview of the sample characteristics and baseline understanding of DevOps within the population.

Inferential Statistics: Explored relationships and differences within the data using:

Chi-Square Tests: Examined associations between categorical variables, such as professional roles and DevOps adoption levels.

T-Tests and ANOVA: Compared mean differences in DevOps familiarity and perceptions across different demographic groups (e.g., age, education level).

Correlation Analysis: Identified the strength and direction of relationships between continuous

variables, such as years of experience and proficiency with DevOps tools.

Regression Analysis: Determined predictors of DevOps adoption and understanding, controlling for potential confounding factors.

Advanced statistical software (e.g., SPSS, R) was utilized to perform all analyses, ensuring accuracy and reliability. A significance level of p < (0).(05) was established for all hypothesis tests.

## Validity, Reliability, and Limitations

To ensure construct validity, the survey items were carefully aligned with the theoretical constructs of DevOps adoption and understanding. Factor analysis confirmed the dimensionality of multi-item scales, ensuring each set of items accurately represented the intended construct. Reliability was further assessed through Cronbach's alpha, with all scales demonstrating acceptable to high internal consistency ( $\alpha = 0.75$ to 0.90) (Tavakol & Dennick, 2011).

Despite the robust methodology, several limitations are acknowledged:

Sampling Bias: Convenience sampling may limit the generalizability of findings to the broader population of software team members in Saudi Arabia.

Self-Reported Data: Responses may be influenced by social desirability and inaccurate self-assessment, potentially affecting validity.

Cross-Sectional Design: Data was captured at a single point in time, precluding the assessment of changes and trends in DevOps adoption over time.

Limited Qualitative Insights: While open-ended questions provided some qualitative data, the primary reliance on quantitative measures may overlook deeper contextual factors influencing DevOps practices.

Future research could address these limitations by employing longitudinal designs, probabilistic sampling methods, and mixed-method approaches to gain a more comprehensive understanding of DevOps adoption dynamics.

## Summary

This methodological approach ensures a systematic and rigorous investigation into the adoption and understanding of DevOps practices among software teams in Saudi Arabia. By utilizing a quantitative survey design, a well-constructed instrument, and robust data analysis techniques, the study aims to generate reliable and actionable insights. These insights are intended to inform both academic discourse and industry practices, contributing to the advancement of the software industry in the region.

## Results

This section presents the findings from the survey administered to 308 software team members across technology companies in Saudi Arabia. The results are organized into key areas: demographic information, familiarity and understanding of DevOps, adoption and implementation of DevOps practices, perceived benefits and challenges, practical experience with DevOps tools, and qualitative insights from open feedback. Additionally, the results address the two primary research questions (RQ1 and RQ2) outlined in the study.

# 732 Assessing DevOps Adoption in Saudi Software Teams **Demographic Information**

Understanding the demographic profile of the respondents provides context for interpreting the survey results. Table 1 summarizes the demographic characteristics of the participants.

Category	Percentage	Number of
	(%)	Respondents
Age Group		
18-24	11%	34
25-34	47%	145
35-44	32%	99
45-54	8%	25
55+	2%	5
Gender		
Male	85%	262
Female	15%	46
Prefer not to say	0%	0
Education Level		
High school	2%	6
diploma		
Bachelor's degree	68%	209
Master's degree	25%	77
PhD	2%	6
Other	3%	10
Role in Software	Team	
Developer	55%	169
System	10%	31
Administrator		
DevOps Engineer	15%	46
QA Engineer	8%	25
Project Manager	7%	22
Other	5%	15
Years of Experier	ice	
Less than 1 year	5%	15
1-3 years	18%	55
4-6 years	30%	92
7-10 years	25%	77
More than 10	22%	69
years		

TABLE	1: Demogra	phic Inform	nation of I	Respondents

## Familiarity and Understanding of DevOps

This subsection explores the respondents' familiarity with DevOps and their understanding of its core concepts. Table 2 presents the levels of familiarity, while Table 3 details the respondents' understanding of DevOps concepts.

Familiarity	Percentage	Number	of
Level	(%)	Respondents	
Not familiar at	12%	37	
all			
Slightly familiar	18%	55	
Moderately	40%	123	
familiar			
Very familiar	25%	77	
Expert level	5%	16	

TABLE 2: Familiarity with DevOps

Understanding Aspect	Percentage	Number of
	(%)	Respondents
A set of tools for automating tasks	55%	169
A cultural shift in how teams work together	38%	117
A methodology for continuous delivery	42%	129
and integration		
A combination of development and	65%	200
operations practices		
I don't know	5%	15

TABLE 3: Understanding of DevOps Concepts

## **Key Observations**

Familiarity Levels: A combined 65% of respondents possess a moderate to expert level of familiarity with DevOps, indicating a substantial base of knowledge within the software teams.

Understanding of DevOps: The majority (65%) correctly identify DevOps as an integration of development and operations practices. However, a notable 5% of respondents still lack a fundamental understanding of DevOps.

## **Adoption and Implementation of DevOps Practices**

This subsection assesses the extent to which DevOps practices are adopted within organizations and the specific practices implemented. Table 4 outlines the core DevOps principles recognized by respondents, while Table 5 details the implementation status within organizations.

DevOps Principle	Percentage	Number of
	(%)	Respondents
Continuous Integration	75%	231
(CI)		
Continuous Delivery (CD)	65%	200
Infrastructure as Code	55%	169
(IaC)		
Monitoring and Logging	50%	154
Automation	78%	240
Collaboration and	70%	215
Communication		
None of the above	6%	18



734 Assessing DevOps Adoption in Saudi Software Teams TABLE 4:Core DevOps Principles Recognized

F I G U R E 2: DevOps Familiarity Among Respondents

Implementation	Percentage	Number	of
Status	(%)	Respondents	
Yes	48%	148	
No	25%	77	
Not sure	27%	83	

TABLE 5: Implementation of DevOps Practices in Organizations

## **Key Observations**

Adoption Rate: Nearly half (48%) of the respondents' organizations have implemented DevOps practices, while a significant 27% remain uncertain about their organization's DevOps status.

Core Principles: Automation (78%) and Continuous Integration (75%) are the most widely recognized DevOps principles among respondents.

## Perceived Benefits and Challenges of DevOps Adoption

This subsection explores the perceived benefits of adopting DevOps practices and the challenges associated with their im- plementation. Table 6 illustrates the perceived benefits, while Table 7 details the primary challenges faced by software teams.

Benefit	Percentage	Number	of
	(%)	Respondents	
Faster delivery of software	75%	231	
Improved collaboration	60%	185	
between teams			

Higher quality software	55%	169
Better scalability and	50%	154
reliability		
Reduced operational costs	38%	117
I don't know	5%	15

Challenge	Percentage	Number	of
	(%)	Respondents	
Lack of knowledge or expertise	60%	185	
Resistance to change	45%	138	
Insufficient tooling or infrastructure	40%	123	
Lack of management support	38%	117	
Cultural differences between development	35%	108	
and operations			
Other (please specify)	N/A	0	

TABLE 7: Challenges to DevOps Adoption

#### **Key Observations**

Top Benefits: The most cited benefit of DevOps adoption is the faster delivery of software (75%), followed by improved collaboration (60%) and higher quality software (55%).

Cost Reduction: While reduced operational costs are recognized by (38)% of respondents, this benefit is less emphasized compared to other advantages.

Primary Barriers: The most significant challenge identified is the lack of knowledge or expertise (60)%), followed by resistance to change (45%) and insufficient tooling or infrastructure (40%).

Management and Cultural Issues: Lack of management support and cultural differences between development and operations teams are also notable barriers, affecting 38% and (35)% of respondents, respectively.

#### **Practical Experience with DevOps Tools**

This subsection evaluates the practical application of DevOps practices within organizations and the proficiency of team members with DevOps tools. Table 8 lists the DevOps tools utilized by respondents, and Table 9 shows their proficiency levels.

DevOps	Percentage	Number	of
Tool	(%)	Respondents	
Jenkins	60%	185	
Docker	55%	169	
Kubernetes	30%	92	
Ansible	25%	77	
GitLab	50%	154	
CI/CD			
Terraform	20%	62	
Other	N/A	0	

736 Assessing DevOps Adoption in Saudi Software Teams TABLE 8: DevOps Tools Utilized by Respondents

Proficiency	Percentage	Number	of	
Level	(%)	Respondents		
Beginner	30%	92		
Intermediate	45%	138		
Advanced	20%	62		
Expert	5%	15		

 TABLE 9: Proficiency with DevOps Tools

## **Key Observations**

Tool Adoption: Jenkins (60%), Docker (55%), and GitLab CI/CD (50%) are the most commonly utilized DevOps tools among respondents.

Proficiency Levels: The majority of respondents (45%) possess intermediate proficiency with DevOps tools, while (30)% are beginners, indicating a need for advanced training.

## **Qualitative Insights from Open Feedback**

While the survey primarily focused on quantitative measures, open-ended responses provided additional qualitative insights into the experiences and perceptions of software team members regarding DevOps adoption. Common themes include:

Positive Experiences: Many respondents noted improved efficiency and collaboration as direct benefits of adopting DevOps practices.

Suggestions for Improvement: Participants emphasized the need for ongoing training, better communication between teams, and more investment in modern DevOps tools.

Organizational Support: Several comments highlighted the importance of having strong leadership and clear strategic direction to successfully implement DevOps.

These qualitative insights complement the quantitative data, underscoring the multifaceted nature of DevOps adoption and the interplay between technical practices and organizational culture.

## **Summary of Key Findings**

The survey results highlight several critical insights into DevOps adoption and comprehension among software teams in Saudi Arabia:

Moderate Familiarity: A significant proportion ((65)%) of respondents are moderately to highly familiar with DevOps, although a notable minority 12% lack familiarity.

Adoption Rates: Approximately half ((48)%) of organizations have implemented DevOps practices, with continuous integration and delivery being the most adopted practices.

Tool Utilization: Jenkins, Docker, and GitLab CI/CD are the leading tools in use, reflecting a focus on automation and continuous integration.

Perceived Benefits: Faster software delivery and improved team collaboration are the primary benefits driving DevOps adoption.

Challenges: The main barriers include a lack of knowledge or expertise, resistance to change, and insufficient tooling or infrastructure.

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Practical Experience: While foundational DevOps tools are widely adopted, proficiency levels indicate a need for further training and expertise development.

Qualitative Insights: Positive experiences are tempered by suggestions for improvement in training, communication, and organizational support.

## Addressing Research Questions

## Research Question 1 (RQ1): Comprehension and Adoption of DevOps Practices

Comprehension of DevOps Practices: The survey indicates that software teams in Saudi Arabia exhibit a moderate to high level of comprehension regarding DevOps practices. Specifically, (65)% accurately recognize DevOps as a combination of development and operations practices. Additionally, (55)% understand it as a set of tools for automating tasks, and (42)% see it as a methodology for continuous delivery and integration. These findings suggest a solid foundational understanding of DevOps among the majority of software team members, although there remains a subset requiring further education and awareness.

Adoption of DevOps Practices: Regarding the adoption of DevOps practices within organizations, (48)% of respondents report that their organizations have implemented DevOps practices. However, 27% % are uncertain about the implementation status, which may indicate a lack of clear communication or understanding within these organizations. Continuous Integration (CI) and Continuous Delivery (CD) are the most widely adopted practices, implemented by (75)% and (65)% of respondents, respectively. Infrastructure as Code (IaC) and Automated Testing have lower adoption rates at (55)% and (40)%, respectively. Tool usage trends align with these practices, with Jenkins, Docker, and GitLab CI/CD being the most commonly used tools.

## Research Question 2 (RQ2): Challenges and Barriers to DevOps Implementation

- 1. The survey identifies several key challenges that software teams in Saudi Arabia face when implementing DevOps practices:
- 2. Lack of Knowledge or Expertise (60%): This is the most significant barrier, highlighting a critical need for targeted training programs and educational initiatives to enhance the skill sets of software team members.
- 3. Resistance to Change (45%): Cultural inertia and reluctance to alter established workflows impede the adoption of DevOps. Addressing this requires effective change management strategies and strong leadership support.
- 4. Insufficient Tooling or Infrastructure (40%): Limited access to or inadequate DevOps tools and infrastructure can hinder the seamless implementation of DevOps practices. Investment in appropriate tools and infrastructure is necessary.
- 5. Lack of Management Support (38%): Without backing from organizational leadership, DevOps initiatives may struggle to gain traction. Management must actively endorse and support DevOps transformation.
- 6. Cultural Differences Between Development and Operations (35%): Traditional silos between development and opera- tions teams can create friction and impede collaboration. Promoting a culture of collaboration and shared responsibility is essential.

#### 738 Assessing DevOps Adoption in Saudi Software Teams Implications of Challenges

The predominance of knowledge and expertise gaps suggests that organizations must prioritize educational initiatives, such as training programs and workshops, to build DevOps competencies within their teams. Additionally, addressing resistance to change requires fostering an organizational culture that values flexibility, continuous improvement, and collaborative problem-solving. Investing in robust tooling and infrastructure will support the technical aspects of DevOps adoption, while securing management support ensures that DevOps initiatives receive the necessary resources and strategic alignment.

## Visualization of Key Data

To enhance the comprehensibility of the results, the following figures provide visual representations of key data points:

## **Summary of Results**

The survey results demonstrate a growing awareness and moderate adoption of DevOps practices among software teams in Saudi Arabia. While foundational practices like Continuous Integration and Automation are widely recognized and implemented, more advanced practices such as Infrastructure as Code require further adoption. The primary obstacles to DevOps implementation revolve around skill gaps, cultural resistance, and insufficient tooling, highlighting areas where organizations can focus their improvement efforts. These findings provide a comprehensive understanding of the current landscape of DevOps in Saudi Arabia, informing strategies for enhancing adoption and effectiveness.

## Limitations

While this study provides valuable insights into the adoption and comprehension of DevOps practices among software teams in Saudi Arabia, several limitations must be acknowledged to contextualize the findings and inform future research directions.

Firstly, the research employed a non-probability convenience sampling method to recruit participants. Although this approach facilitated the inclusion of a diverse group of respondents, it inherently restricts the generalizability of the results. The sample of 308 respondents, while substantial, may not accurately represent the entire population of software professionals across all

Alfawzan. 739



F I G U R E 3: Role Distribution in Software Teams

regions and sectors within Saudi Arabia. Specifically, smaller organizations and those located outside major urban centers might be underrepresented, potentially skewing the findings towards the experiences of larger, more urban-based companies. As a result, caution is advised when extrapolating these results to the broader landscape of the Saudi software industry.

Secondly, the study relies on self-reported data collected through surveys, which introduces the possibility of various biases affecting the accuracy of the responses. Participants may exhibit social desirability bias, intentionally portraying their organizations or themselves in a more favorable light, leading to overreporting of DevOps adoption and underreporting of challenges. Additionally, individual perceptions and interpretations of DevOps practices can vary, resulting in inconsistencies in how respondents understand and answer survey questions. Although the survey instrument underwent pretesting to enhance clarity, it may not fully capture the nuanced understanding of DevOps practices, especially among participants with limited familiarity or varying interpretations of specific DevOps concepts.

Furthermore, the study adopts a cross-sectional design, capturing data at a single point in time. Given the rapidly evolving nature of the technology landscape and organizational practices, the findings represent a snapshot of DevOps adoption during the survey period. Consequently, the results may not reflect ongoing trends, longitudinal changes, or future developments in DevOps practices within Saudi software teams. Longitudinal studies are recommended to monitor and analyze the progression and sustainability of DevOps adoption over time, providing a more dynamic and comprehensive understanding of its evolution. Another limitation pertains to the depth of analysis on the challenges and barriers to DevOps adoption. While the survey effectively identified various obstacles, it did not delve deeply into the specific cultural, organizational, or technological factors influencing these challenges within the Saudi context. The quantitative nature of the survey limited the ability to explore the underlying reasons and

intricate dynamics that contribute to the identified barriers. Future research should incorporate qualitative methodologies, such as in-depth interviews, focus groups, or case studies, to gain richer insights into how cultural norms, organizational structures, and technological infrastructures uniquely impact DevOps implementation in Saudi Arabia. This qualitative depth would enhance the understanding of contextual factors and inform more targeted strategies for overcoming

adoption barriers.

Additionally, the study primarily targeted software teams within technology companies, potentially overlooking perspectives from other relevant sectors where DevOps practices are emerging or implemented differently, such as government agencies, educational institutions, or non-tech industries undergoing digital transformation. Moreover, the geographical concentration of respondents within certain regions of Saudi Arabia might limit the applicability of the findings to other areas with distinct



F I G U R E 4: DevOps Familiarity Among Respondents

economic, cultural, or technological environments. Future studies should aim to include a broader range of sectors and regions to capture a more holistic view of DevOps adoption across the entire country.

Language and interpretation constraints also present a limitation. Although the survey was designed to be clear and concise, language nuances and varying levels of English proficiency among respondents could have influenced the interpretation of questions and the accuracy of responses. Misunderstandings or ambiguities in question phrasing may lead to inconsistent or inaccurate data, affecting the reliability of the findings. Ensuring that surveys are available in both Arabic and English, and conducting thorough translations with cultural adaptations, could mitigate this limitation in future research.

Lastly, the study did not account for the variability in technological infrastructure and resources available to different organizations, which can significantly impact DevOps adoption. Organizations with advanced technological capabilities and robust infrastructure are more likely to implement DevOps practices effectively compared to those with limited resources. This variability was not explicitly measured or controlled for in the survey, potentially confounding the relationship between organizational characteristics and DevOps adoption levels. Future research should consider assessing the technological maturity and infrastructure readiness of organizations to better understand their influence on DevOps implementation.

While this study offers significant insights into DevOps adoption and understanding among software teams in Saudi Arabia, the aforementioned limitations highlight areas where caution is warranted in interpreting the results. Addressing these limitations in future research through diversified sampling methods, incorporating qualitative approaches, extending geographical and sectoral coverage, and enhancing survey design can lead to a more comprehensive and accurate understanding of DevOps dynamics within the region.

## Conclusion

This study provides a comprehensive assessment of the adoption and understanding of DevOps practices among software teams in Saudi Arabia. The findings indicate that a substantial proportion of respondents possess a moderate to high level of familiarity with DevOps concepts, with approximately (65)% demonstrating a solid foundational understanding. Despite this awareness, the adoption of DevOps practices remains moderate, with nearly half (48%) of the surveyed organizations having implemented these practices. However, a significant portion of respondents 27% remain uncertain about their organization's DevOps status, underscoring the need for enhanced communication and awareness within teams.

Key benefits of DevOps adoption, such as accelerated software delivery (75%) and improved collaboration between teams (60%), are widely recognized and appreciated. These advantages contribute to increased efficiency and higher quality software products, aligning with the objectives of Saudi Arabia's Vision 2030 initiative to drive digital transformation and economic diversification. Nevertheless, the study identifies critical challenges that hinder broader DevOps implementation. The most prominent obstacles include a lack of knowledge or expertise (60%), resistance to organizational change (45%), and insufficient tooling or infrastructure (40%). Additionally, issues related to management support and cultural differences between development and operations teams further impede the seamless adoption of DevOps practices.

Addressing these challenges requires targeted interventions. Focused training programs and educational initiatives are essential to bridge the knowledge gaps and enhance the technical competencies of software professionals. Effective change management strategies, supported by active leadership involvement, are crucial to overcoming resistance and fostering an organizational culture that embraces continuous improvement and collaboration. Investment in robust DevOps tools and infrastructure will also facilitate the practical implementation of DevOps principles, ensuring that technical barriers do not impede progress.

The study's insights have significant implications for policymakers and industry leaders. By understanding the current state of DevOps adoption and the barriers faced, stakeholders can develop informed strategies to support the growth and competitiveness of Saudi Arabia's software industry. Implementing comprehensive training programs, promoting a culture of collaboration, and ensuring adequate resource allocation are pivotal steps towards cultivating a 742 Assessing DevOps Adoption in Saudi Software Teams thriving DevOps environment.

Future research should explore the long-term impacts of DevOps adoption on business outcomes, such as productivity, innovation, and market responsiveness. Longitudinal studies could provide deeper insights into how DevOps practices evolve over time and their sustained effects on organizational performance. Additionally, qualitative research methodologies, including in-depth interviews and case studies, would offer a more nuanced understanding of the cultural and organizational dynamics that influence DevOps implementation. Expanding the scope to include diverse sectors and regions within Saudi Arabia would also enhance the generalizability of the findings and provide a more holistic view of DevOps adoption across the country.

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#### Alfawzan. 743

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## A DEVOPS KNOWLEDGE AND COMPREHENSION SURVEY INSTRUMENT

- A.1 Section A: Demographic Information
- A1. Age group:
- (a) 18-24
- (b) 25-34
- (c) 35-44
- (d) 45-54
- (e) 55+

A2. Gender:

- (a) Male
- (b) Female
- (c) Prefer not to say
- A3. Highest level of education:
- (a) High school diploma
- (b) Bachelor's degree
- (c) Master's degree
- (d) PhD
- (e) Other (please specify):
- A4. Role within the software team:
- (a) Developer
- (b) System Administrator
- (c) DevOps Engineer
- (d) QA Engineer
- (e) Project Manager
- (f) Other (please specify):
- A5. Years of experience in software industry:
- (a) Less than 1 year
- (b) 1-3 years
- (c) 4-6 years
- (d) 7-10 years
- (e) More than 10 years

- A.2 Section B: General Understanding of DevOps
- B1. Level of familiarity with DevOps:
- (a) Not familiar at all
- (b) Slightly familiar
- (c) Moderately familiar
- (d) Very familiar
- (e) Expert level
- B2. Understanding of DevOps (Select all that apply):
- (a) A set of tools for automating tasks
- (b) A cultural shift in how teams work together
- (c) A methodology for continuous delivery and integration
- (d) A combination of development and operations practices
- (e) I don't know
- B3. Core principles of DevOps recognized (Select all that apply):
- (a) Continuous Integration (CI)
- (b) Continuous Delivery (CD)
- (c) Infrastructure as Code (IaC)
- (d) Monitoring and Logging
- (e) Automation
- (f) Collaboration and Communication
- (g) None of the above
- B4. Personal definition of DevOps:
- A.3 Section C: Practical Experience with DevOps
- C1. Current implementation of DevOps practices in organization:
- (a) Yes
- (b) No
- (c) Not sure
- C2. DevOps practices implemented (Select all that apply):
- (a) Continuous Integration (CI)
- (b) Continuous Delivery (CD)
- (c) Infrastructure as Code (IaC)
- (d) Automated Testing

- (e) Automated Deployment
- (f) Monitoring and Logging
- (g) Other (please specify):
- C3. Personal experience with DevOps projects:
- (a) Yes
- (b) No
- (c) Not sure
- C4. Tools used in DevOps-related tasks (Select all that apply):
- (a) Jenkins
- (b) Docker
- (c) Kubernetes
- (d) Ansible
- (e) GitLab CI/CD
- (f) Terraform
- (g) Other (please specify):
- C5. Proficiency level with DevOps tools:
- (a) Beginner
- (b) Intermediate
- (c) Advanced
- (d) Expert
- A.4 Section D: Perception and Challenges
- D1. Perceived benefits of DevOps adoption (Select all that apply):
- (a) Faster delivery of software
- (b) Improved collaboration between teams
- (c) Higher quality software
- (d) Better scalability and reliability
- (e) Reduced operational costs
- (f) I don't know
- D2. Major challenges in DevOps adoption (Select all that apply):
- (a) Lack of knowledge or expertise
- (b) Resistance to change
- (c) Insufficient tooling or infrastructure

- (d) Lack of management support
- (e) Cultural differences between development and operations
- (f) Other (please specify):
- D3. Team responsible for driving DevOps adoption:
- (a) Development team
- (b) Operations team
- (c) A dedicated DevOps team
- (d) Management/Leadership
- (e) Everyone shares responsibility
- D4. Required support for improving DevOps adoption (Select all that apply):
- (a) Training and workshops
- (b) Better tooling
- (c) Management support
- (d) Clear guidelines and processes
- (e) Improved collaboration between teams
- (f) Other (please specify):