

# Systematic Literature Review on Cloud-Based Testing Solutions\*

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## ABSTRACT

Cloud-based testing solutions offer scalability, cost efficiency, and the ability to leverage diverse environments, making them a significant focus for modern software testing. This systematic literature review (SLR) explores various aspects of cloud-based testing, including methodologies, tools, benefits, and challenges. By reviewing 10 selected papers, we aim to provide a comprehensive overview of the current state-of-the-art in cloud-based testing solutions.

## 1. Systematic literature review (SLR)

An approach known as a Systematic Literature Review (SLR) is a meticulous and rigorous methodology used to identify, evaluate, and synthesize current research in a specific field or topic. It involves conducting a systematic search and analysis of relevant literature, followed by a comprehensive evaluation and examination of selected studies based on predetermined criteria. The primary objective of an SLR is to provide a comprehensive and unbiased summary of the available information, enabling researchers to gain insights, identify patterns, and draw well-founded conclusions from the collective findings of multiple studies. By adhering to a well-defined methodology, an SLR reduces bias, ensures the ability to replicate the process, and enhances the overall reliability of the review.

## 2. Study design

### 2.1. Review need identification

Cloud-based testing solutions have become increasingly important as software systems grow in complexity and require scalable, cost-efficient testing methods. This review aims to provide an overview of existing research on cloud-based testing solutions, highlighting their development and benefits. The motivation behind this review includes the need to identify effective testing methods, tools, and frameworks that can leverage cloud environments for improved software testing.

### 2.2. Research questions definition

The objective of this systematic literature review (SLR) is guided by the following research questions:

- **RQ1:** What are the benefits of cloud-based testing solutions in software testing?
- **RQ2:** What methodologies and tools are commonly used in cloud-based testing?

- **RQ3:** What are the challenges associated with cloud-based testing solutions?

### 2.3. Protocol definition

The steps and the rules for conducting the SLR are defined during this activity. We define five important steps, whose details are described in the following sections. The phases that we followed to conduct the SLR are:

- **Approach:** the resources and search terms used to search for primary studies
- **Methodology:** the selection process used to include or exclude studies from the systematic review
- **Dataset:** the data extraction strategy, which describes how to obtain the required information from each primary study
- **Metrics and Obtained Results:** the data synthesis of the extracted information and the distribution of the results.

## 3. Conducting the SLR

### 3.1. Search and selection process

#### 3.1.1. Database search

The search operation was performed using the following databases: Google Scholar. The keywords used were: "cloud-based testing", "cloud testing tools", "cloud testing benefits", "cloud testing challenges", and "cloud testing case studies". With this method, 30 initial papers were selected.

#### 3.1.2. Merging, and duplicates and impurity removal

From the initial papers, duplicates and irrelevant studies were removed, resulting in 28 unique papers. Further screening based on abstracts reduced the list to 10 relevant papers.

#### 3.1.3. Application of the selection criteria

The following criteria were applied to select the final 10 papers:

- Full-text availability.
- Peer-reviewed.
- Written in English.
- Relevant to cloud-based testing.

\* This document is a systematic literature review for the topic "Cloud-Based Testing Solutions".

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| Id  | Citation       | Title, Authors   | Year |
|-----|----------------|--|------|
| P1  | Ahmed et al.   | A Survey on Cloud Testing: Issues, Challenges, and Tools   | 2020 |
| P2  | Sharma & Sikka | An Overview of Cloud-Based Testing and Its Challenges      | 2019 |
| P3  | Marijan et al. | Cloud-Based Software Testing: Opportunities and Challenges | 2017 |
| P4  | Smith & Jones  | Cloud Testing Tools: A Comparative Analysis                | 2019 |
| P5  | Wang et al.    | Cloud Testing for Mobile Applications                      | 2017 |
| P6  | Patel & Sharma | Automated Cloud Testing Frameworks                         | 2021 |
| P7  | Gupta & Verma  | Challenges in Cloud-Based Software Testing                 | 2016 |
| P8  | Kumar et al.   | Performance Testing in the Cloud                           | 2015 |
| P9  | Lee & Kim      | Security Testing in Cloud Environments                     | 2020 |
| P10 | Singh & Kaur   | Cost-Effective Cloud Testing Strategies                    | 2019 |

**Table 1**  
List of Selected Articles

| Article | Approach                     | Tools                 | Case Study          |
|---------|------------------------------|-----------------------|---------------------|
| P1      | Survey                       | Literature Review     | Academic            |
| P2      | Systematic Literature Review | Review                | Academic            |
| P3      | Case Studies                 | Survey                | Industry            |
| P4      | Comparative Analysis         | Tool Comparison       | Industry            |
| P5      | Empirical Study              | Experimentation       | Mobile Apps         |
| P6      | Framework Proposal           | Prototype Evaluation  | Web Apps            |
| P7      | Qualitative Analysis         | Case Study            | Enterprise Software |
| P8      | Performance Analysis         | Benchmarking          | Cloud Services      |
| P9      | Security Assessment          | Vulnerability Testing | Cloud Platforms     |
| P10     | Cost Analysis                | Economic Evaluation   | SMEs                |

**Table 2**  
Summary Table with Approaches

### 3.2. Data extraction

In our systematic literature review, we identified 10 relevant studies related to black-box testing, as enumerated in Table 3. Each paper is assigned a unique ID ranging from P1 to P10 and is listed without any particular order. The data extraction process was carried out manually using a structured data extraction form designed to capture essential information from each study.

The data extraction form included key fields such as author, title, year, research approach, evaluation metrics, and conclusions. This manual extraction process ensured the accuracy and completeness of the extracted data. Each study was carefully reviewed, and relevant information related to our research questions was extracted.

For RQ1, we focused on identifying different approaches and techniques used in black-box testing, such as equivalence partitioning, boundary value analysis, and fuzzy testing. We also examined the advantages and limitations of each approach. For RQ2, our focus was on gathering information related to the evaluation of black-box testing approaches, including evaluation metrics, research results, and conclusions drawn from the evaluation process. The extracted data focuses on the approach, methodology, dataset, and results. The selected papers are listed in Table 1.

### 3.3. Data synthesis

The data synthesis phase of the systematic literature review on Cloud-Based Testing Solutions involved analyzing the findings and insights extracted from the selected papers. Each paper provided unique perspectives on methodologies, tools, benefits, and challenges associated with cloud-based testing.

Ahmed et al. (2020) - A Survey on Cloud Testing: Issues, Challenges, and Tools Ahmed and colleagues conducted a comprehensive survey to explore the landscape of cloud testing, aiming to highlight prevalent issues, challenges, and available tools in the domain. Their study involved synthesizing existing research literature from reputable academic databases, resulting in a dataset comprising a diverse range of papers addressing various aspects of cloud testing. Through meticulous analysis, the authors identified scalability, security, and tool selection as primary challenges faced by practitioners and researchers. Concurrently, the survey underscored the benefits offered by cloud testing solutions, such as enhanced flexibility, cost-effectiveness, and resource optimization. By providing a comprehensive overview of the current state-of-the-art in cloud testing, Ahmed et al. offered valuable insights that can guide future research endeavors and industry practices in the field.

Sharma & Sikka (2019) - An Overview of Cloud-Based Testing and Its Challenges Sharma and Sikka conducted a

systematic literature review to offer an overview of cloud-based testing and elucidate the challenges inherent in adopting such solutions. Their study involved identifying relevant studies through comprehensive database searches and meticulously screening them based on predetermined criteria. By synthesizing high-quality literature, the authors delineated common challenges faced by practitioners, including data security concerns, performance variability, and tool interoperability issues. Concurrently, the review highlighted the benefits associated with cloud testing, such as scalability, resource optimization, and enhanced testing efficiency. By elucidating both the challenges and opportunities inherent in cloud-based testing, Sharma and Sikka provided valuable insights that can inform decision-making processes for organizations contemplating the adoption of cloud testing solutions.

Marijan et al. (2017) - Cloud-Based Software Testing: Opportunities and Challenges Marijan and collaborators delved into the realm of cloud-based software testing through case studies, aiming to unearth opportunities and challenges prevalent in real-world implementations. Their study involved scrutinizing concrete cases of cloud testing deployments across diverse industry domains, resulting in insights into the benefits and challenges associated with cloud-based testing practices. Through rigorous analysis, the authors illuminated the benefits of cloud-based testing, including scalability, resource optimization, and enhanced testing flexibility. Simultaneously, the case studies brought to the forefront challenges related to data privacy, regulatory compliance, and vendor lock-in, underscoring the complex landscape of cloud testing implementations. By presenting real-world scenarios and their associated outcomes, Marijan et al. provided valuable insights that can inform organizations' strategic decisions regarding the adoption and implementation of cloud testing solutions.

Smith & Jones (2019) - Cloud Testing Tools: A Comparative Analysis Smith and Jones conducted a comparative analysis of cloud testing tools to evaluate their features, capabilities, and suitability for various testing scenarios. Their study involved analyzing a diverse range of cloud testing tools through meticulous examination of documentation, user reviews, and case studies. By synthesizing findings from their analysis, the authors delineated key features and functionalities offered by different tools, enabling practitioners to make informed decisions regarding tool selection. The comparative analysis highlighted the strengths and limitations of each tool, offering valuable insights that can guide organizations in selecting appropriate tools for their testing needs. By providing a comprehensive overview of available cloud testing tools, Smith and Jones contributed to enhancing the understanding of practitioners and researchers in the field.

Wang et al. (2017) - Cloud Testing for Mobile Applications Wang and colleagues explored the domain of cloud testing for mobile applications, aiming to elucidate its benefits, challenges, and best practices. Their study involved synthesizing existing research literature and industry reports

to identify prevalent trends and practices in cloud testing for mobile applications. Through meticulous analysis, the authors delineated the benefits of cloud testing, such as scalability, device diversity, and cost-effectiveness. Concurrently, they highlighted challenges related to data security, network latency, and testing automation. By offering insights into both the opportunities and challenges of cloud testing for mobile applications, Wang et al. provided valuable guidance that can inform practitioners and researchers in effectively testing mobile applications in cloud environments.

Patel & Sharma (2021) - Automated Cloud Testing Frameworks Patel and Sharma explored automated cloud testing frameworks, aiming to assess their features, capabilities, and suitability for various testing scenarios. Their study involved evaluating existing frameworks through a comprehensive review of documentation, user feedback, and case studies. By synthesizing findings from their analysis, the authors delineated key features and functionalities offered by different frameworks, enabling practitioners to make informed decisions regarding framework selection. The study highlighted the importance of automation in cloud testing and provided insights into emerging trends and best practices in the field. By offering a comprehensive overview of automated cloud testing frameworks, Patel and Sharma contributed to enhancing the understanding of practitioners and researchers in the domain.

Gupta & Verma (2016) - Challenges in Cloud-Based Software Testing

Gupta and Verma's study delves into the intricate challenges inherent in cloud-based software testing. Through comprehensive analysis, they pinpoint infrastructure complexities, resource provisioning hurdles, data privacy concerns, and performance variability as primary obstacles. They advocate for the integration of automated testing tools and the adoption of DevOps practices to streamline testing processes in cloud environments. Moreover, they stress the importance of fostering collaboration among stakeholders to tackle these challenges collaboratively. By shedding light on these impediments, Gupta and Verma's research provides a roadmap for practitioners and researchers to navigate the intricacies of cloud-based testing effectively and refine testing methodologies tailored to the unique demands of cloud-based applications.

Kumar et al. (2015) - Performance Testing in the Cloud Kumar and colleagues investigated performance testing in cloud environments, aiming to understand the unique challenges and best practices associated with assessing the performance of applications deployed in the cloud. Their study involved synthesizing existing research literature and industry reports to identify prevalent trends and practices in performance testing. Through meticulous analysis, the authors delineated the benefits of conducting performance testing in the cloud, such as scalability, flexibility, and cost-effectiveness. Concurrently, they highlighted challenges related to network latency, resource contention, and dynamic provisioning. By offering insights into both the opportunities and challenges of performance testing in the cloud, Kumar et

al. provided valuable guidance that can inform practitioners and researchers in effectively assessing the performance of cloud-based applications.

**Lee & Kim (2020) - Security Testing in Cloud Environments** Lee and Kim conducted a study to explore security testing in cloud environments, aiming to identify key challenges and best practices for ensuring the security of applications and data deployed in the cloud. Their study involved synthesizing existing research literature and industry reports to understand prevalent trends and practices in security testing. Through meticulous analysis, the authors delineated the benefits of conducting security testing in the cloud, such as enhanced scalability, real-world emulation, and comprehensive coverage. Concurrently, they highlighted challenges related to data privacy, compliance, and shared responsibility models. By offering insights into both the opportunities and challenges of security testing in cloud environments, Lee and Kim provided valuable guidance that can inform practitioners and researchers in effectively securing cloud-based applications and data.

**Singh & Kaur (2019) - Cost-Effective Cloud Testing Strategies** Singh and Kaur investigated cost-effective cloud testing strategies, aiming to identify approaches and techniques for optimizing testing processes in cloud environments while minimizing associated costs. Their study involved synthesizing existing research literature and industry reports to understand prevalent strategies and practices in cost-effective cloud testing. Through meticulous analysis, the authors delineated various cost-saving measures, such as resource pooling, on-demand provisioning, and pay-per-use models. Concurrently, they highlighted challenges related to cost estimation, resource allocation, and testing efficiency. By offering insights into cost-effective cloud testing strategies, Singh and Kaur provided valuable guidance that can inform practitioners and researchers in optimizing testing processes and reducing associated costs in cloud environments.

## 4. Results

**RQ1:** The primary benefits of cloud-based testing solutions include scalability, cost efficiency, and the ability to leverage diverse environments, which enhance the overall testing process. Scalability allows testing resources to be dynamically adjusted based on demand, ensuring optimal resource utilization. Cost efficiency stems from the pay-per-use model prevalent in cloud services, enabling organizations to minimize upfront infrastructure investments. Additionally, cloud-based testing facilitates access to diverse environments, allowing testers to replicate real-world scenarios more accurately and comprehensively.

**RQ2:** Common methodologies and tools used in cloud-based testing include automated testing frameworks, performance and security assessment tools, and empirical studies to evaluate effectiveness. Automated testing frameworks streamline testing processes by automating test case execution and result analysis. Performance assessment tools enable testers to evaluate system performance under varying

loads and conditions. Security assessment tools help identify vulnerabilities and ensure the integrity of cloud-based applications. Empirical studies provide valuable insights into the effectiveness of different testing approaches and tools.

**RQ3:** Challenges associated with cloud-based testing solutions involve security concerns, performance variability, and dependency on third-party services. Security concerns arise due to the shared nature of cloud infrastructure and the potential for data breaches or unauthorized access. Performance variability may occur due to fluctuations in network latency, resource allocation, or environmental factors in cloud environments. Dependency on third-party services introduces risks related to service availability, reliability, and compatibility, which can impact testing processes and outcomes. Addressing these challenges requires proactive measures such as implementing robust security protocols, optimizing performance testing strategies, and establishing contingency plans for service disruptions.