

Cloud Testing: Perspective and Challenges

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ABSTRACT

In the recent years cloud computing has emerged as potential technology for software industry as a resource base. With cloud computing, organizations need not require large capital outlays and human expenses for realizing innovative ideas. Cloud computing has provided many potential benefits to organizations for maximizing their profit in different perspectives where software testing is believed to be one of them. Software testing has become an umbrella activity in software development and requires heavy budget and resources to be deployed with effectiveness. Using cloud for testing can help organizations to acquire test environment, tools, resources, software licenses and infrastructure at a very affordable budget without bothering to purchase them. The present paper highlights the essence of cloud testing from different perspectives including testing in cloud and testing of cloud. In addition, various key benefits and challenges in cloud testing have been discussed. This paper also discusses various organizations pioneering in cloud testing.

Keywords

Cloud Computing, Software Testing, Multi-tenancy, Cloud Based Testing, Testing tools.

1. INTRODUCTION

Cloud computing is a new emerging technology in computing world which provides access to large number of computing resources. These resources are pooled at centralized location accessed from remote locations via Internet. Organization can focus on their core business areas without any need to buy expensive infrastructure, storage resources, platforms, software etc.

Cloud computing reduces the execution time of testing process with minimum effort and in budget friendly manner with unlimited storage, availability of scalable services and resources. Organizations adopting for cloud testing leverage the resources and services using cloud infrastructure to perform testing activities to overcome challenges in testing like limited budget, deadlines, test reuse, real time test environment, especially for performance testing.

1.1 Characteristics of Cloud

The key characteristics of cloud are:

- a) Cost Reduction
 - The conversion of capital expenditure to operational expenditure lowers the barrier to entry.
 - Cost savings typically depend on two things:
 - Range of activities supported.
 - the infrastructure that is available in-house
- b) Low Maintenance
 - A user does not need to install cloud computing applications on their computers. Due to this property, the maintenance of cloud computing applications is almost nil.

- c) Performance
 - Constant monitoring of performance of the applications is done.
 - Web services are used to create loosely coupled architectures.
- d) Productivity
 - Improving productivity allows multiple users to work on the same data simultaneously.
 - This also allows us to save time.
- e) Reliability
 - Use of multiple redundant sites improves reliability.
- f) Scalable and Elastic nature
 - Real time dynamic provisioning of the resources.
 - No need to engineer the peak loads.

NIST has defined five essential characteristics of cloud Computing [1]:

- On-demand self-service. A large amount of computing resources and services like server, network storages can be acquired without any human interaction from the cloud provider.
- Broad network access. Resources are available over the broad network and be acquired with help of heterogeneous client platforms such as mobiles, laptops
- Resource pooling. Computing resources and services are pooled to cater the need of diverse group of users by multi-tenant model. These services and resources can be customized according to customer needs.
- Rapid elasticity. Automatic support for up-provisioning and down-provision of computing resources on the basis of demand.
- Measured service. To provide transparency to consumer and vendor, the cloud has metering and billing systems in place which automatically monitor, control and report the usage of resources.

1.2 Service Models

1.2.1 Infrastructure as a Service

The customer adopting IaaS can leverage computing resources instead of actually purchasing them from the market. Cost of the infrastructures depends on the resources acquired and resources consumed. The infrastructures can be scaled up or down according to the demand. The IaaS primarily deals with automatic provisioning of storage, processor and network infrastructure from the cloud. It provides the access to the computing resources required by an organization. These resources also include VM (Virtual Machines), firewalls, IP addresses, VLANs (Virtual Local Area Networks), block storages, Load/Traffic balancers etc. Large pools of resources are installed in the data centers maintained by cloud provider and used by the user to run software such as operating systems and applications.

1.2.2 Platform as a Service

In PaaS, the cloud computing offers platforms such as execution environment for the programming language, web server and database, libraries, tools. While developing software, the problems that most of the developers face is the cost and complexity of purchasing, deploying and maintaining the underlying hardware/software layers. The PaaS removes this problem as the software engineers can make and run their software applications on a cloud platform. PaaS also offers applications like Microsoft Azure or Google App Engine which provide automatic up and down scaling of resources like memory and storage so that user does not have to allocate them manually.

1.2.3 Software as a Service

In SaaS, software application like databases, antivirus, word processing etc are provided to the consumer in cloud and that is why it is also called “on-demand software”. The applications are not freeware; these are priced using subscription fee on a pay-per-use basis. The cloud providers are responsible for pooling software over the cloud and the customer or any organization can obtain software according to their need from the cloud. As a result of which, the users are not required to install and run the application on their PCs, which definitely enhances support and maintenance. Cloud providers also manage the platforms on which these applications are executed. The computing tasks are distributed over multiple VMs to care static and dynamic demand. With the concept of multi-tenancy, SaaS fulfill the demand of multiple users simultaneously according to their customized demand.

1.3 Deployment Models

Private cloud: The cloud infrastructure and services are meant for a particular organization that comprises multiple consumers. In this re-evaluation of existing resources, tackling security issues and virtualizing the business environment is required.

Community cloud: It is set only for specific community of consumers and operated by one or more organizations or some of their combination. The scope of community clouds is limited to a particular community or organization.

Public cloud: General public can use it openly. It is free or paid model. We consider no difference between public and private cloud architecture technically. The access of cloud service providers like Amazon, AWS, Microsoft and Google is generally via Internet. “AWS Direct Connect” and “Azure Express Route” require customers to purchase or lease a private connection offered by cloud provider.

Hybrid cloud: Composed of two or more differentiable cloud infrastructures but are bound together by standardized and proprietary technology. According to Gartner, Inc. it allows one to extend capacity or the capability of a cloud service. It removes isolation and put private, public or community cloud service under one category.

1.4 Cloud Computing Architecture

Cloud computing architecture refers to the different components and their interaction with sub components that constitutes a complete cloud computing infrastructure. These components constitutes front-end platform that access the services of cloud, back-end platforms which mainly include high end servers, storage system, delivery platform, and a network.

Reference Architecture: It forms the basis for documentation of cloud computing infrastructure and complete environment including interaction with outside world. It includes top management point of view. The main activities defined in this architecture include payment contract issues, costing models, guidelines, communication, both vertical and horizontal [2].

Technical Architecture: This architecture addresses the technical issues like cloud components and their interaction with each other, APIs interfaces and clouds services. In addition, it addresses issues like security, privacy, standards and middleware etc. [2].

Deployment Operation Architecture: It is a business oriented architecture particularly meant to address core business areas in cloud computing. It basically defines export policies, legal matter, and marketing strategies. It also deals with operations, monitoring and controlling activities [2].

Table 1. Cloud Computing Architectural Approach [2]

Business Values and Goal	<ul style="list-style-type: none"> - Increases market shares - Quality Assurance and Control - High Return on Investment - Stockholder confidence and satisfaction
Architectural Strategy	<ul style="list-style-type: none"> - Low coupling and high cohesion - Multi tenancy - Caching - Pipelining and parallel processing - Modular and layered system - Strong encryption and cryptography - Reliable communication and messaging
Quality Factors	<ul style="list-style-type: none"> - Scalability - Elasticity - Performance - Efficiency, reliability - Inter operability and compatibility across different platforms - Adaptability - Usability - Security - Standard Compliance

2. CLOUD TESTING

Cloud Testing is an intersection area of software testing and cloud computing.

Testing a cloud generally means the verification and validation of applications; infrastructures and environment are available as per the requirements. The benefit of testing a cloud ensures that the applications, environment and infrastructure perform according to the expectation of the cloud computing business model. In order to test a cloud such that it should perform according to the requirements one should follow the below strategy which includes of certain steps and these steps helps in estimating the performance of the cloud. Following are the steps [3]:

- a) **Make assignment and collect test goal:**
The main goal of this step is to establish assignment by taking into account the steps of cloud from business

point of view. Its main aspects include the following factors:

- Risk
- Result
- Time
- Cost

By establishing the goals one should be able to determine what is required by from the business point of view. The output of these steps includes a test goal table and formulation of the assignment.

b) Determine the risk class:

This step is based on risk analysis. The main idea of this step is to establish what must be tested on which layer of the cloud and what must be examined. If there are multiple test levels, then the test level that determines all test levels is set up for this and this test plan is known as the master test plan. This step includes a table called cloud risk table which defines strategy for each combination of a characteristics of the intensity of testing in a specific test level.

c) Determine the test intensity:

In this step one should test whether the combination of characteristics and object part must be tested intensively, moderately or lightly. Risk class of each object part is used as initial point to determine the test intensively. The initial principle followed here is the more the risk in project, more effort for testing is required.

d) Estimating, planning and feedback:

This step is most crucial step as most of the budget for the test is involved in planning stage. This budget is confirmed based on the needs of the business. If needs are necessary then these are adjusted by following the step 3 and step 4 in a repeated manner. This gives the business direct control of the process and enables the business to manage it by balancing between result and risk. The output of this step is a strategy table.

e) Allocating test design techniques:

If the business seems to fulfill the budget and planning details then the test intensity is translated into concrete statements regarding the desired coverage. This procedure involves allocating test design techniques to the combination of the object part. This technique helps in making the test case in future.

The output of this step is test design table for each test level.

f) Provide control options:

The manager who manages the test process provides the control and the stakeholders certain control options for the IT governance. And its main function is to ensure:

Result: that test goals has achieved.

Risk: test has covered the risks.

Time: checks whether the last date or deadline is realized.

Cost: Whether the test project remains in agreed budget [3].

There are two different facets of cloud testing: i) Testing the cloud and ii) Testing using the Cloud

Testing the cloud ensures the quality of cloud itself including services and infrastructure. Testing using the cloud means performing testing activities using cloud infrastructure.

2.1 Testing the Cloud

The fundamental principle behind testing the cloud is testing the availability, reliability and efficiency of cloud. It validates the quality of cloud from external point of view which is evaluated on the basis of capabilities, various services and performance. The efficiency of services can be measured against factors like cost saving, energy and power efficiency, interface, computing and storage services. Before adopting for any cloud service organization, we must be fully convinced that the quality of service (QoS) that the cloud offers is up to the expectation. Testing the cloud assures that there is no performance degradation or delay in the service and there is timely delivery of services too. From testing the cloud perspective there are factors that need to be addressed for service reliability, service availability, up/downtime maximization of resource utilization like processing, storage and memory [4]. Virtualization is a key technology in cloud computing. Virtual servers need to be tested. "Test the cloud" must validate the cloud infrastructure at different level. At the storage level, testing must cover data center networks, data center connectivity storage/memory system, routers, switches, gateways, bridges for performance and efficiency [4]. At virtualization level, virtual host, virtual machine network (VPN), data rate transfer capacity without any disturbance up to the desired level must be tested. At security level firewalls, intrusion detection system, virtual private networks, gateways must be tested [4].

Different type of testing should be taken in consideration for the verification and validation of service, infrastructure, application and platform [5].

- Availability Testing: It involves testing both uptime and downtime of service, platform, and infrastructure.
- Security Testing: It involves checking the integrity of data. Proper testing procedures should be in place to test any unauthorized access of data.
- Performance Testing: The cloud services must be tested against the web traffic variations using Load and Stress testing.
- Interoperability Testing: A cloud service is meant to be used at any platform so service must have the capability to get executed in any platform
- Recovery Testing: In case of any fault occurrence or ultimate failure it must have the capacity to recover to its functional state.
- Scalability Testing: Test methods should be there to address demands of increasing and decreasing resources in cloud environment.
- Innovative Testing: To test the cloud services using diverse technologies, browsers, platforms and environments.

Testing the cloud infrastructure services: There are testing tools to monitor and manage storage system, routers, switches, data center network in cloud infrastructure. Web servers can also be tested simply by sending http requests. Tests can be constructed on the basis of downloading a URL to check the reliability, availability, throughput and downtime. Load balancers, firewall, VPN server can be tested by checking the performance of web services [6].

Testing the cloud application service: Web Based testing can be used to check web sites and portals. Simple tests can be used to check navigations, links, and validations in web based

systems. Availability, usability, response time, performance testing can be done to test applications [6].

Testing the cloud platform dimension: Platform services can be tested by checking the application hosted over platform provided by cloud. A website test for downloading a page can be used for testing the availability, reliability of a platform on which it is being hosted. API calls can be issued and used to perform integration and system testing of platform hosted over it [6].

Table 2. Cloud Areas and Testing Factor [6]

Areas	Testing Factors
Networking	Availability, Loss, Delay, Data rate
Virtualization	Data rate transfer, Authentication, Availability
Services	Availability, Response Time, Delivery Time
Infrastructure	Server Availability, Response Time, , Throughput Down/up Time
Platform	Availability, Reliability, Response Time, Download/Upload Time

2.2 Testing using the Cloud

Cloud based testing involves testing activities to be performed in cloud environment using cloud technologies. It reduces cost and investment for carrying testing activities including tools, training, infrastructures, human resources, software etc. Further cloud based testing can reduce development and training time which ultimately leads to financial benefits. It enables all the testing process and its allied activities through browsers, servers, testing environments and platforms. Various testing related activities that can be performed with the help of cloud based testing are test modeling, test simulation, testing management, on demand testing, testing quality of service (QoS). Cloud based testing provides some potential benefits like meeting deadlines, low cost per test, reduced budget etc. Due to unlimited storage, flexible, scalable testing environment in cloud based testing reduces capital expenditure and expected time of testing. TaaS can be used to test software applications in real time large scale test environments. An organization migrating their testing process and activities can concentrate and direct their effort in development leading to efficient design and code [2].

Software testing using cloud infrastructure require certain well defined series of steps [7]:

- Identification of functional and non functional requirements of application.
- Clear understanding and characteristics of application like peak usage hours , geographies, behavior pattern of user, latencies, maintenance schedule and up time and down time of application

- Chalk out test management, plan and strategies. It is based on the information gathered from the above steps. Quality assurance team prepares a customized test plan for testing process.
- Identification of test case, test suit and adequacy criteria for testing.
- Setting of test environment and prepare test data: The test data is migrated to cloud testing environment from legacy system.
- Automated testing tools over cloud generates test suit for testing the entire functional and non functional requirements.
- Execution of software testing on cloud and publish test oracles to find out the result of testing and finally the reports are generated with the issuance of quality assurance certificates.

2.2.1 Cloud based test services are [3]:

- Performance testing: It determines how client application or system performs under controlled circumstances and conditions. The main purpose of performance testing is to find out that application fulfils performance criteria under stated conditions.
- Load and stress testing: It determines the client application behavior under normal and peak conditions.
- Usability Testing: It determines whether the application meets its intended purpose and ease of use. It is evaluated on the basis of human system interaction.
- Security scanning: It identifies the potential security weaknesses in web applications. It reviews a web application with the intent of finding weaknesses, security loop holes vulnerable areas.
- Defect management: It includes identification and reporting of defects. After the identification of defects, they must be prioritized, scheduled and ultimately resolved. It involves the implementation of techniques, methods, standards and procedures to reduce the impact of defect.
- Products, test processes and plans to evaluate the quality and content. The main purpose of test reviewing is to find whether products meet standards and various successful criteria.
- Testing infrastructure management: It is the provisioning of test environments to cater the need of client according to its demand. It is the responsibility of test infrastructure management to utilize testing infrastructure optimally.

Table 2. Types of Testing in Cloud [8, 7]

Business Oriented Testing	Performance Testing	Compatibility Testing	Cloud Attribute Testing
Regression Testing	Load Testing	Cross Browser Testing	API Testing
Business Process Testing	Stress Testing	Backward and Forward Compatibility Testing	Multi Tenancy Testing
Business Strategy Validation Testing	Reliability Testing	International and Global Testing	Scalability Testing

Data Integration Testing	Efficiency Testing	Regional /Localization Testing	Metering and Billing Testing
Data Migration Testing	Availability Testing	Interoperability Testing	Upgrading and Update Testing

3. RELATED WORK

3.1 View point of Sergiy Vilkmor in a research paper “Cloud Testing: State of Art Review” [9]:

There are various commercially available tools, methods used for software testing using cloud. IBM has developed an “Integrated Development and test environment” for cloud. It includes various services like IBM testing service for cloud for performance and virtualization testing and IBM rational load scale performance testing. To use cloud infrastructure for software testing, IBM recommends following types of assessments:

- IBM defect analysis starter
- Server consolidation and virtualization assessment for charting out cloud testing strategies

SOASTA is organization whose headquarter is at California, has developed a solution for testing using cloud infrastructure known as ‘CloudTest’. CloudTest is used to perform stress, functional, load and performance testing for web based applications.

SOASTA’s product line includes:

- (a) CloudTest on-demand (testing as a resident in cloud)
- (b) CloudTest pro (web and mobile application)
- (c) Cloud test appliance
- (d) Global test cloud (cross cloud testing)

iTKO (Texas) provides support for validation and testing for virtual machines. Its product line includes:

- (a) LISA test (automated testing of cloud application)
- (b) LISA virtualizes (manages and validates virtualization)
- (c) LISA Development Cloud Manager

Load Impact (Sweden) provides stress, load and performance testing services over cloud. It provides the simulation of web traffic to a web application and can generate different types of test like ramp-up test, fixed test and time-out test.

3.2 View point of Jerry Gao , Xiaoying Bai and Wei-Tek Tsai in a research paper “Cloud Testing-Issues, Challenges, Needs and Practices” [10]:

Cloud based testing provides the ability to test software applications by leveraging the cloud. Cloud based testing provide cloud environment to simulate real world traffic for performing load and stress testing.

Cloud based software testing means carrying out testing activities using cloud infrastructure and environment.

It is a process of providing both static and dynamic testing services for third party. The primary goal of adopting this type of testing model is to reduce the budget on software development and focus on their core business by outsourcing the software testing process. Testing as a service over cloud provides some potential advantages over traditional software testing like scalable test environment, cost and budget reduction, time saving and on-demand testing. No doubt, cloud based testing offers enormous benefits but still there are some challenges and issues that need to be addressed. One primary challenge is to construct on demand test environment for testing based on application domain, secondly there is no available framework solution, metric for evaluating the reliability and performance level in cloud based testing. There is lack of test adequacy criteria, test models, tools, techniques specially designed for security testing in cloud based environment.

Testing the cloud:

Testing the cloud answers the quality of services deployed over the cloud which includes business processes. It validates and verify the features that one define in Service Level Agreement (SLA) provided by cloud vendor like security, scalability, performance, availability. Testing the cloud also includes checking and verifying different APIs of SaaS and cloud connectivity to others.

Challenges:

- 1) Lack of quality assurance standards and validation methods to test connectivity protocols, interfaces, APIs etc.
- 2) Lack of quality standards for security.

3.3 Viewpoint of Atif Farid Mohammad, Hamid Mcheick in research paper “Cloud Services Testing: An Understanding” [11]:

Cloud computing provide several services which can be used by several organizations according to their need on pay basis rather than developing them in house. These services must be thoroughly tested against some predefined policies. There are some major issues that need to be addressed for testing cloud services. There is no clear testing methodology to validate cloud services against security policy. Lack of exhaustive usability testing criterion further escalates the problem. A well defined adequacy criterion for testing a cloud service is needed. Adequate test inputs should be generated to achieve the adequate coverage. In cloud service testing, test Oracles are generated and on the basis of these Test Oracles, it is decided that test outcome is correct or incorrect.

Table 3. Cloud Testing Organizations [2, 10, 12]

Cloud Testing Key Organizations				
Name	Website	Testing service	Products	Test development
SOASTA	http://www.soasta.com/	Performance Testing Scalability Testing Reliability Testing	CloudTest On-Demand CloudTest Appliances	Test editing Test assembly with tools Web-based recording Capturing filtering and automated test execution

iTKO	http://www.itko.com/	Automatic UI Testing, On Demand Testing and Event-based Testing	LISA product suite: LISA Test LISA Pathfinder LISA Virtualize LISA Validate	Codeless test development Building Test cases and integrating them with existing repositories of test suit
PushtoTest	www.pushtotest.com	Web Based Testing, and SOA-based Testing	Test Maker	Unit Testing (Record and play back methods) Component oriented test framework
IBM	www.ibm.com	Performance Testing Virtualization Based Testing	IBM Rational Solutions	Virtual test servers
Load Impact	www.loadimpact.com	Website Testing, App Testing	Load Impact on Demand	Ramp up test Fixed test Time out test
Cloud Testing	www.cloudtesting.com	Script-based Testing developers, and website managers	Cross Browser Testing - Website Testing - Functional testing	Script-based test development - Web-based record/replay
Parasoft	www.parasoft.com	SOA Testing, Cloud Testing, Web Based Application Testing	Parasoft SOAtest	- Web-based record/replay
Blazemeter	www.blazemeter.com	Load Testing Performance Testing	Blazemeter	Create load Testing scripts, Real time monitoring

4. RESEARCH ISSUES IN CLOUD TESTING

Various research issues in cloud testing are [9, 10, 12]:

- a. To determine whether an application is suitable for online testing or not and to develop customized testing package for any customer according to his needs.
- b. Performing quality checks for software that has been tested in the cloud with unification and standardization of test process and activities on multiple vendors leading to test inter-operability.
- c. Developing testing solution for e-commerce, business processes using cloud computing and sourcing testing activities from large pool of testers across the globe to provide 24x7 availability.
- d. Development of efficient and effective strategies for migrating from traditional testing approach to cloud based testing.
- e. Availability of test data: Due to policies and regulation of organizations, the actual data is not provided to outside world. Testing is not feasible in absence of actual test data. Some algorithms and models should be developed which should generate identical test data to facilitate testing on cloud.
- f. Standardization of test policies, mechanisms, protocols for providing secured testing services to customers.
- g. Development of billing services for providing transparency to customer as well as cloud provider in terms of testing services.
- h. Development of infrastructure for cloud based technologies including good testing environment, bill generation, and contract management engines.
- i. Test management, migration, election, scheduling, execution, generation of reports by on demand test engine.

- j. Testing program behavior and performance by test tracking engine including set of tools needed which are managed by tool manager.

5. CHALLENGES IN CLOUD COMPUTING AND BENEFITS.

Various changes encountered while migrating to cloud testing are [7, 10, 13]:

- a. Date security and privacy challenge: In order to secure the sensitive data, cryptography and encryption techniques are required.
- b. Service challenge: It means continuous efforts are required ensuring the availability, efficiency and service assurance in cloud testing.
- c. Lack of standards and procedures in cloud testing: A well defined and universal set of standards are required to perform testing using cloud infrastructure.
- d. Infrastructure challenge: Limited technology and storage infrastructure raises concerns in cloud testing, especially at network and virtualization level.
- e. Frequent upgrade and new releases: Automatic tools and strategies should be placed in service for validating the impact of these upgrades. An automated test library should be created to minimize the testing efforts that are required for each upgrade and new release.
- f. Guidance and business knowledge for efficient and effective testing: In depth and comprehensive knowledge of components of cloud should be acquired.
- g. Privileges and access control: A well defined test plan and strategies should be derived to perform access control and multi privilege validation and verification.
- h. Data migration and integration from existing system. Data transfer from existing system to cloud environment must be tested and properly validated.
- i. Addition of new features and functionalities to meet the market and stakeholder demand. Impact of any change in functionality or feature in cloud must be properly analyzed to minimize an adverse effect on system. Automated tools must be used to execute tests to cover functional and non-functional requirements.

- j. Validation of APIs, protocols and interface connectivity in cloud testing.
- k. Planning of test infrastructure, tools, strategies and test environment to perform cloud testing with maximum utilization of resources.

Following are the benefits of cloud testing:

- a. Efficient and real time testing of web based applications by using on demand testing on cloud.
- b. Efficient use of resources (hardware and software): with cloud testing, organizations can concentrate on core business areas and competency without self testing environment.
- c. Reduction in budget by leveraging cloud services for testing which eliminates the extra cost associated with in house testing.
- d. Better controllability, capability and monitoring of testing resources with elastic nature of cloud.
- e. Reduction of additional staffing cost, development time, and effort with improved product quality.
- f. With on-demand scalable and elastic nature of cloud, the testing resource like test environment, test suites can be provisioned instantly.
- g. Cloud computing promoted green computing with reduction of carbon footprints.

6. SUMMARY

In recent years, the word Cloud testing has gained tremendous attention and hype. Continuous efforts are being made by researcher, industry, academia and various governmental and non government agencies to realize the power of cloud testing. Cloud testing can provide enormous benefit to organizations by saving development cost, effort and time. As a result, organizations can better focus their recourses and energy in core business areas. Present paper has highlighted the core issues, technologies, challenges that are encountered in cloud testing. It has also provided information about various tools and organizations and their testing solutions in cloud testing. As the cloud testing is still in infancy stage, lot of work needs to be done in this direction. Various challenges and issues associated with cloud testing discussed in the present paper can be instrumental in carrying out future research actives in this direction.

Cloud testing is the next wave of information technology not only for individuals but also for private companies and government organizations. It reduces software testing costs as well as it is a base for radical business innovation and new business models. Cloud testing also includes various potential risks. Cloud testing procedures involve test environment, test infrastructure, test process and tools. Many users and government organizations are having doubts about the current use and future path of cloud testing.

Some of them are:

1. What are the potential future benefits of cloud testing?
2. What might hinder cloud testing process?
3. What are the overall benefits of cloud testing in spite of the risks?

Cloud testing has the potential to test new solutions which are technically and economically feasible but were not possible or very costly earlier without the help of cloud like simulation of web traffic and real user. It is predicted that cloud testing will go off in various directions. In upcoming years, pervasive cloud testing services will be the standard for quality assurance and testing. More compatible standards will be available in the upcoming years no matter which cloud provider you leverage.

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