Chapter VII

Review of Literature on Adaptive (Dynamic, Run Time) Automated Software Applications with Cloud and Networked Storage.

# Keywords

Cloud Computing, Cloud Services, Cloud Network, Cloud Database, Cloud Management, Storage Devices, Data Storage, Adaptive Automation, Adaptive Automation, Real Time Systems, Run Time, Dynamic,

# Introduction

Before Cloud, There was a boom on Database applications. But Cloud not only grows rapidly but also developed with variety of applications and services like Platform, Services and Products.

In this chapter, a review of literature is discussed in order to provide a theoretical background and to develop an understanding of the significance and role of Adaptive Automation of Software Applications in cloud,

The focus should be confidentiality integrity and availability of data in cloud. This study aims at presenting a broad introduction to cloud computing, Applications Development and Automated Testing challenges and opportunities in cloud.

It also tracks the background of cloud computing by surveying the main technological spreads that significantly contributed to the advent of this evolving technology, with the objective of clarifying the misperception over the “innovative or evolutionary” cloud computing technology. In addition, this chapter presents review of the research work.

Cloud services deployment models and related topics are dominating the IT landscape.

Many organizations actively addressing these deployment models and has developed an approach to enable to leverage them in a consistent manner to meet business needs.

Before delving into the cloud services deployment models and their security considerations a

Distinction must be made between cloud services offered by Cloud service providers and those offered by third parties.

Web-based network management revolving about database puts forward a feasible mode for network information processing and has the characteristics of wide distribution, full interactivity, real-time dynamic and so on in the application; and is beneficial to timely adjustment for network performance and rapid recovery for fault.

For this purpose cloud management system plays important role. Cloud Computing is a general term used to describe a network based computing over the Internet. Cloud Computing is basically a step up from Utility Computing and much more includes collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform), Using the Internet for communication and transport provides hardware, software and networking services to clients. These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface). The cloud is used as a storage location can be accessed and computed from anywhere. The large number of web application makes the use of distributed storage solution in order to scale up.

There are some important literature and views on Cloud computing from different authors and researchers:

National Institute of Standards and Technology (NIST) defines the Cloud as follows:

“Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.”

Most of the organization uses the definition provided by NIST (National Institute of Standards and Technology) which can be found here: <http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf>

Elbaum et.al reported that in regression testing feedback may play positive or negative role in test case prioritization. Do et.al presented an empirical study on assessing the ability of prioritization techniques to improve the rate of fault detection of test case prioritization techniques, measured relative to mutation faults in. The major difference between this work and other test case prioritization techniques is the prioritization is carried out on-the-fly as testing proceeds, which means testing history information is collected and used for future decision making. Other related studies include defect removal and its impact on software testing. Okamura proposed a new reliability estimation method that considers defect removal. This study presents a rigorous model for the defect removal process and its impact to the software under test, and developed the according methodology for testing and parameter estimation.

# Cloud Computing (why, what, who, services)

There are few questions those need to be answered if cloud computing is been used for Dynamic Run Time Adaptive Automation and Data Access/Storage.

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What is definition of "cloud computing"?** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | As per definition provided by NIST (National Institute of Standards and Technology) which is summarized as follows: Cloud computing model is for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be provisioned/released with minimal effort or service provider interaction.  The full definition and explanation can be found in [this](http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf) public NIST document. Additionally, NIST has published a final version of cloud computing technology roadmap. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | | | |  | | | | |  | | | | |  | | | | |  | | | | |  | | | | |  | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |  |  |  |  |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | |  | | | | |  | | | | |  | | | | |  | | | | |  | | | | |  | | | | |  | | | | | | [**Question**](javascript:) **: 2. What are the different types of clouds? What makes them distinct? ‎** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | There are four kinds of cloud deployment models: private clouds, community clouds, public clouds, and hybrid clouds.  A private cloud infrastructure is provisioned for exclusive use of organizations. It’s owned, managed, and operated by organizations, by third parties, or combination of them. It may exist on or off organizations premises.   A community cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises. A public cloud infrastructure is open to use by the general public. A public cloud may be owned, managed, and operated by a business, academic organization, or government organization (or some combination of the three). The infrastructure for this type of cloud exists on the premises of the cloud provider.  A hybrid cloud is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology which enables data and application portability (e.g., cloud bursting for load balancing between clouds). | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | **Question: 3. I keep encountering terms like “Software as a Service” or “Platform as a Service”. What is a "Service"? ‎** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | http://social.mastercard.com/_layouts/images/blank.gif | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | ​A service is something that provides “value” to the organization’s lines of business. There are mainly three basic service models: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Another service model (that is not officially defined by the National Institute of Standard and Technology) is Database as a Service (DaaS). | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | **Question: 4. What are the different service models?** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | http://social.mastercard.com/_layouts/images/blank.gif | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | ​Software as a Service, or SaaS, is the delivery of applications that are developed and hosted by the SaaS vendor. The end user accesses the applications over the Internet.  Unlike traditional packaged applications the SaaS vendor owns the software and runs it on computers in its data centre. The customer does not own the software but can rents it, usually for a scheduled time fee.   Platform as a Service, or PaaS, is a model in which the user creates an application or service using tools and/or libraries from a provider. The provider provides the networks, servers, storage, operating systems, and other services that are required to host the consumer’s application or service.  Although less established and not as widely available as compared to SaaS and IaaS offerings, ready-to-use application platforms offer great promise for organizations that aren’t compelled to own and manage the underlying infrastructure. A well-known platform that uses the PaaS model is Google App Engine.    Infrastructure as a Service, or IaaS, is the virtualized processing, storage, and networking services along with automation and management capabilities in this area offer the most flexible level of services in the cloud computing model.  A well-known platform that uses the IaaS model is Amazon Elastic Compute Cloud.  Database as a Service, or DaaS, is a cousin of SaaS. It is a physical data management strategy for managing an on-site private cloud made up of several different database architectures.  These architectures are capable of providing varying degrees of database service to an application based on business requirement’s related to availability, scalability and performance.  The main objective of the DaaS strategy is to provide a high quality database service while maximizing ROI on database software/hardware and supporting agile development efforts through faster service delivery. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | **Question: 5. Who are the major public cloud service providers?**  Cloud computing assists in realizing the aspiration of facilitating commerce across all devices and all geographies.  Organizations currently use a number of SaaS offerings including human resources (Work Day), Organization University (Cornerstone), sales/account management (SaleForce.com) and website acceleration (Akamai).Organizations have invested heavily in technologies that are required for cloud computing such as virtualization and automation. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

# Importance of proposed Investigation

The problems in building systems that must exhibit robustness to a changing environment; embedding significant COTS/Community Sourced independently evolving components; problems building systems that involve user scripting and ‘plug-ability’.

In proposed design the researcher will study to evaluate and estimation of the run time dynamic network characteristics and behavioural changes occurred due to applications fine tuning its network resources on server platform due to various reasons.

Here the importance is make and work the system using one interface application adaptive to environment so that the estimation matrix database from testing environment can be exported to the automated testing tool work on adaptive methodology and adaptive approach and same can be applied to change test strategies to finalize inputs of the network component under test (network node, NIC, HBA, etc..) With respect to the run time characteristics obtained thorough feedback mechanism.

There are various plugs and play hardware devices i.e. USB devices. Same way there should be plug and play software systems and it is possible only if software is designed on adaptive patterns. The current proposed investigation will try to find out how the adaptive patterns be implemented in automated software systems. In short, problems building the sort of systems we are called on to construct all the time.

We need to develop engineering models and methods for assembling software systems that can dynamically adapt to context and can ‘account for themselves’. Here the Software development is no longer garage ‘design and make’. Most software products and services are embedded in a network of complex inter-product and inter-supplier dependencies. Software is the result of the operation of a 'supply chain' that must be designed and forms part of an 'ecosystem' that must be accommodated. Rethinking software production requires a new discipline of business model and software system co-design.

Therefore Importance of adaptive system varies on the basis of application and environment and it will come with design algorithm and methodologies and code base libraries of adaptive nature intelligent enough to understand their execution environment and input from the user so that program simulate itself as per the nature of (storage networking) protocol, High Performance Networking Systems and can give adequate result/throughput for high performance storage and control systems.

## Following problem sources put force on importance of proposed investigation

* Improper Analysis: happens mostly due to miss-communication between end-users and system analysts.
* Inconsistent System Requirements Specification of automated applications.
* Incomplete or Obsolete or Ambiguous Design of automated Systems.
* Incomplete, Inconsistent Automated Test Plan.
* Improper Feature, Load Tests.
* Continuously changing run time dynamic networking environment.

# Scope of the proposed study/research

Due to complexities in modern high performance computing and high performance storage networking systems because of using multi-layered protocol for data transfer on high speed (e.g. Fiber Optics, Ethernet) medium, becoming more complex over the years. As a result there has been as need for automation of functions to cope with this increased complexity. Although several recommendations have been made to develop some sort of automation frameworks and thereby using of various programming techniques for developing automated programs those can be used across platforms.

These techniques has started in use with some new human factors issues and concerns, for example, the ability to intervene effectively when an automated subsystem fails is one of the key issues in automated control systems. Other difficulties that operators of automated systems may face include loss of system awareness and manual skills degradation. These kinds of problems may be characteristic of complex systems in which automation is implemented in a fixed or "static" manner.

In contrast, systems in which automated aids are implemented dynamically, in response to changing task demands on the operator, may be less vulnerable to such problems. It has been proposed that systems with adaptive automation are superior to conventional automation because they provide for regulation of user workload and vigilance, maintenance of skill levels, and task involvement.

Adaptive automation has been proposed as a means for further increasing the number and flexibility of levels of automation in the high performance networked systems. One outcome of this concept is that the adaptive system could select its own level of automation, depending upon the operating environment and system performance. The feasibility of this approach and its impact on operator and system performance is poorly understood. At present, the only consensus in the design of adaptive automation systems seems to be that the philosophy of the user's role in the system will be critical.

Typically, it is argued that the user must interact with the automation as a control system, and as such provides consent to the level of automation assumed by the system. For adaptive automation to work, the system must utilize an accurate operator-state classifier for the real-time assessment. Operator state classifiers, such as discriminate analysis and artificial neural networks.

How an accuracy of 70% to 85% in real-time? An important part to properly implementing adaptive automation is figuring out how big a workload needs to be to require intervention. There has been various effect/essence of Adaptive Automated Testing Tools and Test Strategies in run time dynamic network testing environment. This proposed investigation does critical Study and performance/usability statistics of various Implementations of automated (open source) software testing tool used in high performance different/networking environment/technologies. Further study tries to understand the applications and design of open source automation frameworks and their selection criteria in Technical Organizations to design automated software testing and Adaptive Automated Test Strategies

In proposed design and study, there will be an evaluation and estimation of the network characteristics and behavioural changes occurred due to applications fine tuning its network resources on server platform. To make the system adaptive to environment the estimation matrix database will be exported to the testing tool and adaptive approach will be applied to change test strategies to finalize matrix database of the network component under test (network node, NIC, HBA, etc..) With respect to the run time characteristics obtained thorough feedback mechanism.

The peripheral situations affect the performance of systems; therefore, though one-shot human-cantered automation (HCA) designs might provide better results than the systems designed based on the "automate it as possible" philosophy.

## Following Points are kept in mind while studying

* Scalability: Devise a software and hardware architecture that scales up by some factor. That is, an application's storage and processing capacity can automatically grow by a factor of a million, doing jobs faster just by adding more resources.
* The Turing Test: Build a computer system processing task in less time.
* Trouble-Free Systems: Build system used by people each day and yet administered and managed by a single part-time person.
* Secure System: Assure that adaptive automated algorithm automate the system in a way that only services authorized users, service cannot be denied by unauthorized users, and information cannot be stolen
* Always Up: Assure that the system is always available. Automatic Programmer: Devise a specification language or user interface that
* Makes it easy for people to express designs (1,000x easier),
* Computers can compile/Interpret, and can describe all applications
* The system should reason about application, asking questions about exception cases and incomplete specification. But it should not be onerous to use.
* Formalizing Common Sense for minimum input consideration
* Machine Readable Specification and design
* Automatic Code Verification: i.e. Profiling Tools
* Automatic Feature and Load Testing
* Automatic Action Tracking: i.e. Switching Throughput
* Automatic Problem discovery and Recovery

# Review of work (Literature) already done on the subject

In our research work, it is proposed to discuss how an adaptive algorithm can simulate itself according to system environment and its parameters. Now As per review of literature, researcher needs to see how much work already done in this area.

Covering Following areas for Literature review:

* Neuro-ergonomics, computerized adaptive test and Level of Automation
* Dynamic (Run Time) Storage Allocation
* Automated System Testing
* Automation Tools for Software Systems Testing
* Adaptive Patterns/Algorithms for Development and Testing
* High Performance Cloud and Storage Network

## Neuro-ergonomics, computerized adaptive test and Level of Automation

As **Huey-Min Wu, Bor-Chen Kuo and Jinn-Min Yang** submitted research paper on Evaluating Knowledge Structure-based Adaptive Testing Algorithms. They developed a theoretical mathematical model called computerized adaptive test (CAT) for the students. Hence adaptive algorithm based on knowledge structure and called it, knowledge-structure-based adaptive testing (KSAT) algorithms. As per their findings the following are several major interfaces of system. The user management interface in is multi-functional. It allows new users to have access to creating new user accounts, creating multiple new user accounts, importing accounts from other sources such as Excel, and giving access to the database. The test administration interface displays the items and allows the examinees to answer the items presented. Since the KSAT system is an adaptive test, only one item per screen is presented.

The group profile interface in displays the group result of the exam. For example, in some concept of the interface, x students passed and y students failed test. Instructors can then take this information and understand the distribution of students’ knowledge states and identify the strengths and weaknesses within a group. This information can be utilized for remedial instruction. Upon completion of the test, the student receives a personalized profile including name, scores, percentile, utilization of test items, date taken, and so forth.

There are several strategies by which adaptive automation can be implemented **(Morrison & Gluckman, 1994; Rouse & Rouse, 1983).**

One set of strategies addresses system functionality. For instance, entire tasks can be allocated to either the system or the operator, or a specific task can be partitioned so that the system and operator each share responsibility for unique portions of the task. Alternatively, a task could be transformed to a different format to make it easier (or more challenging) for the operator to perform.

A second set of strategies concerns the triggering mechanism for shifting among modes or levels of automation **(Parasuraman et al., 1992; Scerbo, Freeman, & Mikulka, 2003).** One approach relies on goal-based strategies. Specifically, changes among modes or levels of automation are triggered by a set of criteria or external events. Thus, the system might invoke the automatic mode only during specific tasks or when if it detects an emergency situation. Another approach would be to use real-time measures of operator performance to invoke the changes in automation.

A third approach uses models of operator performance or workload to drive the adaptive logic **(Hancock & Chignell, 1987; Rouse, Geddes & Curry, 1987, 1988).** For example, a system could estimate current and future states of an operator’s activities, intentions, resources, and performance. Information about the operator, the system, and the outside world could then be interpreted with respect to the operator’s goals and current actions to determine the need for adaptive aiding. Finally, psycho-physiological measures that reflect operator workload can also be used to trigger changes among modes.

**Billings (1991)** instead focuses his attention on automation at work: how automation may correctly perform some activities or parts of them, how automation may interact with humans or support them in their tasks.

Billing (ibidem) defines LoA in functional terms: a level of automation corresponds to the set of function that an operator can autonomously control in a standard situation united to system ability at providing answer and solutions, at acting properly according to the proposed solution, and to check the results of its actions.

Tightly coupled with Billings’s definition are Rouse’s observations (1988): the adaptive automation provides variable levels of support to human control activities in complex systems, according to the situation. Moreover, the situation is defined by the task features and by the psychophysical status of human operator. As a consequence, the human machine interaction should depend on what has to be automated, and on how and when.

There are several studies reviewing empirical researches about AA **(Parasuraman, 1993), (Hilburn et al., 1993), (Scallen et al., 1995), (Parasuraman et al., 1996), (Kaber, 1997), (Kaber & Riley, 1999)** that focused on the performance effects of Dynamic Function Allocation (DFA) in complex systems, specifically monitoring and psychomotor functions. These studies brought into evidence that AA significantly improves monitoring and tracking task performance in multiple task scenarios, as compared to static automation and strictly manual control conditions.

A further development for AA systems is the Neuroergonomics approach, which uses psychophysiological measures to trigger changes in the state of automation. Studies have shown that this approach can facilitate operator performance **(Scerbo, 1996).**Less work has been conducted to establish the impact of AA on cognitive function performance (e.g. Decision-making) or to make comparisons of human-machine system performance when AA is applied to various information processing functions **(Kaber et al., 2002)**.

**Scerbo (1996)**specifies that the AA can start different types of automation, in relation with the context (system and operator).An integration to this conclusion is provided by Kaber and Riley (1999), which defined adaptive automation as a programming or a pre-definition of the control assignment between human and system, in order to improve the human performance.

Human performance is in fact a crucial aspect of the functioning of complex system. As a consequence, the human operator should be involved in the control task, in order to avoid the out-of-the-loop performance.

As stated by **Norman (1989)**, without appropriate feedback people are indeed out-of-the-loop; they may not know if their requests have been received, if the actions are being performed properly, or if problems are occurring. Sharing the functions control is not only a matter of quantitative task to accomplish, but it involves the responsibility of the whole operation execution.

The dynamic function allocation (DFA) is a peculiar aspect of AA **(Kaber et al, 2001)**. It basically consists of assigning the authority on specific functions to either the human operator or the automated system, depending on the overall context (i.e. operator’s state and outer conditions) and on a defined set of criteria. DFA should therefore be designed by taking into account both the human and the system status, and considering the means for allowing context recognition.

Focusing on the participation and the autonomy that humans and machines may have in each task to be performed there is some debate. Some researches face the crucial issue of the authority that each part should have in controlling the system. Historically, humans played Human-Computer Interaction, New Developments the role of the supervisory control i.e. the machine decides about the actions and the humans evaluate these decisions; depending on this assessment, control on the actions is either regained by human operators or provided **(Sheridan, 1992)**.In this effort a crucial role is played by the human skills and abilities and by the systems natural limits **(Parasuramanet al., 2000)**.

There is a clear difference between the AA approach and the Level of Automation **(Kaber &Endsley, ibidem)**.

By contrast with the traditional view of automation that is shortly a fixed and highly regulated process designed to eliminate human interaction, AA is designed to expect and anticipate changes under active control of a developer while maintaining precise control of all background variables not currently of interest **(Kay, 2006)**.

AA is based on the dynamic allocation of the control of the whole task or of some parts, crossing along time manual and automated phases. The Levels of automation instead allow only a static function assignment, because the task level of automation is established in the design phase **(Kaber & Endsley, ibidem)**.

AA allows users to experiment with variables seen as key parameters in a system while preventing undesired secondary effects that could unexpectedly arise from variations in parameters not under study, which in manual systems might not be precisely controlled. The Adaptive Automation Design Consideration. From this point of view it is possible to state that Work systems perform functions or units of work. Roles, instead, are more difficult to define. They make sense to consider it as an activity that can be performed either by human or machine **(Harrison, Johnson, Wright, 2001)**.

The York Method (developed at the Department of Computer Science, University of York): provides theoretical instruments to define functions, rules and scenarios, and then represents them by some specific grids. The aim is to decide which functions are suitable to which rules, considering different scenarios **(Calefato, Montanari, and Tango 2007)**.

“A function may be separable from all roles, and technically feasible and cost effective to automate, in which case the function may be totally automated.

Alternatively it is possible that the function maps entirely to one of the roles, and is infeasible to automate, in which case the function is totally performed within that role. In most cases however functions fit into neither category.

In this situation the function is to be partially automated” **(Harrison, Johnson, Wright, 2001)**. Functions and roles have to be set into one or more scenarios.

In taking into account the driving scenario, it has to be measured the driver’s competences in tasks critical to performance and safety. These concept can be clarified by an example belonging to the automotive domain. We can hypnotize to have to design a preventive safety system. In order to design the application, the driving scenario and its corresponding manoeuvres have been broken down into functions and sub-functions in order to outline which functions have to be performed manually, automatically or both.

Secondly, system and driver’s roles have been combined with functions in order to outline which functions suite best to which roles, considering the given scenarios. The scenarios have been selected in order to measure the driver workload and situation awareness. Consequentially the selected scenario shows the whole behaviour of the system, along the seven LoA implemented **(Calefato, Montanari, and Tango 2007)**.

**Recently, Mozer (2004)** described his experiences living in an adaptive home of his own creation. The home was designed to regulate air and water temperature and lighting. The automation monitors the inhabitant’s activities and makes inferences about the inhabitant’s behaviour, predicts future needs, and adjusts the temperature or lighting accordingly. When the automation fails to meet the user’s expectations, the user can set the controls manually.

The heart of the adaptive home is the adaptive control of home environment (ACHE) and functions to balance two goals:

1) User desires and

2) Energy conservation.

Because these two goals can conflict with one another, the system uses a reinforcement learning algorithm to establish an optimal control policy. With respect to lighting, the ACHE controls multiple, independent light fixtures, each with multiple levels of intensity. The ACHE encompasses a learning controller that selects light settings based on current states. The controller receives information about an event change that is moderated by a cost evaluator. A state estimator generates high-level information about inhabitant patterns and integrates it with output from an occupancy model as well as information regarding levels of natural light available to make decisions about changes in the control settings. The state estimator also receives input from an anticipator module that uses neural nets to predict which zones are likely to be inhabited within the next two seconds. Thus, if the inhabitant is moving within the home, the ACHE can anticipate the route and adjust the lights before he arrives at his destination. **Mozer (2004)** recorded the energy costs and as well as costs of discomfort (i.e., incorrect predictions and control settings) for a month and found that both decreased and converged within about 24 days.

**Mozer (2004)** had some intriguing observations about his experiences living in the adaptive house. First, he found that he generated a mental model of the ACHE’s model of his activities. Thus, he knew that if he were to work late at the office, the “house” would be expecting him home at the usual time and he often felt compelled to return home! Further, he admitted that he made a conscious effort to be more consistent in his activities. He developed a meta-awareness of his occupancy patterns and recognized that as he made his behaviour more regular, it facilitated the operation of the ACHE, which in turn, helped it to save energy and maximize his comfort. In fact, Mozer claimed, “the ACHE trains the inhabitant, just as the inhabitant trains the ACHE”. **Mozer (2004)** also discovered the value of communication. At one point, he noticed a bug in the hardware and modified the system to broadcast a warning message throughout the house to reset the system. After the hardware problem had been addressed, however, he retained the warning message because it provided useful information about how his time was being spent. He argued that there were other situations where the user could benefit from being told about consequences of manual overrides.

**The “horse-rider paradigm** “is introduced at first time in 1990 by Connell and Viola, then it was developed by **Flemish et al (2003)**, that named it “H-metaphor” and faced also by **Norman (2007)**.

The “Horse-Rider paradigm” explains the relation between human and automation like the relation that a rider establishes with his/her horse: the human receives information about the actual system status through an osmotic exchange with it. Human intention and actions become the parameters the system uses to offer him the correct solution or answer to the faced context.

In this way it is possible to improve the human performance that represents the crucial hearth of the interaction in complex systems. Besides the operator is maintained in loop during the system control, in order to avoid or reduce the out-of-the-loop performance.

## Dynamic (Run Time) Storage Virtualization

## Automated System Testing

Lazic Ljubomir has examined that Organizations are constantly working to leverage today’s best practices for testing within the context of their existing IT environments. As IT works to balance the business needs for a certain application and the testing limitations with regards to resources and schedules, making the best use of the testing environment becomes critical. Optimized testing is a way for organizations to move their testing efforts forward to reflect changing business environments and resource constraints.

Palanisamy V has analysed that select test cases to maximize the proportion of program elements of a given type (e.g. statements, branches, conditions, and loop) that are covered (executed). The coverage based technique makes use of greedy algorithm in order to prioritization out the repeatedly executing test cases. So, by prioritization with the number of executing test cases the overall quality of the testing process can be improved.

Alqrainy Shihadeh has analyzed that our utmost effort should be in identifying a comprehensive list of software risk factors that covers wider range of threats through the SDLC. This list can serve as a checklist that can guide project team in identifying probable risk factors and help them in designing strategies to (mitigate/avoid) them

## High Performance Cloud and Storage Network

# Research gaps identified in the proposed field of investigation

Researcher has seen that As Huey-Min Wu, Bor-Chen Kuo and Jinn-Min Yang submitted research paper on “Evaluating Knowledge Structure-based Adaptive Testing Algorithms”. In this automated adaptive tool have interface and as per the login to user that tool was easily distribute questionnaires to take the exams and even was able to display results, but the scope was limited to evaluation and it was not to adapt the nature of run time environment.

Morrison & Gluckman, 1994; Rouse & Rouse, 1983 discussed about different strategies, mainly interaction between operator and machine, where machine could estimate different states of an operator’s activities, intentions, resources, and performance. Therefore same Information about the operator, the system, and the outside world could then be interpreted with respect to the goals and actions to determine the need for adaptive aiding, hence machine learning is proposed with regard to operator activities not as per dynamic environment. Kaber et al, 2001, told that the dynamic function allocation (DFA) is a peculiar aspect of AA. It basically consists of assigning the authority on specific functions to either the human operator or the automated system.

The York Method (developed at the Department of Computer Science, University of York) tell about the design consideration and desire of control to automate.

The “Horse-Rider paradigm” explains the relation between human and automation like the relation that a rider establishes with his/her horse.

As per all above findings , they were able to success in their design criteria but no algorithmic solution was provided to select criteria for automated tools as per the adaptive nature of environment and no study was done to design algorithm adaptive as environment changes and their implementation criteria in run time dynamic environment.

The researcher observed that there in all previous studies, no implementations and design done towards applications verifying networking cloud/environment and component under test (network node, NIC, HBA, etc...) With respect to the run time characteristics obtained thorough feedback mechanism.

It is clear there are different approaches to develop adaptive algorithms, especially in the area of avionics, Neuro-ergonomics, Educations, robotics and missile/space and communications technology but nobody have considered enough to implementation in testing of high performance storage networking and control systems and even no appropriate automated tool being developed on the basis of adaptive philosophical theory to work and test the technological and networking systems and high performance control systems.

# Research Methodology

## Automation Tools for Software Systems Testing

### Selenium WebDriver

Selenium is an open source library with bindings in multiple languages (Java, C#, Python, etc.) that allows an engineer to write code that is then translated into human-like interactions with various browsers and mobile devices.   At its core Selenium spins up a lightweight server on a machine that sends commands in the JSON format to a browser or device.  These JSON commands typically include information such as the action to be performed (click, enter text, submit form, etc.) as well as information about how to identify the element for the action to be performed on.

These pieces of identifying information are based on the Document Object Model (DOM) or a web page or app and, for all intents and purposes, can be thought of as the HTML of a page.

### Selenium

It is test automation framework for Web applications. Selenium is an automation framework of choice for Web automation engineers, particularly for those who possess advanced programming and scripting skills. Selenium become a core framework for other open-source automation tools such as Katalon Studio, Watir, Protractor, and Robot Framework. Selenium supports multiple operating systems (Windows, Mac, and Linux) and multiple browsers (Chrome, Firefox, IE, and Headless browsers). And it can be programmed with scripts can be written in various programming languages such as Java, Groovy, Python, C#, PHP, Ruby, and Perl. Engineers have flexibility with Selenium, can write complex and advanced test scripts to meet various levels of complexity, it requires advanced programming skills and effort to build automation frameworks and libraries for specific testing needs.

It is the most popular automation testing tool for web applications. Selenium can be run in multiple browsers and operating systems**.** It is compatible with other automation testing frameworks.

With selenium, a browser-centered automation test scripts can be created which are scalable across different environments. Scripts can be created using Selenium that is of great help for prompt reproduction of bugs, regression testing, and exploratory testing.

### Robot framework

Robot Framework implements the keyword-driven approach for acceptance testing & acceptance test-driven development (ATDD). Test capability can be extended by implementing additional test libraries using Python and Java. Selenium WebDriver is an external library in Robot Framework. Test engineers can leverage Robot Framework as an automation framework for web testing as well as for Android and iOS test automation. Robot Framework can be easy to learn for engineers who are familiar with keyword-driven testing.

### [JBehave](http://jbehave.org/)

JBehave is an open source BDD (Behaviour Driven Development) library that allows users to write their test cases in plain English and have them automatically translated into chunks of Java code to be executed.

JBehave allows someone like a product owner or scrum master to write test cases, hand them off to automation engineers and have those engineers write the automation scripts.

JBehave also creates easily digestible and human readable reports after execution, including information such as what test cases were run, how many test cases passed/failed and provides screenshots for any failed test cases.

Everything in JBehave is customizable and flexible, giving each team the power to define their own test runs and even create custom reports.

### [RestAssured](http://rest-assured.io/)

RestAssured is an open source framework that allows for easy and flexible testing of API based applications.

### [Docker](https://www.docker.com/)

Docker is an open source tool that allows users to "containerize" applications and environments.

Using a simple Docker image and 1-2 commands a user can instantly deploy an environment on their local machine with a set of predefined conditions such as installed browsers with specific versions, specific applications installed or preconfigured network settings.

### [TestNG](http://testng.org/doc/)

TestNG is a lightweight testing framework in between JUnit and JBehave/Cucumber.  TestNG is ideal for teams that don't want to deal with the overhead of configuring BDD frameworks or are writing tests (such as API level) that do not lend themselves to BDD concepts such as stories or features.

### Cucumber

Cucumber is another commonly used BDD library.  It is very similar to JBehave but will be more familiar to those coming from a non-Java coding background.

It is designed over the concept of BDD (Behaviour-driven development). It performs the automated acceptance testing by running the stories that best describe the behaviour of the application. It gets a single up-to-date living document that is having both specification and test documentation.

Cucumber is scripted in Ruby. It also supports Java and.NET. It also has cross-platform OS support.

### Apache JMeter

It is Java desktop application designed for load testing. It mainly focuses on web applications. This tool can be used for unit testing and limited functional testing.

Its architecture is centered on plugins with the help of which JMeter provides a lot of out of box features. It supports many types of applications, servers and protocols like Web, SOAP, FTP, TCP, LDAP, SOAP, MOM, Mail Protocols, shell scripts, Java objects, and database. It also include Test IDE, dynamic reporting, command line mode, portability, multithreading, caching of test results and highly extensible core. It supports many types of applications, servers and protocols like Web, SOAP, FTP, TCP, LDAP, SOAP, MOM, Mail Protocols, shell scripts, Java objects, and database.

### Appium

This Test automation framework is intended for mobile applications, and automation of native, hybrid and mobile web applications built for iOS and Android. This tooluses vendor-provided automation frameworks and is based on client/server architecture. Appium is easy to install and use.

### Robotium

It is an open-source test automation framework primarily meant for Android UI testing? It supports both native and hybrid applications. Using Robotium, time-saving, readable and easy to use automated gray box UI tests intended for android apps can be written. System testing, functional testing, and user acceptance testing over Android-based apps with the help of Robotium can be performed.

### UFT

**Unified** Functional Testing (UFT) is a commercial testing tool for functional testing. It provides a feature set for API, web services, and GUI testing of desktop, web, and mobile applications across platforms. This tool has advanced image-based object recognition feature, reusable test components, and automated documentation. UFT uses Visual Basic Scripting for testing processes and object control. UFT can be integrated with Mercury Business Process Testing and Mercury Quality Center. This supports CI with Jenkins. It was previously known as QuickTest Professional (QTP).

It brings developers & engineers coming together under one umbrella and provides high-quality automation testing solutions. It makes functional testing less complex and cost-friendly. Its features include **Cross browser & multi-platform compatibility,**Optimized distributed testing, multiple testing solutions, image-based object recognition and canvas, visual test flows.

### IBM Rational Functional Tester

IBM RFT is a data-driven testing platform. It supports applications such as .Net, Java, SAP, Flex, and Ajax. RFT uses VB, .Net and Java as programming languages. RFT has a feature called as Storyboard testing in which users’ actions on AUT are recorded and visualized in a storyboard format through application screenshots. It can be integrated with IBM Jazz application lifecycle management systems such as IBM Rational Team Concert and Rational Quality Manager.

This tool is intended for**automated functional testing & regression testing**. It allows to perform data-driven and GUI testing. The automated testing is based upon script assure technology which highly improves the efficiency of testing and provides easy script maintenance. This tool does automated performance testing over web and server based apps. It has RCA capabilities to remove performance bottleneck. It provides real-time reporting and test data customizations. It also offers load and scalability testing.

### TestComplete

Environment Supported are web, mobile, and desktop testing. Programming/scripting languages support: JavaScript, VBScript, Python, and C++Script. Testing performed: keyword-driven and data-driven testing with Test Complete offers easy-to-use record and playback feature. Like UTF, TestComplete’s GUI object recognition capability can automatically change with UI objects which helps reduce the effort to maintain test scripts when the AUT is changed. It can be integrates with Jenkins in a CI process. This tool works for desktop, mobile and web applications. With Tet Complete, Functional UI tests can be built and run via robust record & replay capabilities or by scripting in your favorite languages, including Python, JavaScript, VBScript With support for applications, such as .Net, and native and hybrid iOS and Android apps, along with regression, parallel, and cross-browser testing capabilities.

### HP Quality Center

HP Quality Centre software standardizes testing. It is an integrated IT quality management software application. Automated testing is one of its key features which constantly allows to test earlier and quicker. Sharing with reusability allows HP QC to have bug-free and reliable applications.

## Approach and Steps of Study/Analysing Right Tool

1. Market Research: I have done Search for tool available whether Free Open Source, Community versions or Paid one fit in the requirements. To study open source automated tools and based design algorithm and methodologies and simulation of code base libraries of adaptive nature intelligent enough to understand their execution environment.
2. Experts View: Get feedback from the users and experts or from Forum of experts to get experiences on the features of tools. To take input from the users for their feedback to make the algorithm in a way so that it simulate itself as per the nature of protocol and requirements
3. Personal Experience: As per my personal work experience working with tools I have done research shortlisted best tools that best suits requirements and affordability of adaptive tools.
4. I Prepared comparison chart and done SWOT Analysis to select the best tool works on the principle of Run time Dynamic Adaptive Automation. Studied the level of satisfaction/experience of users before using automated (adaptive design and test pattern algorithm) Build and Test of software applications. Then Study the level of satisfaction of users after using automated (adaptive) software applications.
5. As per the comparison and study of tools and methodologies find problems in application of Adaptive Software in Technical Organizations and designed a engineering algorithm in terms of model and methods for assembling software systems that can dynamically adapt to context and can ‘account for them-selves’ specific to run time dynamic environment.
6. Then done minimizing tools for the requirements fits exactly we have to get through above mentioned guidelines.

## Questionnaires

Work and Responsibilities in Organization in Software Development, Software Testing, Quality Engineering and Software Integration and Deployment

Describe the methods of development and Testing used in organization

Describe the methodologies and status of manual testing

Problems associated with manual testing

Problems used with manual testing tools

Repositories used for Test Cases

Uses of Cloud storage in Development and Testing Environment

Methodologies of using Dynamic Storage in Software Environment

Opinion of using automated testing as a solution coming with manual testing.

Factors needed to be considered before implementation of automation.

What should be the process of implementing automation?

As per the current situation is there any automated process carrying out doing software build, Testing and Delivery?

Opinion and suggestions implementing Adaptive Automation with Storage

Challenges of implementing adaptive automation?

Overcoming the challenges of implementing adaptive automation using tools and techniques

Level of satisfaction after implementing adaptive automation in System development, System Testing, Thereafter Integration and Delivery.

## Patterns/Algorithms for Adaptive System Design, Development and Test

I came up with a simulated adaptive algorithm based on Search Algorithms, Informed Heuristic Search strategies and Fuzzy Logic.

Hill-Climbing Search

Local Beam Search

Simulated Annealing

Travelling Salesman Problem

Pure Heuristic Search

A \* Search

Greedy Best First Search

Fuzzy Logic