

Impact of Open Source on Functional Test Automation Systems and Scope for Further Research

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Abstract - To sustain and excel, Companies are expected to deliver 'Quality' products and Services. Software Industry is no exception and IT Companies are investing heavily to deliver Quality Software's. Software Testing is a Quality Control activity performed throughout the Software Development Life Cycle that helps minimize business risk. Manual Testing and Test Automation are the two modes of Software Testing. Manual Testing helps to stabilize the initial version of the software and when incremental versions of software are released, Test Automation is the preferred mode as it reduces time to market, improves reliability, speed and accuracy, runs 24*7*365 days, etc., Test Automation refers to automating the functional testing of Software and employs functional test automation tools. Software Test Managers, Functional testers along with Test Automation Tool Experts build and manage 'Functional Test Automation Systems. Today's there is a huge impact of Open Source Test Automation Tools on Functional Test Automation Systems. IT Research giants like Gartner, Forrester and IDC forecast that Open Source Test Automation tools will be supplementing proprietary tools and also acknowledge that these tools are in high adoption today by Software Companies. With the adoption of Open Source test automation tools in the rise, a research work on analyzing the impact of Open Source on Building and Managing Functional Test Automation Systems in Indian Context is proposed.

Keywords: Test Automation, Open Source; Functional Test Automation Systems

I. INTRODUCTION

Today, there is an increased usage of software applications in society and business. With 24*7*365 days availability of Internet at low cost and high penetration of smart phones, handheld devices and webapps, the usage of software applications is in the rise. In this decade, web based software applications are developed and used predominantly. Whatsapp, facebook, Twitter are some of the popular web applications in use by public and some of the business sectors heavily dependent on software applications include e-commerce, banking, retail, ticket reservations, healthcare, etc.,

To provide bug-free software, Software Companies perform various types of testing. The types of testing performed can be broadly categorized into two types - Functional Testing and Non-Functional Testing [1]. Functional Testing is performed to validate whether the software is working as intended and Non-Functional Testing is performed to validate the behavior of the software by simulating different scenarios. Non-Functional Testing include Performance Testing, Stress Testing, Availability Testing, Compatibility Testing, Security Testing, Reliability & Usability Testing, etc.,

Test Automation tools were employed extensively in building and managing Functional Test Automation Systems. To achieve this, Software Companies were

procuring Test Automation tools from proprietary vendors till recently. But now, there are plenty of Open Source Test Automation tools available and are adopted. This being the trend, a research proposal on analyzing the impact of Open Source on Building and Managing Functional Test Automation Systems is proposed.

This paper is organized into four sections. The first section provides the need for Functional Test Automation and the second section documents the popular Functional Test Automation Tools available in market. The third section discusses the steps involved in building a Functional Test Automation System and highlights the impact of Open Source in each step. The fourth section proposes the scope of further research involving open source test automation tools.

II. NEED FOR FUNCTIONAL TEST AUTOMATION

During the initial version of developing a software application, the application is tested to check whether the various features of the software are working as desired. This type of testing is termed as 'Functional Testing' and can be performed either manually or by employing test automation tools. Functional Testing verifies each feature of the system works as desired as per the requirement. In the initial iterations of the software development, manual

testing is the preferred mode of functional testing and will be performed by expert manual testers.

Once the software is stable and further versions of software's are released with new features, testing has to be performed to confirm that there is no impact on the existing features due to the addition of new features. The testing done to ensure that the existing features of the software are working as expected is referred to as 'Regression Testing'. Regression Testing is the testing performed to ensure that the old programs still work as expected with the addition of new programs/features [2] Regression Testing focuses on repetitive testing and is a monotonous job. Expert Manual Testers identify the test cases that are to be executed to ensure the existing features are working as desired and make a 'Regression Test Suite' [3]. This Suite is automated using Functional Test Automation Tools.

Proprietary Functional Test Automation Tools for Web Testing:

S.No	Tool Name	Tool Vendor	Description of the Tool
1.	Unified Functional Testing [6]	Micro Focus	UFT is an automation tool to perform functional and regression testing of Web applications, ERP, CRM, REST and SOA Services.
2.	TOSCA [7]	Tricentis	A leader in the Gartner – Magic Quadrant 2017 – Tosca is available in 3 editions – Exploratory, Modern Apps and Premium. Modern Apps and Premium edition supports Web Testing
3.	Rational Test Workbench [8]	IBM	Supports DevOps, gets integrated with Open source and various tools and helps automate functional UI Testing, API Testing and Service Virtualization
4.	Parasoft [9]	Parasoft	Positioned as Niche Player in Magic Quadrant, Parasoft improves test coverage and provides test results as an interactive report
5.	Ranorex Studio [10]	Ranorex	Helps to run end-to-end testing across web, mobile and desktop applications
6.	Eggplant [11]	TestPlant	Eggplant helps user centric, universal, productive and simple script development

Open Source Functional Test Automation Tools for Web Testing:

S.No	Tool Name	Tool Vendor	Description of the Tool
1.	Selenium [12]	Thoughtworks	Open Source leader for testing web applications
2.	Sahi [13]	Tyto Software Pvt. Ltd.,	Bundled with features for automated testing of Web, Windows Desktop and Java application
3.	Watir [14]	Ruby Gems	Watir, pronounced as water is built using ruby libraries and is meant to test web browsers
4.	Katalon Studio [15]	Upstar Labs	Possess various features to test Web and Mobile Applications
5.	Sikuli [16]	MIT	Sikuli is a powerful and open source tool for test automation
6.	Protractor [17]	Github	Targeted to test AngularJS applications, Protractor is suitable to test web applications also

IV. BUILDING FUNCTIONAL TEST AUTOMATION SYSTEMS

Test Automation means huge investment from the Management Perspective and is a Strategic decision. The Returns on Investments (ROI) can be realized only in the long run [18].To kick start the automation project Test automation team comprising of functional test automation tool expert, manual testers and Test Managers is formulated. Typically, the following steps are followed [19]:

Test Automation is preferred over Manual Testing because it provides various benefits [4]. Some of the benefits include improvement in test efficiency, reduction in cost, generation of correct and accurate results, running the tests in multiple platforms, rerunning the tests, etc.,

III. FUNCTIONAL TEST AUTOMATION TOOLS

Test Automation Tools are specialized software that simulates test data into the system under test and generates test reports by comparing expected and actual results [5]. Test Automation tools are available from Proprietary Vendors and Open Source. Some of the Popular Proprietary and Open Source tools to perform functional testing of Web applications are tabulated below.

a. Scanning the Tool Market

b. Evaluation & Selection of Tool

c. Implementation & Start working with the Test Automation System

d. Utilization and Maintenance of the Test Automation System

a. Scanning the Functional Test Automation Tool Market:

Initially, Test Automation Team scans the Functional Test Automation Tool market by referring to research reports published by IT Research companies like Gartner, Forrester, and IDC and so on. Today multiple blogs, websites and other resources on specific tools are published in Research Journals and Websites of Tool vendors. The current trend in tool adoption, the key drivers for adoption, most popular tools for specific business domain, technology combination is explored by the Test Automation Team.

The current trend is high adoption of Open Source Test Automation tools augmenting Proprietary tools. Some of the key drivers for high adoption of these tools include No Lock-in Period, highly Economical; Customization is possible, frequent upgrades, User friendliness of the tool, Ease of Learning, Integration with other tools, etc., [20]. The source code of Open Source Functional Test Automation tools can be changed and customized to the needs of the organization. This makes it more flexible and unique when compared to proprietary tools. As these tools are reliable, available free of cost and there are no lock-in periods, companies have started adopting them in par with proprietary functional test automation tools. Some tools like 'Selenium' has become the de-facto standard for Automation tool for web testing [22] and is forcing proprietary tool vendors to develop features available in it and also provide integration with it. In other words, the scenario is such that slowly Open Source Tool Vendors are setting benchmarks for Proprietary tool vendors.

b. Evaluation and Selection of Functional Test Automation Tool (s)

Once the current trends in market and the tools for specific business domain, technology combination are identified, the next step is to identify the specific requirement of the company and match it with the existing tools in the market. Some of the factors influencing the Selection of a Test Automation tool include Ease of Scripting, Online Support, Supporting Multiple Browsers and Languages, Availability of Tutorials, Exception handling, etc.,

Before selecting a specific tool or multiple tool(s), a comparative analysis and evaluation of various tools available in the market on the following features of the tools are done: Record/Playback feature, Report

Generation, Generation of Log Files, Auto Generation of Comments, Checkpoints, Synchronization, Debugging, Built-in and User defined functions, etc., are some of the features evaluated for selecting the Automation tool [21]. Test Manager decides the tool(s) suitable for the company in consensus with the Test Automation Team.

Today, both proprietary and open source functional test automation tools are in high adoption and they supplement each other [22][23]. It is accepted that Open Source tools are driving the test automation tool market and companies have started adopting a combination of Commercial and Open Source tools for their testing needs [24]. The reason is that all the features available in Proprietary tools are available in Open Source tools.

c. Implementation of the tool(s) and start working with the Test Automation System

Once the tool(s) are selected, the required Infrastructure for Implementation – Hardware, Software and Networks are made ready and the tools are installed by adopting the best framework suitable for the organization [25][26]. One of the competitive advantages of open source tools over proprietary tools is that these tools can be customized as per the requirement of the organization.

Meanwhile, Test Manager prepares the training schedule to train the Automation testers on the tools and ensures that testers are trained by Tool Experts. Here also training the testers on Open Source Test Automation Tools is much easier an economical when compared to getting the testers trained on proprietary tools. Once the tools are installed and Automation testers are trained, Automation testers will start working on the built Test Automation System to automate Regression Suites.

d. Utilization and Maintenance of Test Automation Systems

Test Automation Systems are used to support 'Live projects' involved in automating Regression Suite of software under test, to help trained testers in improving their Test Scripting skills and also train Novice Automation testers. There are various features in the Test Automation tools and depending on the expertise of the Test Automation testers, features are utilized. The utilization of Test Automation Systems is an area less explored and the methods used to assess the utilization are an area for further research.

Summary of the Impact of Open Source on Functional Test Automation Systems

S.No	Phase of Building Functional Test Automation Systems	Impact of Open Source/Research Gap
1.	Scanning the tool market	Open Source Tools are preferred as there is No Lock-in Period, highly Economical; Customization is possible, frequent upgrades, User friendliness of the tool, Ease of Learning, Integration with other tools, etc.,
2.	Evaluation of the Tool	Open Source is preferred over proprietary tool because all the features of Proprietary tools are available in Open Source tools at low cost.
3.	Implementation of Tool	These tools can be customized as per the requirement of the organization
4.	Training the Automation Tester	Training the testers on Open Source Test Automation Tools is much easier and economical
5.	Utilization of the Test Automation Systems	The utilization of Test Automation Systems is an area less explored and the methods used to assess the utilization are an area for further research.
6.	Maintenance of the Test Automation System	If the open source test automation tool is realized to be not suitable for the organization, then the test automation team will discard this tool and start searching for a new tool immediately.

Test Automation Systems enter into the Maintenance phase after Test Automation Experts start working on it. Technical support and periodic upgrades are done to maintain the Test Automation System. During the maintenance phase, if the open source test automation tool is realized to be not suitable for the organization, then the test automation team will discard this tool and start searching for a new tool immediately. This is another competitive advantage of adopting open source test automation tool a there is no lock in period unlike proprietary tools.

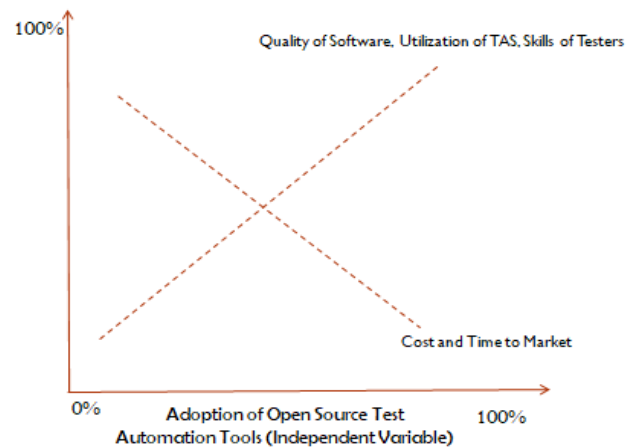
V. PROPOSED RESEARCH WORK

Though there are several qualitative researches done in identifying the impact of Test Automation tools, Empirical studies on the impact of Open Source Test Automation tools on the following aspects in Indian context is identified as research gap:

1. Cost of Managing Test Automation System (TAS)
2. Time to Market
3. Quality of Software under test
4. Utilization of Test Automation System
5. Skills of Automation Experts

In other words, an empirical research on identifying how the 5 dependent variables said above [Cost, Utilization, Quality, Time to Market and Skills of Automation Experts] will change with the Increase in the Adoption of Open Source Test Automation Tools [Independent Variable] is an area of exploration in Indian Context. So, a research work in this direction is proposed.

The proposed findings are shown below.



It is expected that with the increase in the adoption of Open Source Test Automation tools, there will be:

1. Decrease in the cost of managing Test Automation System
2. Decrease in Time to Market
3. Increase in the Quality of software under test
4. Increase in the Utilization of Test Automation System
5. Increase in the Skills of Automation Experts

VI. CONCLUSION

The importance of Open Source Testing tools in Test Automation market is quiet evident with Gartner including “Open Source based Testing Acceleration” as one of the 10 critical capabilities expected from a test automation tool [27]. With many companies adopting DevOps as their Software development methodology, Continuous Testing is a default activity and Open Source tools help to achieve these objectives in a highly economical way. The role of Open Source testing tools is expected to grow more in the next wave of ‘Intelligent Automation tools’ and a research on identifying the impact of Open Source Test Automation tools on building and managing functional test automation systems will help IT Managers and Decision makers to understand the impact of these tools on Test Automation Market, contributions of these tools in improving the

Quality of software tested and also get insight on their impact on the various factors related to managing Test Automation Systems.

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