

Software Test Automation in Practice: Empirical Study from Sri Lanka

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Abstract: In today, software projects are more complex than ever before, bugs are found before the product released and always creep in and often reappear. The Objective of the automated testing is to simplify as much of the testing effort as possible with minimum scripts. Automated software testing is the best way to increase the effectiveness, efficiency and coverage of software testing for software projects and also enables an organization to influence technology to perform tedious repetitive tasks efficiently, saving both time and cost. Along with that it gives more time to create test and increasing overall test coverage. The Current Literature suggests that nowadays it is very noticeable when considering the number of companies investing in automated testing tools due to the increased importance of Test Automation in software engineering. This paper will focus on how software test automation is in practice of today's Sri Lankan's software developments projects and will present the empirical observations. The objective of this empirical study is to shed light on the problems and the limitations in using the test automation tools and to figure out how test automation in Sri Lanka utilizes its significant key roles to succeed in software development projects in managing the mundane tasks. This paper can be used in future as a reference to obtain the knowledge and the findings of Test Automation use in Sri Lanka for early adopters.

Keywords: Test Automation, Empirical study, Sri Lanka, Testing, Software.

I. INTRODUCTION

In today's fast packed economy, it is a challenge for any company to continuously maintain and improve the quality and efficiency of software systems development. Testing have been neglected in many software projects due to time and cost constraints. This leads to a lack of product quality, followed by customer dissatisfaction and ultimately to increase overall quality costs [1]. Automated software testing is a process in which software tools execute pre-scripted tests on a software application before it is released into production. The objective of automated testing is to simplify as much of the testing effort as possible with a minimum set of scripts [2]. Test automation can automate some repetitive but necessary tasks in a formalized testing process already in place, or add additional testing that would be difficult to perform manually. There are two types of software testing: manual testing and automated testing. Manual testing is testing of the Software manually i.e. without using any automated tool or any script. Manual testing is performed by a human sitting in front of a computer carefully going through application screens, trying

various usage and input combinations, comparing the results to the expected behavior and recording their observations. Manual tests are repeated often during development cycles for source code changes and other situations like multiple operating environments and hardware configurations. An automated testing tool is able to playback pre-recorded and predefined actions compare the results to the expected behavior and report the success or failure of these manual tests to a test engineer. Once automated tests are created they can easily be repeated and they can be extended to perform tasks impossible with manual testing. Because of this, managers have found that automated software testing is an essential component of successful development projects.

In today's current software companies invest more money on Test Automation tools, so what makes automated testing so important to these companies. They are

- Automated Software Testing Saves Time and Money.
- Testing Improves Accuracy.
- Increase Test Coverage.

- Automation Does What Manual Testing Cannot.
- Automation Testing is used to re-run the test scenarios that were performed manually, quickly and repeatedly.
- Automated QA Testing Helps Developers and Testers [3].

Sri Lankan companies' uses Test Automation tools to obtain these benefits and also some companies have understood the worth of using Test Automation in their projects. Therefore this paper focus on how software test automation is in practice in today's Sri Lankan's software developments projects and the empirical observations. This study discusses the certain research questions. Such as

- What are the problems and the limitations in using the test automation tools?
- How test automation in Sri Lanka utilizes it significant key roles to succeed in software development projects in managing the mundane tasks.
- What are challenges faced when an existing and a new test team practicing and using the test automation tools.
- What kind of the benefits obtained in using Test Automation.
- What more improvements are needed to enhance in practicing test automation.

This research paper aims to discuss how the Test Automation is in practice in Sri Lankan software industry.

The rest of this paper is organized as follows. Section2 discusses the related works consists of the background study of the existing researches and the current researches of Test Automation. Section 3 describes the methodology of this paper. Result and discussion is presented in Section 4 and finally Conclusion is presented in Section 5.

II. LITERATURE REVIEW

Emil Alegroth et.al focused on capability of visual GUI testing (VGT) in industrial System. Authors have been shown VGT is good and safety for software testing. But if developers use VGT, developers want some expert technique knowledge. Because there are some limitations. VGT tool is unpredictable. But there are so many benefits of VGT testing. It is increased test execution speed, flexible with any application and also it can detect the all faults which are found in manually. VGT is beneficial for test automation [4].

Saswat Anand et.al focused on most famous test automation techniques, such as symbolic execution, model based, combinatorial, adaptive random and search-based testing. This is a group survey which covered many areas of techniques. Authors show these techniques limitations and advantages too. Authors have been shown

effectiveness and efficiency of software testing automation and by using this techniques they can reduce labor intensive and cost more than half [5].

Cristian Cadar et.al focused on modern symbolic execution techniques. It is for checking errors. Authors also reviewed the related tools and their impact in practice. There are some of limitations. Those are manage the many number of paths in the code. Handling compositional techniques, reducing redundant paths, reducing complex, mathematical functions are very difficult to solve. Test case generation for web applications and security problems of solving string constraints [6].

Laurie Williams et.al focused on Nunit automated testing frame work. These frame works were written by developers by completing codes. Before that they use peer reviews to unit testing. But this automated Nunit frame work is useful to developers very well. By using this frame work they can find complex defects easily within less time. Authors also produce version2 of frame work. Microsoft and IBM have found that defects are decreased in larger when automated unit tests are written with test driven development (TDD).It is beneficial to automated unit testing too [7].

Suresh Thummalapenta et.al focused on automating test automation. Authors showed a technique to convert form of test steps to a form ready for mechanical interpretation automatically. Because of that it can decrease the cost of test automation largely. This automates the conversion to script form. Manual test steps are informal. Therefore this can use to drive a program under test [8].

Authors have focused future of automated testing. Authors found TT-Medal (Test and Testing Methodologies for Advanced Languages) as future in testing. Other applications are TTCN-3 (Testing and Test Control Language) methods and tools. TTCN-3 is mature for industrial use in today. Because of ETSI (European Telecommunications Standards Institute) standards this technology is very successful [9].

Jussi Kasurinen et.al focused on identifies the factors affecting state of testing and automation in qualitative study. Automation is inefficient rather than manual testing. Authors have concerned about test process related subjects and common test related tool to implement unit and regression testing. Authors concluded test automation in software organization is a demanding effort [10].

Ram Chillarege focused on 28 software testing best practices. Author wants to adopt the best practices in the industry. So author has discussed as automated test execution, automated test generations. In the automated test generation he has been showed technology of automation is not successful as they expected. Because the some test automations are successful in some environments not always in every places [11].

Kristian Wiklund et.al focused on case studies related to test execution automation. Authors have discussed an overview of test process improvement models and test process maturity models etc. Also they presented about test execution automation in the subsystem of a large complex telecommunications system. So Authors have observed three situations and discussed about technical debt by using

case studies software design principles when maintaining test automation system [12].

James Bach focused on agile test automation for medium to large projects. Author has discussed principles of test automation, principles of agile test automation, How agile automation progresses, toolsmiths and etc. According to this discussion agile test automation is beneficial. But there are some limitations. They are technical knowledge problems, handling number of test cases are difficult and etc. [13].

Suchismita Harichandan et.al focused on scrum testing with backlog management in agile development environment. Nowadays agile is most useable methodology. Testing automation is provided more efficiency of testing. In agile environment testing is done in iterative manner. Scrum process develop change in requirements in testing. Authors have been discussed about basic concepts of agile development environment such as product backlog, sprint backlog, scrum meeting and related works. Also they have showed some limitations of agile methodology. They are more number of test cycle are needed to scrum process. Because of that increase the complexity of testing [14].

Ina Schieferdecker et.al focused on model based security testing (MBST).It is a dedicated to the methodical and efficient specification and documentation of security test objectives. Authors have discussed about risk based security system and model based fuzzing. This paper provides basic survey on model based security testing and related works. These main approaches are developed in the European ITEA2 project called DIAMONDS (Development and Industrial Application of Multi-Domain Security Testing Technologies), in 6 countries. Under this project they have found advantages and disadvantages of MBST. But overall survey is successful [15].

III. METHODOLOGY

In this Study the team used the following method to accomplish the proposed tasks, representing the high accuracy, real time and effective way to gather responses. A quantitative evaluation was utilized for this study leveraging subjective methods such as Questionnaires and observations to collect substantive and relevant data, direct and crucial questions were asked to determine how well software test automation was in practice today's Sri Lankan software development. As the first step of conducting the research, the research problem was defined clearly and analyzed the results of systematic literature review thoroughly, which is the main basis for starting the survey. The main aim of the Questionnaire was to figure out the background usage, benefits, Challenges and the current tools being used in software test automation. Using quantitative approach, research design was organized and data collection was created by using two approaches questionnaire and observation. Questionnaire was targeted to particular audiences who are currently working in the business industry, related to Information Technology field and was mainly focused to QA engineers and Test

Automation Engineers. Questions were asked from the targeted audience, as another method the team observed from the existing literature reviews in order to acquaint with the available body of knowledge of Software Test Automation. Out of total population, 50 % of responses in the questionnaires were taken as the selected sample and the collection of data were studied. We selected Google drive as our Questionnaire tool for conducting the Questionnaire. This tool allowed us to develop the questionnaires in user friendly manner with many options and an online link was generated by this tool for accessing the questionnaire. We prepared questionnaires in a way that gives a good ground for analysis of software Test Automation. As it is an online survey we tried to reach as many professionals as possible. The survey link is distributed to different Facebook groups & Google groups to different employees in different organizations. The Study can be used in Software development in actual scenario and can be kept as a future work to experiment it and from the feedback it is very understandable for the need for software Test Automation in today's Software Development in Sri Lanka

IV. RESULTS AND DISCUSSION

This section presents the questionnaire and analysis is made to the results obtained from the targeted audiences. In total the team got 19 respondents from the targeted population and the following results shown are based from them. The survey questionnaire was divided mainly into five Sub parts as to have a clear idea when preparing the questionnaires and to make easier for the responders to respond. The following Sub parts are

- Demographic Questions- To find the details for the respondent.
- Questions related to the factors influencing the Software Test Automation in practice.
- Questions related to the benefits obtained by using Software Test Automation.
- Questions related to the challenges faced when using Software Test Automation.
- Questions related to the current tools, framework and programming languages used in Software Test Automation.

A. Results obtained from Demographic Questions.

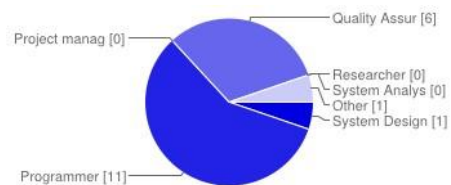


Fig 1: Current Position.

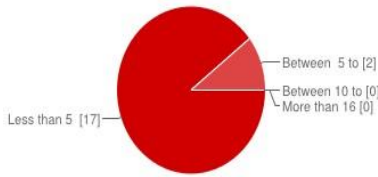


Fig 2: Years of Experiences.

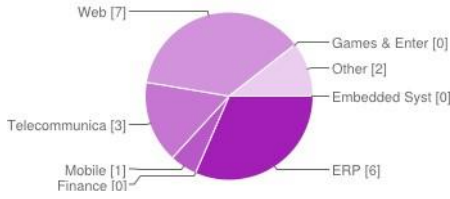


Fig 3: Application domains working on.

According to the results of questionnaires, majority is who filled the survey are programmers. Then we can think majority of the programmers are also doing testing part of software life cycle. And also they have experiences less than 5 years. Their working domain is web application. We can think Web applications need more testing.

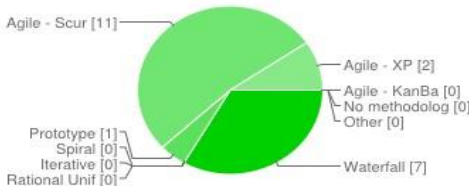


Fig 4: Methodology used.

They are using agile scrum methodology mostly. Agile Scrum is methodology which has three roles product owner, scrum master, team member. It is faster and more efficient methodology to build more flexible methods to satisfy the requirements of software developing phases.

B. Results obtained from factors influencing the software Test automation.

According to the results Testing is covering more high risk area.

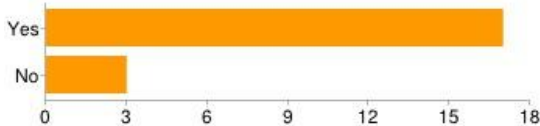


Fig 5: Is covering of risk area high.

We can conclude tester have enough technical skills to build automation. But testing needs extra experience for designing and maintain test tools and techniques.

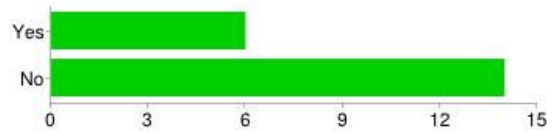


Fig 6: Is Automated testing fully replace the manual testing.

Considering the figure 6, automated testing is not fully replaced the manual testing. Because testing automation need more technical people to who know use the testing tools. And it may be cost.

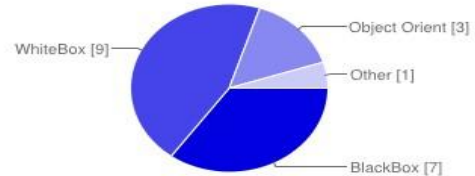


Fig 7: Testing approach used.

According to the results they are using white box testing as the approach of testing. In software testing, White box testing can apply to unit testing, integration testing, system testing. So many code coverage areas are included in white box test design techniques. They are Statement coverage, Decision coverage, Control flow testing, data flow testing, branch testing, and etc.

C. Questions related to the benefits obtained by using Software Test Automation.

In this section we discussed benefits of using test automation. According to the results more people are not using test automation tools. Another important factor are, without using test automation tools, efficiency, repeatable testing, and faster defect identification are average level not high. According to the results automated software testing provides more confidence in the quality of the product and increases the ability to meet schedules.

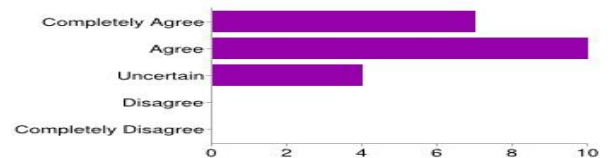


Fig 8: Is Automated testing improves the product quality by better test coverage.

Following figure show more responses to agree to prove by having a complete automation it reduces the cost of software testing dramatically and also facilitates continuous testing.

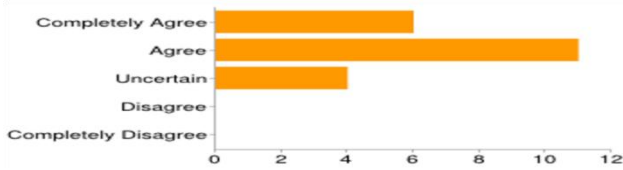


Fig 9: Automation testing reduces the cost of software testing and facilitates continuous testing.

D. Questions related to the challenges faced when using Software Test Automation.

In this section we discussed what are the difficulties faced when using test automation. There are problems in practice of software test automation According to the following figure more responses are shown towards the lack of skilled resources is high.

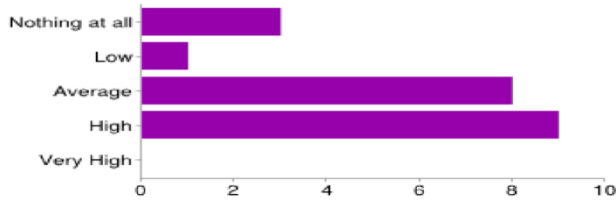


Fig 10: Lack of skilled resources.

In following figure focused on lack of management understanding. It shows more responses to high. Because lack of management understanding is a main difficulty to practice the test automation.

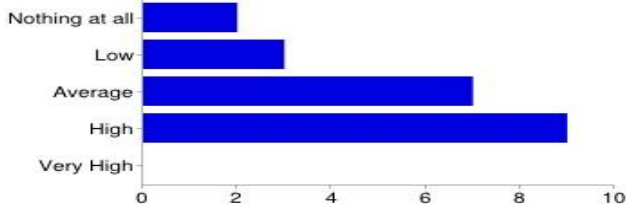


Fig 11: Lack of management understanding.

E. Questions related to the current tools, framework and programming languages used in Software Test Automation.

In this topic we asked about the current testing tools, framework used and language. Following figure shows the selection of test automation tools. More used tool is selenium.

Second one is JIRA. Selenium is a testing framework which is using for web applications. It provides playback tool for authoring test. Because of this reason selenium is the most popular testing framework. Jira is the best solution for capture issues.

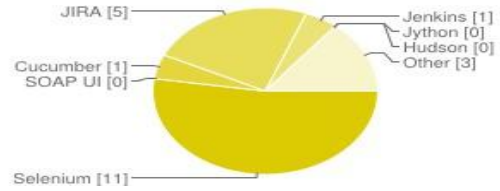


Fig 12: Automation tools that are used.

Among various types of testing phrases unit testing, system testing, integration testing are the common stages of a project to use the automation tools. According to the following figure of results data driven framework is used to drive automation. Data driven testing is creation of test scripts. It runs their related data set together. This framework improves test coverage by providing are usable test logic to decrease maintenance. Many type of databases can use to data driven testing. They are ODBC Sources, Data Pools, Excel files and etc.

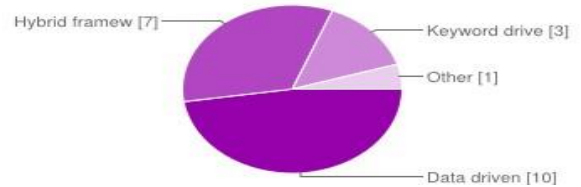


Fig 13: Framework used.

Considering all results of questionnaires we can conclude using test automation is more effective way to improve quality of software. Also it identifies defects in fast manner. Test automation increases in confidence in testing results. Reduction of risk is great advantage to software development. Also it increases test coverage. But there are some barriers to overcome. Those are lack of skilled resources, slow to respond to changing requirements, poor automation framework, Lack of coding standards and best practices.

If someone can overcome this problems and get a good practice in software test automation it is a best way to testing rather than doing testing manually. Because according to the survey, testers are highly satisfied with using test automation tools. But there is a not considerably amount of automation test tool users. Practice of software test automation is must improve. According to the conclusions more used automation tools are selenium and jira. Because of its benefits of using those anyone can use them and can get many advantages to improve software industry. Finally we can conclude Software test automation is highly efficient in testing. We can urge to use test automation tools in further in Sri Lanka.

V. CONCLUSIONS

More than half of all software projects fail to meet objectives or suffer significant schedule and budget slippage because defects are discovered too late. Software Testing has found its place in the software industry, with

more and more organizations understanding the crucial role that it plays in quality software production [16]. As analysis of current literature states number of companies investing in automated testing tools due to the increased importance of Test Automation in software engineering so this research paper focused on an empirical study to observe the factors influencing, benefits, challenges, current tools, framework and programming languages used in today's software development companies in Sri Lanka. A quantitative evaluation was utilized for this study leveraging subjective methods such as Questionnaires and observations to collect substantive and relevant data from the targeted audience. Out of the total population 50 % of responses in the questionnaires were taken as the selected sample and the collection of data was studied.

From the results obtained from the questionnaires, the study stated that most responders work on Web and ERP system by using Agile-Scrum as their methodology. Most Used test automation tools are selenium and jira and they are used in the stage of Unit Test, Regression Test and Integration Test. Mostly worked framework are Hybrid Framework and data driven. The testing approached most used are White Box and Black Box techniques. The results states from the number of responders using test automation tools have obtained the following benefits highly.

- Efficiency
- Faster Defect Identification
- Earlier defect identification
- Reduction of cost
- Increase in confidence
- Test coverage

The most faced challenges by using test automation are

- Lack of Skilled Resources
- Lack management understanding
- Cost
- Slow responding in changing requirements

Since the research was done in academic level only questionnaires and observations were analyzed and results were obtained and discussed to give a brief study on software test automation practice in today's Sri Lanka's software development companies. As in the future, this paper can be used as a reference to obtain the knowledge and the findings of Test Automation use in Sri Lanka for early adopters and the study can be used in Software development in actual scenario and can be kept as a future work to build a framework and experiment it.

VI. ACKNOWLEDGEMENT

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