Automation Testing with a Robot Framework for Agile Software Development

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Abstract— The objectives of this research were (1) develop automation test scripts by using robot framework on agile methodology. (2) Automate testing by using robot framework on agile methodology. (3) Evaluate performance for automate testing by using robot framework on agile methodology. Research methods consist with (1) The process for develop automation test scripts by using robot framework on agile methodology. (2) The process for Automate testing by using robot framework on agile methodology. (3) The process for evaluate performance for automate testing by using robot framework on agile methodology. This research measured from total 88 testing tasks in 151 representative sample by divided into 2 indicators (1) The testing result of automation compared with manual testing on agile software development proved that automation testing is more quality than manual testing by MMRE equal with 19.76, 19.22 and 9.61 respectively. And MMRE for performance for automate testing by using robot framework on agile software development equal with 11.65 for testing error qual with 12.11 and for testing time using qual with 14.73

Keywords- Automation Testing, Robot Framework, Agile Methodology

I. INTRODUCTION

Due to several high competition of businesses in technological field, many businesses have invented software that are easy to use and satisfy customers' needs. However, a good software is based on a good and standardized process. Agile methodology helps improve the effectiveness of the process. Many works dealing with technologies often bring agile technology to help manage the testing of systems.

Each system testing processes can be occurred according to the users. When the analysis team received suggestions from the users, they brought those suggestions into agile system in order to improve the system to satisfy customers' needs. Then, they transferred to developing team to develop the system according to what the analysis team had designed. After the system was completed, it was sent to the system testing team for testing. The staffs tested the whole system with the reference from the analysis team. When the testing was completed, the system testing team used the system with the real users. After this stage, the system was sent to the developing team and used in real environment. Therefore, the users were able to use the new system.[1]

From the researcher's previous study concerning automation testing and manual testing, the researcher saw that the automation testing is more effective than the manual testing in terms of the testing duration and the mistakes from the testers. Moreover, the researcher saw that agile methodology is an effective way to help testing the system. Therefore, automation testing was applied with agile methodology to increase the system's efficiency. Furthermore, the testing was combined with the robot framework. Therefore, this study was to automation testing with a robot framework for agile software development.

II. THE OBJECTIVE OF THE STUDY

1. Develop automation test scripts by using robot framework on agile methodology.

2. Use automation testing by using robot framework on agile methodology.

3. Evaluate performance for automation testing by using robot framework on agile methodology.

III. RESEARCH METHODOLOGY

In this study, the researcher used automation testing of robot framework to develop the agile technology. The detail of the study is presented as follows

A. Conceptual Framework

The use of automation testing with robot framework on agile methodology is the study to compare between automation testing and manual setting concerning their time precision, system's correction, and the efficiency of the software testing. The conceptual framework of the automation testing with robot framework on agile methodology is presented in Figure 1.

B. Develop automation test scripts by using robot framework on agile methodology.

1) Population

The population in this study was staffs who work in the field of technology and system testing in QA Digital Platform. The population consists of 151 people in 48 teams of company A.
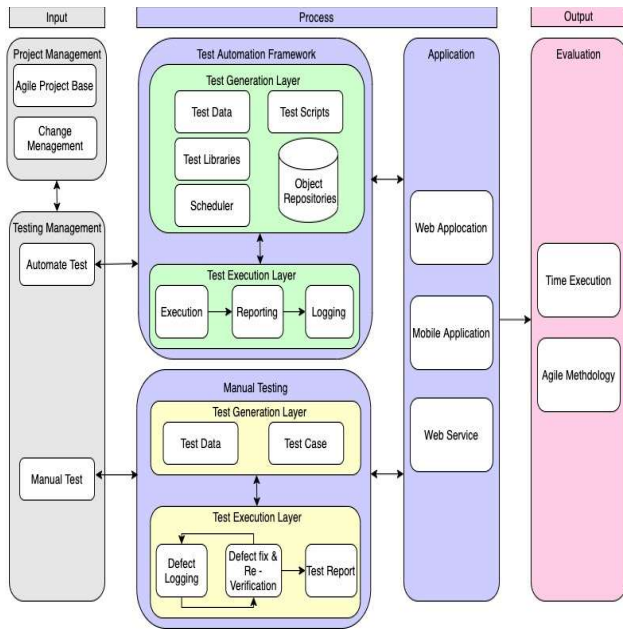
Figure 1. Conceptual Framework

2) Sampling

The sample in this study was staffs working in the field of information technology and dealing with system testing of company A in 2020. Simple random sampling and Krejcie & Morgan's technique were used to select the sample. The random sampling for automation and manual testing contained 108 samples.

The researcher conducted the research to study and develop automation setting and manual setting using robot framework. The testing and analysis results are shown in Figure 2.

3) Automation Test Case

The development of automation testing with robot framework consists of many stages as follows.[2]

a) Requirement / User Story

This stage is to analyze the document and create the test scenario. The scenario can be divided into two situations, which are positive scenario and negative scenario. Looking at both scenarios is enable us to understand the system easier and clearer.

b) Test case

This stage is to separate the test scenario into cases. For example, the system consisted one testing case, which was the login testing case. The case was to examine the login whether it was normal or not normal. In the case of normal login, there is only one case, which was that the user filled in the correct password and was able to login. This is similar to the login page that is not normal. The user filled the password incorrectly and cannot login.
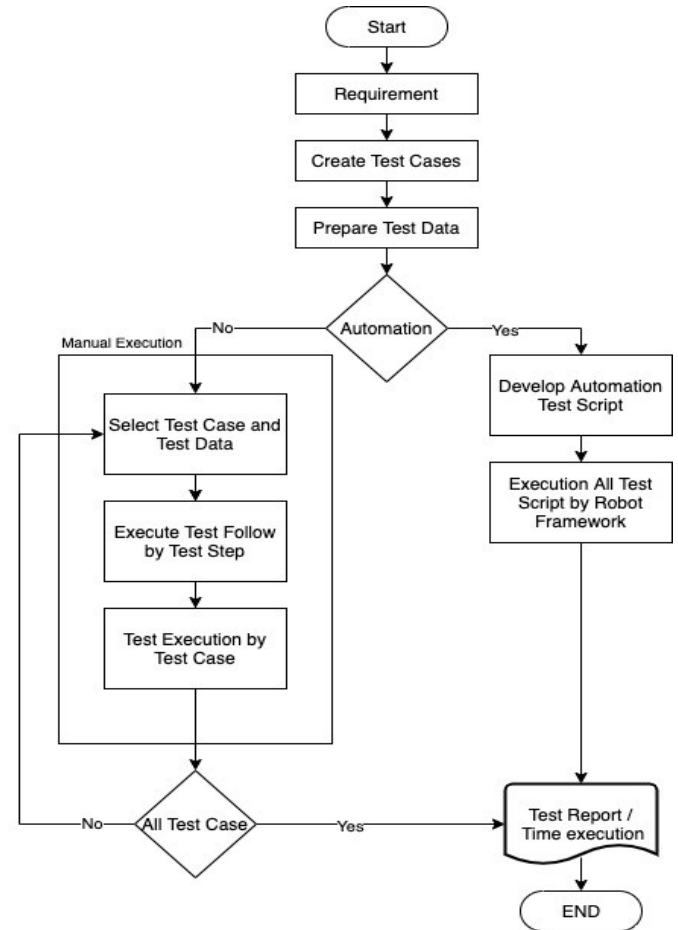

Figure 2. Process flow diagram of automation testing with a robot framework for agile software development

c) Prepare Data for Testing

This stage is to prepare data for testing. Various variables are separated into files and used with robot framework when testing.

d) Develop Automation Test Script [3]

This stage is to transform the prepared testing into automation testing. The automation test can be named according to the designed test. The function of documentation was used to explain the objective of the study. Keyword was used as the stage of testing, and variables were used as data management.

e) Test Execution

This stage is to proceed automation testing using Command Line by conducting change directory to the file that would be tested.

Figure 3. The sample of the case using automation testing with robot framework

f) Test Summary Report

The results of the automation testing using robot framework were saved in .html files and kept at Directory (-d). The results consisted of the details of testing and time spent on each testing. The results are presented in Figure 4.
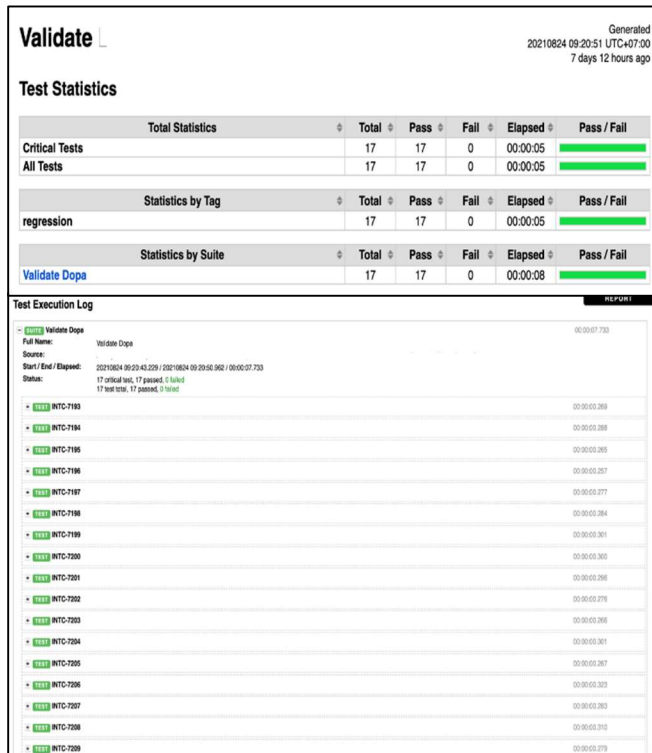

Figure 4. The report of test using robot framework

4) Manual Test

The development of manual testing contained the following stages.[4]

a) Requirement / User Story

This stage is to analyze the document and create the test scenario. The scenario can be divided into two situations, which are positive scenario and negative scenario. Looking at both scenarios is enable us to understand the system easier and clearer.

b) Create test case

This stage is to separate the test scenario into cases. For example, the system consisted one testing case, which was the login testing case. The case was to examine the login whether it was normal or not normal. In the case of normal login, there is only one case, which was that the user filled in the correct password and was able to login. This is similar to the login page that is not normal. The user filled the password incorrectly and cannot login.

c) Prepare Data for Tesing

This stage is to prepare data for testing by saving into file of manual testing.

d) Manual Testing

The staffs were asked to do the testing and were allowed to choose the testing case. Furthermore, they performed the test and compared with using their eyes until the test completed.

e) Test Summary Report

After the testing was completed, the testers recorded the testing results in document for the report. The document consisted of the testing result and the time spent on testing.

C. Automation Testing by Using Robot Framework on Agile Methodology.

The researcher made the test summary report of the automation testing using robot framework on agile methodology. The times spent on the testing of both automation and manual testing were compared to figure out the relative error of 108 testing. However, one sample can perform more than one time. Then, the Magnitude of Relative Error (MRE) was calculated according to the following formula. [5]

$$MRE = \frac{|actual_i - predicted_i|}{actual_i} \quad (1)$$

If there is a large amount of data set, Mean-MMRE should be investigated. If the value of MMRE is high, this means that the accuracy of lost estimation value is low. If the value of MMRE is close to 0, this means that the accuracy value is high as formulated below.

$$MMRE = \frac{1}{n} \sum_{i=1}^{i=n} \frac{|actual_i - predicted_i|}{actual_i} \times 100 \quad (2)$$

D. Evaluate performance for Automation testing with a robot framework for agile software development.

1) Manifest variable

Using referenced indicators in automation testing with a robot framework for agile software development is concluded as follows:

TABLE I. AUTOMATION TESTING WITH A ROBOT FRAMEWORK FOR AGILE SOFTWARE DEVELOPMENT

Indicator	Description
Q2	Automation testing is reliable to use with agile methodology.
Q3	Automation testing reduces the complication of developed system when using agile methodology.
Q4	Automation testing is fast and effective when using agile methodology.
Q5	Automation testing provides precise results when using agile methodology.
Q6	The ability of people responsible to the document affects the automation testing using agile methodology.
Q7	Document presenting the needs for new system of the users affects the reliability of automation testing using agile methodology.
Q8	Document presenting the needs for new system of the users reduces the complication of developed system when using agile methodology.
Q9	Document presenting the needs for new system of the users affects the testing duration of automation testing using agile methodology.
Q10	Document presenting the needs for new system of the users affects the precision of automation testing using agile methodology.
Q11	The ability of system analysists affects the automation testing using agile methodology.
Q12	The analysis and system design affect the reliability of automation testing using agile methodology.
Q13	The analysis and system design reduces the complication of automation testing using agile methodology.
Q14	The analysis and system design affect the testing duration of automation testing using agile methodology.
Q15	The analysis and system design affect the precision of automation testing using agile methodology.
Q16	The ability of system developers affects the automation testing using agile methodology.
Q17	The system development affects the reliability of automation testing using agile methodology.
Q18	The system development reduces the complication of automation testing using agile methodology.
Q19	The system development affects the testing duration of automation testing using agile methodology.
Q20	The system development affects the precision of automation testing using agile methodology.
Q21	The use of real system through automation testing using agile methodology affects the reliability of the system.
Q22	The use of real system through automation testing using agile methodology reduces risk of system failure.
Q23	The use of real system through automation testing using agile methodology affects the effectiveness of the system.
Q24	The automation testing using agile methodology affects the precision when used in the system.
Q25	The use of real system through automation testing using agile methodology affects the satisfaction of the users.

Rating scale: 1 = Very Low, 2 = Low, 3 = Moderate, 4 = More, 5 = Most)

2) Updating Data to Standard Values

From the generated questionnaire, some questions have different data units, such as some variables have quantitative data. Some variables are qualitative data, Likert score, and some variables are 0-5, which may give rise to an error in the modeling. Therefore, the researcher must update the data to be the same unit, ie to update the data to standard values by using standardized techniques. For example, the TC_Eff indicator is converted to a standard value, ZTC_Eff.

3) Factor Analysis[5]

Factor analysis is a statistical technique to gather similar variables in the same groups. The result can convey both positive or negative directions. The variables in the same groups or components will be highly related, where as the variables with the different components will be less related, or have no relation. Therefore, the empirical variables should be standardized in order to prevent errors from size and measuring unit from each variable, this can be formulated as follows:

$$F_j = w_{j1} + x_1 + w_{j2} + x_2 + .. + w_{jp} + x_p + e \quad (3)$$

Where: F = factor,
w = coefficient of variable x
x = manifest variable
e = margin of error

4) The Factor Analysis of Experimental Group

The experimental group focused on the factor analysis method by principal component analysis to provide a measure that is relevant to the factors in the same way as rotation varimax to reduce the number of points. This should measure the weight of each factor to as low as possible. Results from the analysis of new factors with KMO = 0.738, and new factors from extraction consisting of four main factors $F1$, $F2$, $F3$, $F4$ and $F5$ are shown in Table II.

TABLE II. RESULTS OF MAIN FACTORS AND VARIABLES

Factor	Factors Name	Variable of Factor
F1	System Development	ZQ16, ZQ17, ZQ18, ZQ19, ZQ20
F2	The Use of Real System	ZQ21, ZQ22, ZQ23, ZQ24, ZQ25
F3	Automation Testing	ZQ2, ZQ3, ZQ4, ZQ5
F4	System Analysis	ZQ11, ZQ12, ZQ13, ZQ14, ZQ15
F5	Satisfying the Needs of System	ZQ6, ZQ7, ZQ8, ZQ9, ZQ10

E. Structural Equation Modeling

Structural Equation Modeling (SEM) is a technique of statistical analysis by emphasizing on investigating the

casual relationship model between latent variables. Either latent variables or observed variables can be analyzed using the casual relationship model. Estimation of parameters using structural equation modeling is used as confirmatory that proves the correction of the study compared to the empirical data [6].

1) Modeling of Structural Equations

The results from the factor analysis will be used to generate the model of the initial structural equation as shown in Fig. 5. The prototype model is then analyzed for its significance, relevance, and ability to explain relationships and distribution (Covariance) by the method of maximum likelihood as shown in Figure 5. Equation.
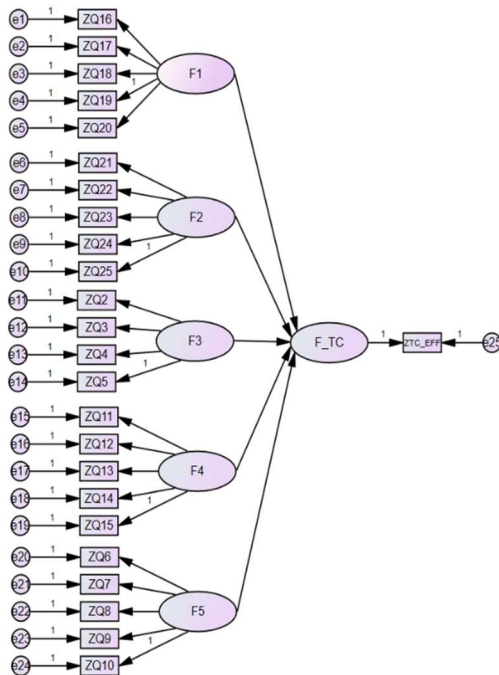

Figure 5. Model of initial structural equation

In Figure 5, the researcher determines automation testing with a robot framework for agile software development. Percentage variables used for information service are F1, F2, F3, F4 and F5.

IV. RESULT

Automation testing with a robot framework for agile software development. The research results are summarized as follows.

A. Result automation testing by using robot framework on agile methodology.

The result data of automation software testing by using robot framework on agile methodology from divide 2 group per project and test software more than one time or Regression Testing can analysis as follows.

1) Automation testing by using robot framework on agile methodology and manual test on agile methodology of group one time per project equal to all test case 34 time by all test case have 769 test case finding.

1.1) Automation testing by using robot framework on agile methodology use total testing time 12:02:23 minute and manual test on agile methodology use total testing time 19:17:27 minute, where automation testing by using robot framework on agile methodology can reduce software testing time is 07:15:04 minute in of all test case have 769 test case.

1.2) Automation testing by using robot framework on agile methodology total success 760 item by percentage 98.83 of all test case and manual test on agile methodology total success 748 item by percentage 97.27 of all test case. Automation testing by using robot framework on agile methodology has more success manual test is 12 item by percentage 1.56 of total success.

1.3 Automation testing by using robot framework on agile methodology total error result 9 item by percentage 1.17 of all test case and manual test on agile methodology total error result 21 item by percentage 2.73 of all test case. Automation testing by using robot framework on agile methodology less error manual test is 12 item by percentage 1.56 of result in testing.

The result automation testing by using robot framework on agile methodology in one time per project it takes less time to test. Have higher success values and the error value is less manual test on agile methodology.

2) Automation testing by using robot framework on agile methodology of the software testing group more than one time per project or regression testing. There are total number of tests. 74 time have all test case have 3,685 test case finding.

2.1) Automation testing by using robot framework on agile methodology use total testing time 53:11:49 minute and manual test on agile methodology use total testing time 19:17:27 minute, where automation testing by using robot framework on agile methodology can reduce software testing time 165:44:35 minute in all test case have 3,685 test case 3,685 test case.

2.2) Automation testing by using robot framework on agile methodology total success 3,810 item by percentage 98.58 of all test case and manual test on agile methodology total success 3,713 item by percentage 96.07 of test case, where automation testing by using robot framework on agile methodology has more success manual test is 97 item by percentage 2.51 of total success in test case.

2.3) Automation testing by using robot framework on agile methodology and manual test on agile methodology total error result 55 item by percentage 1.42 of all test case and manual test on agile methodology total error result 152 item by percentage 3.93 of all test case, where automation software testing by using robot framework on agile methodology less error manual test is 97 item by percentage 2.51 of result in testing.

The result automation software testing by using robot framework on agile methodology in one time per project and it takes less time to test or regression testing it takes less time to test. Have higher success values and the error value is less manual test on agile methodology.

B. *The results analysis of factor efficiency automation testing by using robot framework on agile methodology*

1) *The model of structural equation using automation testing by using robot framework on agile methodology of efficiency*
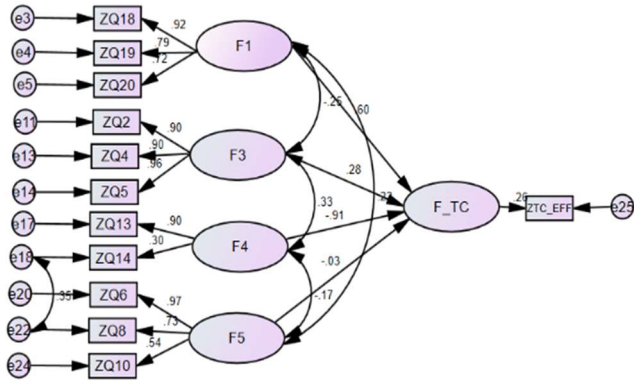

Figure 6. The model of structural equation using automation testing by using robot framework on agile methodology of efficiency

From Figure 6 the model of structural equation developed from the survey found that there were 4 factors affecting the effectiveness of automation testing by using robot framework on agile methodology. The equation is presented as follows.

$$ZTC\_EFF = 0.26 \times F\_TC \quad (4)$$
$$F\_TC = F1+0.60 \times F3+0.28 \times F4+(-0.91)$$
$$\times F5+(-0.03) \quad (5)$$
$$F1 = 0.92 \times ZQ18 + 0.79 \times ZQ19$$
$$+0.72 \times ZQ20 \quad (6)$$
$$F3 = 0.90 \times ZQ2+0.90 \times ZQ4+0.96$$
$$\times ZQ5 \quad (7)$$
$$F4 = 0.90 \times ZQ13+ 0.30 \times ZQ14 \quad (8)$$
$$F5 = 0.97 \times ZQ6 + 0.73 \times ZQ8$$
$$+0.54 \times ZQ10 \quad (9)$$

2) *The model of structural equation using automation testing by using robot framework on agile methodology from the system's mistakes*
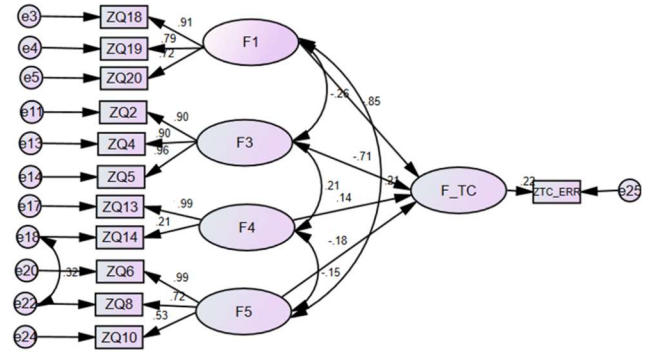

Figure 7. The model of structural equation using automation testing by using robot framework on agile methodology from the mistakes of testing

From Figure 10 the model of structural equation developed from the survey found that there were 4 factors affecting the effectiveness of automation testing by using robot framework on agile methodology. The equation is presented as follows.

$$ZTC\_ERR = 0.22 \times F\_TC \quad (10)$$
$$F\_TC = F1+(-0.85) \times F3+(-0.71) \times F4+0.14$$
$$\times F5+(-0.18) \quad (11)$$
$$F1 = 0.91 \times ZQ18+0.79 \times ZQ19+0.72$$
$$\times ZQ20 \quad (12)$$
$$F3 = 0.90 \times ZQ2+0.90 \times ZQ4+0.96$$
$$\times ZQ5 \quad (13)$$
$$F4 = 0.99 \times ZQ13+0.21 \times ZQ14 \quad (14)$$
$$F5 = 0.99 \times ZQ6+0.72 \times ZQ8+0.53$$
$$\times ZQ10 \quad (15)$$

3) *The model of structural equation using automation testing by using robot framework on agile methodology from the testing duration*
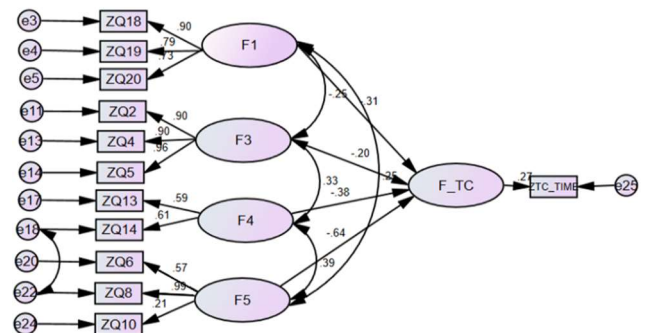

Figure 8. The model of structural equation using automation testing by using robot framework on agile methodology from the testing duration

From Figure 11 the model of structural equation developed from the survey found that there were 4 factors

affecting the effectiveness of automation testing by using robot framework on agile methodology. The equation is presented as follows.

$$ZTC\_TIME = 0.27 \times F\_TC \quad (16)$$
$$F\_TC = F1+(-0.31) \times F3+(-0.20) \times F4+(-0.38)$$
$$\times F5+(-0.64) \quad (17)$$
$$F1 = 0.90 \times ZQ18+0.79 \times ZQ19+0.73$$
$$\times ZQ20 \quad (18)$$
$$F3 = 0.90 \times ZQ2+0.90 \times ZQ4+0.96$$
$$\times ZQ5 \quad (19)$$
$$F4 = 0.59 \times ZQ13+0.61 \times ZQ14 \quad (20)$$
$$F5 = 0.57 \times ZQ6+0.99 \times ZQ8+0.21$$
$$\times ZQ10 \quad (21)$$

TABLE III.   STATISTICS FOR MODEL VALIDATION

Model	Statistic value	Default		
		ZTC_EFF	ZTC_ERR	ZTC_TIME
CMIN-P	P > 0.05	0.216	0.273	0.07
CMIN/DF	CMIN/DF< 3	1.157	1.116	1.581
GFI	GFI > 0.90	0.913	0.915	0.910
RMSEA	RMSEA < 0.08	0.043	0.036	0.072

C. Accuracy Estimation

1) The results of accuracy estimation of automation testing using robot framework on agile methodology compared to manual testing on agile methodology to find MMRE were as follows. Regarding the software testing for one time per one project, MMRE was equal to 19.76%. Concerning the software testing for two times per one project, MMRE was equal to 19.22%. For the software testing for three times per one project, MMRE was equal to 15.70%. Finally, regarding the software testing for four times per one project, MMRE was equal to 9.61%. The results are shown in Figure 9
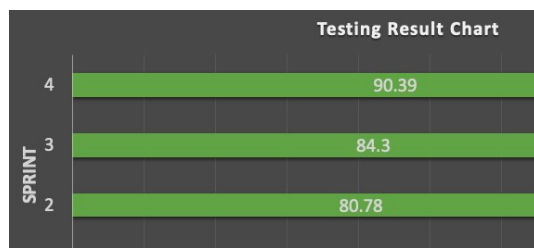

Figure 9. A graph representing the result of automation testing using robot framework on agile methodology

2) The accuracy estimation of automation testing using robot framework on agile methodology from the software size used structural equation technique until the model was completed and pass the criteria. MMRE was equal to 11.647%.

3) The accuracy estimation of automation testing using robot framework on agile methodology from testing mistakes used structural equation technique until the model

was completed and pass the criteria. MMRE was equal to 12.11%.

4) The accuracy estimation of automation testing using robot framework on agile methodology from the testing duration used structural equation technique until the model was completed and pass the criteria. MMRE was equal to 14.73%.
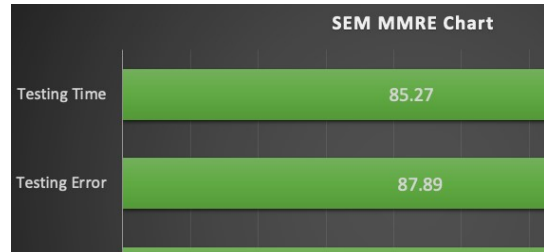

Figure 10. Graph representing the average MMRE of structural equation model.

V.   SUMMARIZE AND DISCUSSION

The results of the study are discussed as follows.

1) The automation testing can be further investigated and developed using continuous integration and regression testing.

2) The automation testing is appropriate for logic test. However, the testing has limitation concerning semantic test since the quality of automation testing might not be the same as testing by staffs.

3) This study is to compare the testing duration as well as the mistakes between automation testing and manual testing. Therefore, the tests were not done repeatedly for 100 percentage results.

4) The size of variable should be increased using Bootstrap to promote the effectiveness of the model.

5) To develop agile methodology, the relationship between the developers and users should be identified.

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