

# Software Testing System Development Based on ISO 29119

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**Abstract**—The software testing process is an important method in various fields. Every task in software process must be tested before delivery to the customer. So, in the software field, a testing process is necessary for create application. Today, many researchers find a testing methodology from a software testing standard that will ensure many people around the world. This paper chooses the ISO 29119 standard to create a prototype for the testing process. It is suitable for small business and guides developer to generate their software. The result of paper is shown step to test software and creates document to compare results between an actual result from user and an expected result from ISO 29119 standard. Finally, the system is tested with black box methods and evaluated by the specialist that test user satisfaction survey. The results appear a satisfaction average value at 78.4%.

**Index Terms**—software testing process, software testing standard, ISO 29119, testing standard

## I. INTRODUCTION

Nowadays technology is growing up in several businesses, many fields that needed a stable and high performance of the software and removal of faults to use in the business project for a competitive encounter [1], [2]. So, the software testing can bring the software to high quality [3].

The testing process is important for the evaluation of the software in terms of nature, quality ability to perform functions. That is one of the important and primary parts for achieving high-quality software that several organization or businesses worry about problem [3], [4].

ISO/IEC/IEEE 29119 is a relatively new standard for software testing with the most recent part published in 2016 [5]. Organizations are adapting this standard to use in their existing software development process.

In this work, we create a guideline of testing software process following by ISO 29119 standard. In addition, developer can receive software testing document, for example, test plan, test case, organizational test strategy etc. It can check input data from a user with ISO 29119 standard and alert to user when input wrong data. At last of the paper, the software can show input data from the user (expected result) and actual result from ISO 29119 standard for comparison between the expected result and actual result. Section II of this paper is related work.

Section III is the software testing process, and ISO 29119. Section IV is an overview of the results and User Interface (UI) of the program. Section V is the conclusion of this paper and future work.

## II. BACKGROUND AND RELATED WORK

### A. Background of Work

#### 1) Software development

Software development is a process or step for developing a software system. Software development consists of 3 parts are analysis, design, and implementation, there are suitable for small software. Software development life cycle compose of nine steps: Planning, Analysis, Design, Development, Testing, Evaluation, Data Conversion, Production, and Support. This research chooses testing step to create the software testing system development based on iso 29119 standard.

#### 2) Software testing process

The software testing process is partial in the software development process. Which is testing the program performance to have quality satisfy a requirement. This process has 4 steps composed of test design and implementation, test environment set-up and maintenance, test execution and test incident report as shown in Fig. 1 [6].

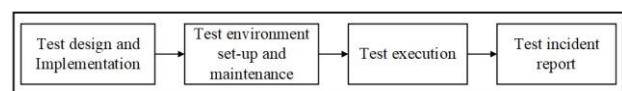


Figure 1. Testing process.

This research used a software testing process to define system development steps. The developed system consists of a test management module, dynamic test module, and test environment module which is shown the details in part 3.

### B. Related of Work

#### 1) Software testing standard ISO/IEC/IEEE 29119

ISO 29119 is an international standard in the software testing process with purpose of supporting software testing. Organization can adapt to use in a software development life cycle or organization's development process their existing. When using international standard, user will receive standards accepted by many people around the world and the high quality of the testing process in the organization.

ISO 29119 consists of 5 parts as follows: [5]  
 ISO/IEC/IEEE 29119-1: Concepts and Definitions  
 ISO/IEC/IEEE 29119-2: Test Process  
 ISO/IEC/IEEE 29119-3: Test Documentation  
 ISO/IEC/IEEE 29119-4: Test Techniques  
 ISO/IEC/IEEE 29119-5: Keyword Driven Testing

#### 2) *ISO/IEC/IEEE 29119-1: Concepts and definitions*

Part one describes the vocabulary follow ISO 29119 standards. This part gives a description of the ideas of software testing and methods to use the processes, documents, and techniques described in the 29119 series.

In part one is covers the topics: the introduction to software testing in an organizational and project context. Within general testing processes in the software life cycle, test practices, test sub-process, risk-based testing, automation in testing and defect management.

#### 3) *ISO/IEC 29119-2: Test process*

Part two describes a general process model for testing process. The model specifies test processes that can be used to govern, manage and implement software testing in any testing activity, organization or project etc.

The testing process consists of a three-layer process model as shown in Fig. 2 [5].

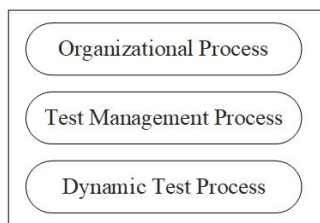


Figure 2. ISO/IEC 29119-2: Test process.

Fig. 2 Test process that covers: Organizational process is involved organization information such as organize test plan development, identify risks, design test strategy, determine staffing and scheduling etc. Test management process is involved in test monitoring and control processes. Dynamic test process is involved in test design and implementation, test environment set-up, test execution and test incident reporting.

#### 4) *ISO/IEC 29119-3: Test documentation*

Part three: Defined templates for test documentation that cover the entire software testing life cycle. All templates according to the test process defined by ISO 29119-3 standard such as organizational test process documentation and dynamic test process documentation.

#### 5) *ISO/IEC 29119-4: Test techniques*

Part four: A software test design technique can be used during the test design and implementation process within any organization or software development life cycle model.

ISO/IEC/IEEE 29119-4 covers a variety of commonly used dynamic software testing techniques: specification-based testing techniques, structure-based testing techniques and experience-based testing techniques.

#### 6) *ISO/IEC 29119-5: Keyword driven testing*

Part five is a method of explaining test cases that used an established set of keyword. Keywords are names of associated with a set of actions that are needed to perform

a specific step in a test case and use to explain test steps replace natural language, test cases can be easier to understand, to maintain and to automate.

From analyzing iso 29119 5 parts above which the researcher can apply an ISO 29119 in part 2 is test process and part 3 is test documentation to develop this system.

#### 7) *McCall's factor model*

McCall's model is a software quality factor. Various models of software quality existing are shown a more fixed and quantitative quality structure. So, factor in McCall's Model can separate into 3 factors are : Product Operation, Product Revision and Product Transition. And in this model has 11 attributes are availability/ reliability, correctness, efficiency, flexibility, interoperability, maintain- ability, portability, reusability, integrity, testability and usability [7].

In this system, apply McCall's model to define a software quality factors in the system user satisfaction survey.

### III. METHODS

#### A. *Procedure of Software Testing Process in This System*

Software testing system development is proposed to present software testing based on ISO 29119 standard developed by the software development process, by supports to create the test plan for test software, create a test case for testing, identify data specification in testing and investigate source code with the program created. This program has a compare result process with comparing between expected result from customers and the actual result executed from the program. In this paper, mainly focus on ISO 29119-2 standard represent test process and ISO 29119-3 standard represent test documentation.

#### B. *Process Details of This System*

In organizational test process, this is collected data from organization information by customers input data compose of develop organizational test specification, monitor, and control use of organizational test specification, and update organizational test specification to instantiation for test policy and organization test strategy. In these processes, researcher receives test policy and test strategy for the organization and sent test policy and test strategy to test management process.

In test management processes that is related test planning process output of this process is test plan. Activity of test plan as the following: understand context, identify, and analyze risks, organize test plan development, design test strategy, identify risk mitigation approaches, determine staffing and scheduling, record test plan. There gains consensus about test plan in communicating test plan and make available.

#### C. *Diagram of Each Process in the System*

In Fig. 3, this is test plan process is used to plan a test in each project. Which using those details for creating a system and need input data from the user. Test plan process has 9 steps as the following-input project name,

test plan name, organization's requirements and policies, test cost and project cost, scope of test, customer requirements, identify and analyze risks, staff's skills and number and tasks schedule. So, in a system when user input data, it checks input type and specification based on ISO 29119-2 such as in Test cost and project cost must input numeric data type by test cost separate into 2 parts, which are planning test cost and actual test cost.

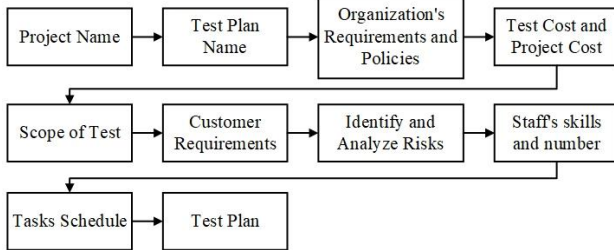


Figure 3. Test plan process.

In dynamic test process is used to design a test and planning test environment. Which is a main of a test process, consists of 5 main processes are test design and test implementation process, test environment set-up and maintenance process, test execution process, test monitoring and control process, and test completion process. Output of this process are test case and test environment. Test design and test implementation process have output is test case specification as shown in Fig. 4.

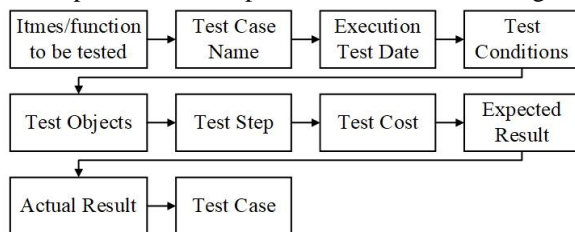


Figure 4. Test case process.

From Fig. 4, this is test case process is used to create a case in each project to test. That has steps as following-items/function to be tested, test case name, execution test date, test conditions, test objects, test step, test cost, expected the result and actual result is executed by a system, and system created need input data. It is received from step by step of test case process.

Test environment Set-Up and maintenance process can separate into two parts are instantiation for test environment and instantiation for test data. There are two activities are established test environment and maintain test environment.

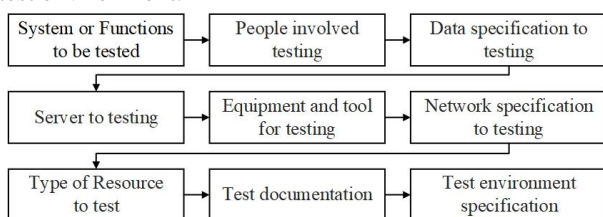


Figure 5. Test environment process.

From Fig. 5, this is test environment process is used to setting the environment to test that has steps as following

system or function to be tested, people involved testing, data specification to testing, server to testing, equipment and tool for testing, network specification to testing, type of resource to test and test documentation and system created need input data. It is received from step by step of test environment process.

#### D. Create a Function in the System

The function in this system created from ISO 29119-3 is information items. That adjusts to only suitable and necessary for a testing process which is a classified function from procedure and process methods.

So, this system consists of 6 functions are project information function, test policy function, test strategy and environment specification function, test plan function, test case function and documentation function each topic is shown unit 4.

### IV. SOFTWARE TESTING SYSTEM

#### A. Function in the System

Software testing system development has been created the system for help developer to use in test process and get easier when apply in existing software testing process in organization. This system has a function cover software testing document based on software testing standard.

A user can only input information that is related to software. User is not necessary to find information about software testing document because it has been existed in the system. When user input all completed information, user can see documentation and the system can suggest user about each function by comparing input (expected result) with the actual result.

From unit 3 can conclude total function in this system into 6 functions are project information function, test policy function, test strategy and environment specification function, test plan function, test case function and documentation function. So, the details of each function is shown below.

##### 1) Project information function

Project information is the first part of the system that involves project information necessary in project. First part of system consists of project name, organization name, project manager, created by, executed by, created date, project id (automate generation), test plan name, test case id, test case name, module name, module test, test cost planning, test cost actual and organization's requirement all function as shown in Fig. 6.

Figure 6. Project information.

When user input wrong information, this system can alert user as shown in Fig. 7.

Figure 7. Alert wrong input information.

## 2) Test policy function

Part two of system involves organizational test policy. This part is needed specific information about the policy of organization, so user must input only information to get better information in test policy. Example test policy page as shown in Fig. 8.

Figure 8. Test policy page.

Test policy part consists of objectives of testing, the overview of the system, issuing organization, approval authority, change history, scope, references, glossary, test organization structure, tester training, tester ethics, standards, other relevant policies and test asset archiving and reuse. In the system can recheck input when user forget input information. This system can alert user. If user don't want to input information, the system will instead with “\_\_Empty\_\_” as shown in Fig. 9.

Figure 9. Alert when forget input information.

## 3) Test strategy and environment specification function

Part three of system involves organizational test strategy and environment specification as shown in Fig. 10. Test strategy and environment specification part consists of generic risk management, test automation and tools, configuration management of test work products, incident management, test sub-process-specific organizational test strategy statements, entry and exit criteria, test completion criteria, type of software to test, data specification, server to testing, tools or equipment to test, people involved testing and network specification to testing.

Figure 10. Test environment page.

## 4) Test plan function

Part four of system involves the test planning process as shown in Fig. 11. Test plan part consists of a context of testing, testing deliverables, risk and contingencies, pass criteria, fail criteria, staffing information (staff name, staff roles, staff activities, staff responsibilities, and staff hiring) and testing task. By test plan id, test plan name can retrieve data from project information part.

Figure 11. Test plan page.



### 5) Test case function

Part five of the system involves test design and test case specification. Test case part consists of test data, test function, test condition and test step as shown in Fig. 12. By test case id, test case name that are retrieved data from project information part.

Figure 12. Test case page.

### 6) Documentation function

Last part of the system involves the test documentation. The result of the system can be indicated in this part. The user can recheck the input information by comparing the input information (expected result) with the output from the system (actual result) based on ISO 29119 (software testing standard).

In Fig. 13 Document page is shown conclusion project information such as test plan id, test plan name, organization name, project manager, module name, test case id, test case name etc. and user can select the type of document on this page.

Figure 13. Document page.

Documentation part, it can separate into two parts: Organizational test process documentation and Tests management process documentation.

1. Organizational test process documentation includes Test policy and Organization test strategy as shown in Fig. 14. This page is only show, cannot input, or delete that

information. Information on this page include tester ethics, standards, other relevant policies, test asset archiving and reuse, risk management, test tools and automation, configuration management to test, incident management, entry and exit criteria and test completion criteria.

Figure 14. Organizational document page.

2. Test management process documentation includes Test Plan and Test Cases, for example as shown in Fig. 15. In this paper, user cannot input or delete information by a user, but can read only. Information on this page include test plan id, pass criteria, fail criteria, risk contingency, test deliver, test cost plan, test cost actual, approve authority, staff information and scheduling of test.

Figure 15. Comparing result.

### B. Evaluation

After the system develops finished that has tested the system with a black-box testing method. Shown some functions in Table I.

TABLE I. BLACK BOX TEST CASE

Test Case	Expected Result	Actual Result
<b>Alert Generation</b>		
Alerting when input the wrong type of data	The system can alert to user when input wrong type of data	The system can successfully alert to user when input wrong type of data
Alerting when forgot to input data	The system can alert to user when missing input data	The system can successfully alert to user when missing input data
<b>Key Generation</b>		
Auto input entry into project id, test plan id and test case id	The system must auto input project id, test plan id and test case id	The system can successfully to auto input project id, test plan id and test case id
<b>Key Board Generation</b>		
Pressing the "Prev" button	Back to the previous page	Previous page is shown
Pressing the "SAVE" button	Save all information element of the current page	All information element of the current page saved
Pressing the "Next" button	Go to next page	Next page is shown
Run "Menu" in documentation page	Display a correct page follow pressing.	Page display correctly.

### C. System User Satisfaction Survey

Details of satisfaction based on software quality factors in McCall's Factor Model use to measured. For system user satisfaction survey use into 10 software quality factors that are suitable for the system. Which is correctness, reliability, efficiency, integrity, usability, maintainability, flexibility, testability, portability, and reusability. Correctness is required accuracy of output and availability of the information. Reliability is a software system failure rate. Efficiency to perform all functions in the system. Integrity is software security that define person authorize access into the system. Usability is the system that can be done following a user requirement. Maintainability is can identify the reasons for failures and verify the success of the corrections. Flexibility can adapt the software to the various customers. Testability is a testing of an information system. Portability can adapt the software system to other environments with is different hardware and operating system. Reusability can use software modules originally.

The system user satisfaction survey can separate the rating scale into 5 levels from calculating the mean value in each quality factor. Which 5 levels composed of Very satisfied have mean value at 4.21-5.00, Satisfied ave mean value at 3.41-4.20, OK have mean value at 2.61-3.40, Dissatisfied have mean value at 1.81-2.60 and Very dissatisfied have mean value at 1.00-1.80. The summary of system user satisfaction which is shown in Table II.

TABLE II. SUMMARY SYSTEM USER SATISFACTION SURVEY

Quality factor	Mean (Percentage)	Level
Reliability	4.25 (85)	Very Satisfied
Correctness	4.15 (83)	Satisfied
Portability	4.10 (82)	Satisfied
Reusability	4.05 (81)	Satisfied
Efficiency	4.00 (80)	Satisfied
Usability	3.95 (79)	Satisfied
Integrity	3.85 (77)	Satisfied

Testability	3.80 (76)	Satisfied
Maintainability	3.65 (73)	Satisfied
Flexibility	3.40 (68)	OK
<b>Total</b>	<b>3.92 (78.4)</b>	<b>Satisfied</b>

Surveyed 20 people involved with software testing, software development and the software system. Users are satisfied with the reliability the most, at 85%, and Users are dissatisfied at flexibility the most, at 68% because users need the system can use in various fields of work such as in manufactory, bank, etc.

### V. CONCLUSION

Software testing system development is created for help developer, organization or people interested in software testing and software development, this system is suitable for small business or small project. A user can apply the system in project about software testing documents consist of organization test process documentation, test plan, and test case. A user can trust in the system because researcher have shown the way and reference every step of function based on ISO 29119 standard. Moreover, advantages of the system can alert about wrong input, it can check based on an international standard. When a user does not want to input some information, the document part is shown the function that is necessary for software testing standard by showing "Necessary" that means user must input this information. The system was tested with black box methods before release to use and the system has a satisfying average value at 78.4% from 20 people .

Future work will be solving a flexibility problem in the system, create several types of testing documents and upgrade this system to automation test.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

### AUTHOR CONTRIBUTIONS

Dr. Pattama Charoenporn and Miss Chadatarn Raksawat had collaborated to conduct the research in all of the parts cover 5 units. In analyzed standard, function features, user interface of the system and wrote the paper and all authors had approved the final version.

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