UNIVERSITI PUTRA MALAYSIA

AUTOMATED TESTING APPROACH FOR CORRAD (WEB APPLICATION FRAMEWORK

MOHD FAISAL IMRAN B ISMAIL

FSKTM 2015 37

AUTOMATED TESTING APPROACH FOR CORRAD (WEB APPLICATION FRAMEWORK)

By:

MOHD FAISAL IMRAN B ISMAIL

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Computer Science

July 2015

COPYRIGHT PAGE

DEDICATION

To my beloved parents, Ismail Latiff and Faezah Mohd Yusof,
who have blessed me with an admiration of nature.

And to my lovely wife, Intan Diana Noorshah,
whose love and confidence is a constant source of inspiration and encouragement.

"I share the happiness of finishing the research and this thesis with you.
Thank you for your endless love, support, and encouragement."

ABSTRACT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Computer Science.

AN AUTOMATED TESTING APPROACH FOR CORRAD

(WEB APPLICATION FRAMEWORK)

By

MOHD FAISAL IMRAN B ISMAIL

July 2015

Every software development group tests their products, yet delivered software is not 100% free defects. Test engineers strive to catch them before the product is released but they always creep in and they often reappear, even with the best manual testing processes. In most cases, testing has to be done repeatedly throughout the development cycles to ensure quality. Manually repeating these tests is costly and time consuming.

The most plausible solution to overcome this problem is by using automated testing. Not only it increases the effectiveness, efficiency and coverage of the software testing, automated tests can also be run over and over again at no additional cost. Furthermore, automated testing is much faster than manual tests, which can reduce the time to run repetitive tests from days to hours.

Given the suggestion about automated testing above, this research is proposed to apply the automated testing approach on a web application framework, and a framework named CORRAD is chosen as the pilot study platform. The research demonstrated the approach with an automated testing tool that is integrated as a plugin for CORRAD. Evaluation of this approach shows that the automated testing approach can increase the effectiveness and efficiency of the testing process. Therefore, this approach is expected to increase the quality of the products developed using CORRAD, and reduce the time and cost needed for the testing process. In addition, it is believed that the developed tool can be commercialized as an added value for CORRAD.

ACKNOWLEDGEMENTS

Throughout the completion of this report, many people have contributed and are of assistance to me. It is my greatest pleasure to acknowledge these people whose name may or may not appear in the report, but whose hard work, guidance, cooperation, friendship and understanding were crucial to the development of this report. Many people have devoted long hours for this report. Without them, this report would not have been possible. I have tried to reflect this in the acknowledgement, but if there have been any omissions, my sincerely apologize for the oversight.

This report was prepared under the general direction and being supervised by my supervisor, Dr. Khaironi Yatim b Sharif, who totally has given a lot of effort giving comments and guidance to ensure that the report being done successfully. His advices and opinions have led me to develop this report in a proper way. Under a tight time schedule, he scrutinizes every aspect of the project and made countless suggestions for improving the accuracy and the completeness of the report. He was the one who always there to help me in any kind of time.

Enormous thanks to my parents, wife and family members for all the guidance and inspiration, and my friends for always supporting and sharing knowledge with me. I am fortunate to have work on this report with a lot of talented and dedicated people around. Their opinion and positive critics have built confidents in me.

I would also like to express my gratitude to Encoral Digital Solutions Sdn Bhd and all staffs that are involved with the research. The cooperation given by the company and

staffs have helped me a lot in finishing this report. May the company and the CORRAD framework will always be successful in the future.

I sincerely appreciate the efforts that have been put by all the people above which truly cannot be described by words. Thank you very much to all for improving the quality of the report. As well as people who will use the tool that is developed, I would sincerely appreciate your comments, criticisms, corrections and suggestions for improving the research.

APPROVAL SHEETS

This thesis is submitted to the Faculty of Computer Science and Information Technology of Universiti Putra Malaysia and has been accepted as fulfillment of the requirements for the degree of Master of Computer Science.

Accepted and approved by,

_____

Dr. Khaironi Yatim b Sharif

Department of Software Engineering & Information System

Faculty of Computer Science & Information Technology

Universiti Putra Malaysia

Date: _____

DECLARATION FORM

I hereby declare that the report is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and it is not concurrently, submitted for any other degree of Universiti Putra Malaysia or at any institutions.

_____

MOHD FAISAL IMRAN B ISMAIL
GS36942

Date: _____

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ATT	Automated Testing Tool
BDI	Belief-Desire-Intention
CORRAD	Coral Rapid Application Development Framework
eNC	Encoral Digital Solutions Sdn Bhd
IQR	Inter-Quartile Range
QA	Quality Assurance
RAD	Rapid Application Development
SPPB	Sistem Pengurusan Pili Bomba
TAM	Technology Acceptance Model
UAT	User Acceptance Test
UML	Unified Modelling Language

CHAPTER 1

INTRODUCTION

1.1 Background

Software testing is one of the most crucial quality assurance (QA) processes in software development life cycle, in ensuring the developed software meets its requirements. Software testing aimed at finding defects before the delivery of software to avoid software failure. Defects, or also known as faults, in a software product might occur due to human error or mistake, and defects may lead to software failure, where the software may depart from its required behavior during operation [1]. Lack of testing usually resulted in a low quality product, and might later cause additional costs during the maintenance period. However, software testing is also known as repetitive processes. In ensuring the quality of the developed software, some of the tests have to be done repeatedly during the development cycles. Manually repeating these tests usually consumes a lot of time and resources. The most plausible solution to overcome this problem is by using the automated testing approach.

Automated testing is the act of performing the testing process, such as generating test cases, executing test cases, and comparing the actual outcomes with the predicted outcomes, using some kind of automated testing tool [2]. The tool can

generate test cases, execute the test cases, produce test results, give hints for possible errors based on the test results, and document the testing process. Automated testing can reduce the costs and increases the quality of the testing processes. Not only it allows tests to be executed many times without any additional cost, the automated testing approach can also reduce the time taken to do the testing processes from days to hours, making it much faster than the manual testing approach. These advantages have made automated testing to become an important type of test method in the software development life cycle. The automated testing increases the effectiveness and efficiency of the testing process, and is seen as parallels with the rapid application development (RAD) methodology adopted by many frameworks [2].

Application framework, or framework, is a set of abstract classes with reusable designs of all or part of the software systems in a particular application domain. The presence of framework can reduce the developer's effort and time in developing applications, by providing a common structure that promotes the reusability of code or features provided, so that developers don't have to always redo it from scratch. Among the framework that is widely used in Malaysia is Coral Rapid Application Development (CORRAD) Framework.

CORRAD is a web application framework that has been commercialized by Encoral Digital Solutions Sdn Bhd (eNC) since 2011. Initially developed in 2005 to ease internal development, this framework provides simple yet powerful application engine for people who desire rapid web application development. Until today, many government and private sectors in Malaysia has bought and used CORRAD for their in-house development.

CORRAD is backboned with PHP language and supports leading databases such as MySQL, Microsoft SQL Server, Oracle, Sybase and PostgreSQL. Its goal is to provide a configuration-driven development to enhance the efficiency and ease of use in a web application development. Most of the configurations are GUI-based, and requires little technical expertise to learn and use it. Like many other frameworks, most of the coding processes have been automated by CORRAD, yet testing is still being done manually.

This research is constructed to propose an automated testing approach for web application framework, and CORRAD will be used as the pilot study platform. In demonstrating this approach, an automated testing tool, named as CORRAD Automated Testing Tool (CORRAD ATT), is developed as a plugin for CORRAD. Since repeating every testing process in exact details, especially after a long time, is difficult, the presence of the tool may reduce mistakes originated from human factors, such as operating skills and fatigue level, and is expected to bring more reliable results during the testing process. With this, not only will it increase the quality of products developed using CORRAD, it will also reduce the time and cost needed for the testing process. In addition, it is believed that the tool can be commercialized as an added value for CORRAD.

1.2 Problem Statement

Manual testing approach has always been highlighted as a time consuming and resource expensive approach. Some of the testing processes are repetitive and sometimes it is hard to repeat each process in exact way, especially after a long time.

Although web application framework such as CORRAD has been developed to reduce the development time and cost, it still prone to the problem mentioned above.

The problem statement for this research can also be described in below research questions:

RQ1: How to automate the testing process for web based application framework?

RQ2: How can the automated testing approach be adapted in web based application framework?

RQ3: How can the automated testing approach help increases the productivity of the testing process?

1.3 Objective

Prior to the given problem statements, the research is proposed with the following objectives:

i. To enable the automated testing approach in web application framework

The current manual testing approach in web application framework can be laborious and time consuming. As some of the testing processes are repetitive, human factors such as fatigue may lead to human mistakes. Enabling the automated testing approach offers a possibility to perform the testing process in a more effective and efficient way. Once the test has been developed, it can be executed repeatedly at no additional cost.

ii. To develop an automated testing tool as a plugin for web application framework

An automated testing tool is developed as a plugin for CORRAD, and is named as CORRAD Automated Testing Tool (CORRAD ATT). The plugin will act as an additional tool for CORRAD and will give flexibility to users as it can be installed and removed from CORRAD at any time. Since it is not attached directly with CORRAD, it can also be commercialized on its own.

iii. To evaluate the effectiveness, efficiency and technology acceptance of the automated testing approach in web application framework

As the automated testing tool is targeted to be commercialized, it is important that it can increase the productivity, measured by effectiveness and efficiency, of the testing process. In order to prove that, a prototype is prepared for empirical study and usage of the automated testing tool is tested by eNC's staffs. At the end of the study, questionnaire is given to evaluate the technology acceptance by the staffs. Results of the empirical study is collected and analyzed.

1.4 Scope

This research is conducted within CORRAD, as the pilot study platform. However, results of this research is expected to be applicable for any web application framework, and the developed tool is intended to be used by anyone who wants to test their web application. The developed tool is designed to enable the automation of test case and test script generation, automation of the test execution, and to provide the test environment. The automated testing approach in this research is focused on testing the functional behavior and business flow of the application, which is also

known as black box testing. This approach is proved by measuring its effectiveness, efficiency, and technology acceptance using appropriate measurements.

1.5 Methodology

To accomplish the research objectives, this research is performed in four main phases, which are Preliminary Information Gathering phase, Design & Development phase, Experimentation phase and Finding & Documenting phase. Activities in each phase are described as below:

i. Preliminary Information Gathering

This is the first phase of the research where the research title is proposed, milestone of the research is planned, and information related to the research is gathered through a series of literature review.

ii. Design & Development

Once the proposed research is accepted, the tool for the automated testing approach (automated testing tool) is designed, developed and tested. The process of designing, developing and testing the tool is an iterative process.

iii. Experimentation

During this phase, a case study is designed to evaluate the tool. Experimentation is then conducted based on the case study, where the eNC's staffs use the tool for their testing processes. Details of the experimentation process are described in Chapter 3, Methodology.

iv. Finding & Documenting

This is the final phase of the research, where data from the experimentation is collected and analyzed. Summary of the evaluations are produced and documented in this research report.

1.6 Thesis Outline

This thesis consists of six (6) chapters, which are described as below:

Table 1: Thesis Outline

Chapter	Description
Chapter 1	This chapter introduces the subject matter and problem(s) being studied, and indicates its importance and validity.
Chapter 2	This chapter encompasses a critical and comprehensive review of the literature related to the topic of thesis.
Chapter 3	This chapter contains a description and justification of the materials, theoretical approaches, experimental designs and methods (including statistical analysis) used to achieve the stated objectives of the study undertaken.
Chapter 4	The chapter presents a complete account of the results obtained in the study in the form of text, figures or tables so that the key information is highlighted.
Chapter 5	This chapter illustrates the significance of the study and stresses the findings upon which a conclusion or conclusions are drawn in line with the objectives set, acknowledges the limitations, and suggests further research which may be carried out on the topic.

REFERENCES

1. Fenton, Norman E., and Shari Lawrence Pfleeger. "Software Metrics: A Rigorous and Practical Approach." PWS Publishing Co., 1998.

2. Dustin, E., Rashka, J., Paul, J., "Automated Software Testing: Introduction, Management and Performance." Addison-Wesley, 2000.

3. Huang, Cheng-hui, and Huo Yan Chen. "A Tool to Support Automated Testing for Web Application Scenario." Systems, Man and Cybernetics, 2006. SMC'06. IEEE International Conference on. Vol. 3. IEEE, 2006.

4. Javed, Abu Zafer, Paul A. Strooper, and G. N. Watson. "Automated Generation of Test Cases using Model-Driven Architecture." Automation of Software Test, 2007. AST'07. Second International Workshop on. IEEE, 2007.

5. Sampath, Sreedevi, et al. "Composing a Framework to Automate Testing of Operational Web-Based Software." Software Maintenance, 2004. Proceedings. 20th IEEE International Conference on. IEEE, 2004.

6. Kung, David. "Agent-Based Framework for Testing Web Applications." 2013 IEEE 37th Annual Computer Software and Applications Conference. Vol. 2. IEEE Computer Society, 2004.

7. Qi, Yu, David Kung, and Eric Wong. "An Agent-Based Testing Approach for Web Applications." Computer Software and Applications Conference, 2005. COMPSAC 2005. 29th Annual International. Vol. 2. IEEE, 2005.

8. Qi, Yu, David Kung, and Eric Wong. "An Agent-Based Data-Flow Testing Approach for Web Applications." Information and software technology 48.12 (2006): 1159-1171.

9. McMaster, Scott, and Xun Yuan. "Developing a Feedback-Driven Automated Testing Tool for Web Applications." Quality Software (QSIC), 2012 12th International Conference on. IEEE, 2012.

10. Huang, Yao-Wen, et al. "A Testing Framework for Web Application Security Assessment." Computer Networks 48.5 (2005): 739-761.

11. Maogui, Hu, and Wang Jinfeng. "Application of Automated Testing Tool in GIS Modeling." Software Engineering, 2009. WCSE'09. WRI World Congress on. Vol. 4. IEEE, 2009.

12. Paydar, Samad, and Mohsen Kahani. "An Agent-Based Framework for Automated Testing of Web-Based Systems." Journal of Software Engineering and Applications 4.02 (2011): 86.

13. Basili, Victor R., Richard W. Selby, and David H. Hutchens. "Experimentation in software engineering." Software Engineering, IEEE Transactions on 7 (1986): 733-743.

14. Kitchenham, Barbara, Lesley Pickard, and Shari Lawrence Pfleeger. "Case Studies for Method and Tool Evaluation." IEEE Software 4 (1995): 52-62.

15. Kitchenham, Barbara, Stephen Linkman, and David Law. "DESMET: A Methodology for Evaluating Software Engineering Methods and Tools." Computing & Control Engineering Journal 8.3 (1997): 120-126.

16. Vos, Tanja, et al. "Evaluating Software Testing Techniques and Tools." Actas de XVI JISBD (2011): 531-536.

17. Davis, Fred D. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology." MIS Quarterly (1989): 319-340.

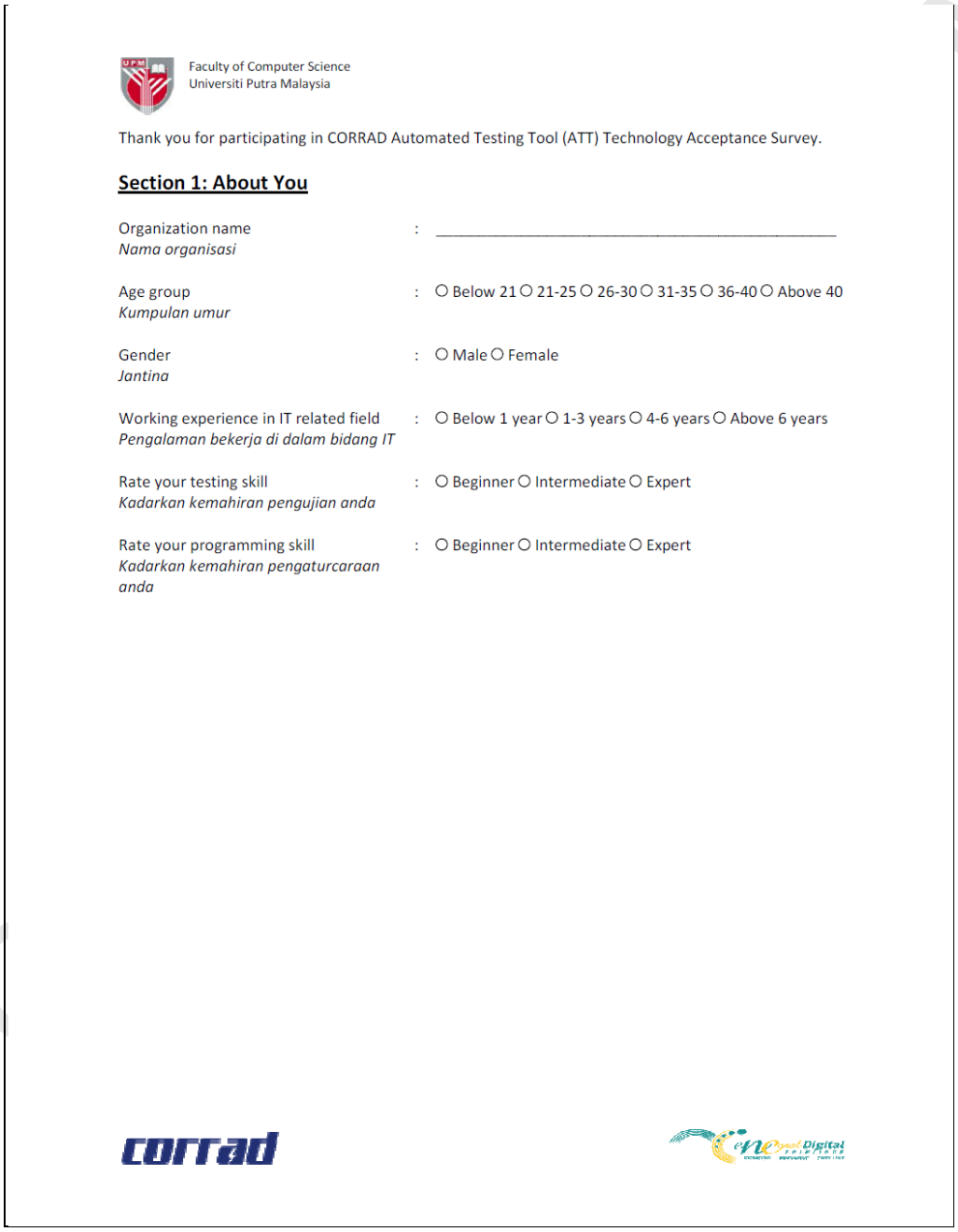
18. Surendran, Priyanka. "Technology Acceptance Model: A Survey of Literature." International Journal of Business and Social Research 2.4 (2012): 175-178.

19. Davis, Fred D. "User Acceptance of Information Technology: System Characteristics, User Perceptions and Behavioral Impacts." International Journal of Man-Machine Studies 38.3 (1993): 475-487.

20. Uma, Sekaran, and Bougie Roger. "Research Methods for Business: A Skill Building Approach." John Wiley and Sons Inc., New York (2003).

APPENDIX A

TECHNOLOGY ACCEPTANCE QUESTIONNAIRES



Faculty of Computer Science
Universiti Putra Malaysia

Thank you for participating in CORRAD Automated Testing Tool (ATT) Technology Acceptance Survey.

Section 1: About You

Organization name : _____
Nama organisasi

Age group : ○ Below 21 ○ 21-25 ○ 26-30 ○ 31-35 ○ 36-40 ○ Above 40
Kumpulan umur

Gender : ○ Male ○ Female
Jantina

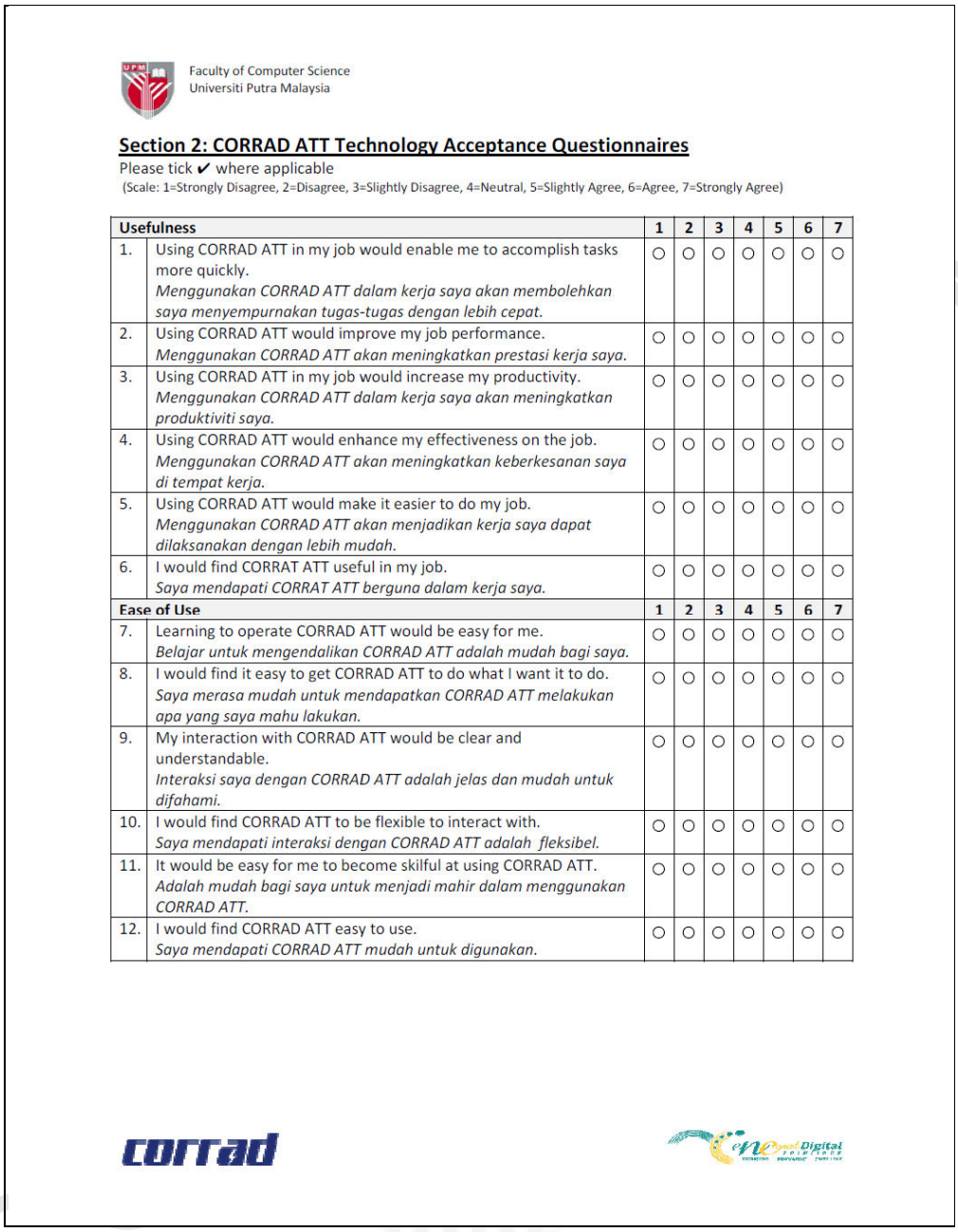
Working experience in IT related field : ○ Below 1 year ○ 1-3 years ○ 4-6 years ○ Above 6 years
Pengalaman bekerja di dalam bidang IT

Rate your testing skill : ○ Beginner ○ Intermediate ○ Expert
Kadarkan kemahiran pengujian anda

Rate your programming skill : ○ Beginner ○ Intermediate ○ Expert
Kadarkan kemahiran pengaturcaraan anda

corrad

Figure 18: Technology Acceptance Questionnaire (Demography)



Faculty of Computer Science
Universiti Putra Malaysia

Section 2: CORRAD ATT Technology Acceptance Questionnaires

Please tick ✔ where applicable

(Scale: 1=Strongly Disagree, 2=Disagree, 3=Slightly Disagree, 4=Neutral, 5=Slightly Agree, 6=Agree, 7=Strongly Agree)

Usefulness		**1**	**2**	**3**	**4**	**5**	**6**	**7**
1.	Using CORRAD ATT in my job would enable me to accomplish tasks more quickly. *Menggunakan CORRAD ATT dalam kerja saya akan membolehkan saya menyempurnakan tugas-tugas dengan lebih cepat.*	○	○	○	○	○	○	○
2.	Using CORRAD ATT would improve my job performance. *Menggunakan CORRAD ATT akan meningkatkan prestasi kerja saya.*	○	○	○	○	○	○	○
3.	Using CORRAD ATT in my job would increase my productivity. *Menggunakan CORRAD ATT dalam kerja saya akan meningkatkan produktiviti saya.*	○	○	○	○	○	○	○
4.	Using CORRAD ATT would enhance my effectiveness on the job. *Menggunakan CORRAD ATT akan meningkatkan keberkesanan saya di tempat kerja.*	○	○	○	○	○	○	○
5.	Using CORRAD ATT would make it easier to do my job. *Menggunakan CORRAD ATT akan menjadikan kerja saya dapat dilaksanakan dengan lebih mudah.*	○	○	○	○	○	○	○
6.	I would find CORRAT ATT useful in my job. *Saya mendapati CORRAT ATT berguna dalam kerja saya.*	○	○	○	○	○	○	○
Ease of Use		**1**	**2**	**3**	**4**	**5**	**6**	**7**
7.	Learning to operate CORRAD ATT would be easy for me. *Belajar untuk mengendalikan CORRAD ATT adalah mudah bagi saya.*	○	○	○	○	○	○	○
8.	I would find it easy to get CORRAD ATT to do what I want it to do. *Saya merasa mudah untuk mendapatkan CORRAD ATT melakukan apa yang saya mahu lakukan.*	○	○	○	○	○	○	○
9.	My interaction with CORRAD ATT would be clear and understandable. *Interaksi saya dengan CORRAD ATT adalah jelas dan mudah untuk difahami.*	○	○	○	○	○	○	○
10.	I would find CORRAD ATT to be flexible to interact with. *Saya mendapati interaksi dengan CORRAD ATT adalah fleksibel.*	○	○	○	○	○	○	○
11.	It would be easy for me to become skilful at using CORRAD ATT. *Adalah mudah bagi saya untuk menjadi mahir dalam menggunakan CORRAD ATT.*	○	○	○	○	○	○	○
12.	I would find CORRAD ATT easy to use. *Saya mendapati CORRAD ATT mudah untuk digunakan.*	○	○	○	○	○	○	○

Figure 19: Technology Acceptance Questionnaire (Technology Acceptance)

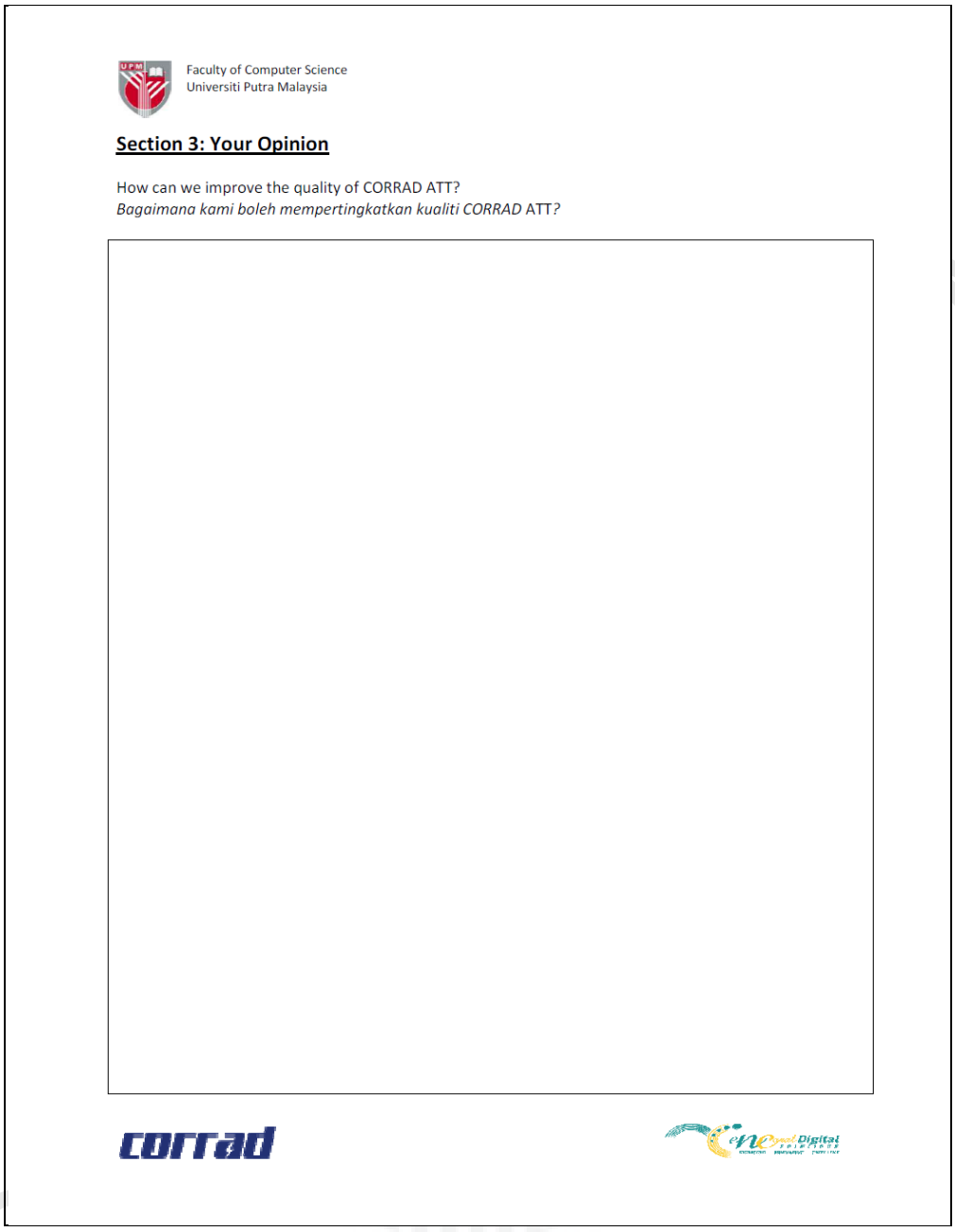


Figure 20: Technology Acceptance Questionnaire (Opinion)