UNIVERSITI PUTRA MALAYSIA

PORTING PROCESS MODEL FOR MOBILE APPLICATION

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By

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**Thesis Submitted to the School of Graduate Studies,
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PORTING PROCESS MODEL FOR MOBILE APPLICATION

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The current trend of Information and Communication Technology (ICT) is the convergence of communication, computing and the Internet. The birth of 3rd Generation mobile phone standard (3G) contributed to the development of smartphones. In the view of this trend, the mobile application development companies are developing different kind and type of applications to use in these smartphones. As these smartphones have different brands and models, it becomes an issue for the developers to develop an application that runs on any smartphones. Developers are also finding difficulties to port the native applications to other platform due to lack of standard porting process. This thesis analyzes the issues in mobile application porting processes and proposes a process model for mobile application porting. This process model is timely as the existing software development process models could not able to cater a specific guideline during mobile application porting. The research methodology used in this research composed of four phases; Literature Review, Preliminary Study, Design Proposed Model and Evaluation Proposed Model and were sequentially executed. To ensure legality, accuracy, reliability and validity of the research, some ethical considerations, quality of sample data collected and data sources were considered. The proposed process model composed of eight (8) processes, namely: Feasibility Analysis, Porting Requirement, Gaps Analysis, Porting Specification, Porting Design, Porting, Ported Mobile Application Testing and Test Report verification. Each of the processes were discussed in detail to provide comprehensive guidelines for the developers. A case study based porting assignment has been created (i.e. An Android application was ported to Windows Mobile 8.0 platform) to evaluate the effectiveness and efficiency of the proposed process model. Initially the porting assignment and proposed process model were reviewed by the experts. Finally, to justify the creditability of the proposed process model, Static-Group Comparison study was used. The data was collected from the comparison of two groups (i.e. Ad-Hoc and Treated), and then quantitatively evaluated. The overall finding shows that the proposed process model possesses most disciplined tasks where clear instruction were given throughout their porting process. Therefore, porting activities can be optimized and all necessary activities can be clearly identified and controlled. Thus,

the proposed process model has greatly help the developers to complete the porting project within costs and time, as well improves the quality of the application.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MODEL PROSES PENGALIHAN UNTUK APPLIKASI MUDAH ALIH

Oleh

KESAVA PILLAI A/L RAJADORAI @ RAJOO

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Trend semasa Teknologi Maklumat dan Komunikasi (TMK) bertumpu pada komunikasi, pengkomputeran dan Internet. Kelahiran standard Generasi ketiga (3G) telefon bimbit, menyumbang kepada perkembangan telefon pintar. Berdasarkan trend ini syarikat pembangunan aplikasi mudah alih menghasilkan pelbagai jenis aplikasi untuk digunakan pada telefon pintar. Memandangkan telefon pintar terdiri daripada pelbagai jenama dan model, pembangun perisian menghadapi isu menghasilkan satu aplikasi yang boleh digunapakai pada kesemua jenis telefon pintar. Pembangun perisian menghadapi kesukaran untuk mengalihkan aplikasi asal ke platform lain disebabkan ketiadaan piawaian proses pengalihan. Tesis ini menganalisa isu dalam proses pengalihan dalam aplikasi mudah alih dan mencadangkan satu model spesifik untuk pengalihan aplikasi mudah alih. Kemunculan model proses ini tepat pada waktunya kerana model proses pembangunan perisian yang sedia ada tidak dapat memenuhi keperluan garispanduan spesifik semasa pengalihan aplikasi. Metodologi kajian yang digunakan dalam kajian ini merangkumi Kajian Literatur, Kajian Awal, Reka bentuk model yang dicadangkan dan Penilaian Model yang dicadangkan dan dilaksanakan secara berperingkat. Sebagai etika, kualiti pengumpulan data sampel dan sumber data telah dipertimbangkan untuk memastikan kesahihan, ketepatan, kebolehpercayaan dan kesahan kajian. Model proses yang dicadangkan mengandungi 8 proses iaitu Analisa Kebolehlaksanaan, Keperluan Pengalihan, Analisis Jurang, Spesifikasi Pengalihan, Reka Bentuk Alihan, Pengalihan, Pengujian Perisian Aplikasi Yang Dialih dan Penentusahan Laporan Pengujian. Satu kajian kes berdasarkan tugasan pengalihan telah direka (i.e Aplikasi Android yang dialih ke platform Windows Mobile 8.0) untuk menilai keefektifan dan keefisienan model proses yang dicadangkan. Pada mulanya tugasan pengalihan model proses yang dicadangkan telah disemak semula oleh pakar. Akhirnya untuk mengadili krediliti model proses yang dicadangkan, kajian perbandingan kumpulan statik telah digunakan. Data yang dikumpulkan daripada hasil perbandingan kedua-dua kumpulan (i.e Ad-hoc dan Treated) telah dinilai secara kuantitatif. Penemuan keseluruhannya menunjukkan model proses yang dicadangkan mempunyai disiplin tugasan di mana arahan yang jelas diberi sepanjang proses pengalihan. Maka aktiviti pengalihan dapat dioptimumkan dan segala aktiviti yang diperlukan dapat dikenalpasti dengan jelas dan dikawal. Oleh itu model proses

yang dicadangkan telah sangat membantu pembangun perisian untuk menyempurnakan projek pengalihan dalam lingkungan kos dan masa yang ditentukan, dan juga penggunaan model proses sebegini memperbaiki kualiti aplikasi.

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I certify that a Thesis Examination Committee has met on 12 December 2017 to conduct the final examination of Kesava Pillai a/l Rajadorai @ Rajoo on his thesis entitled "Porting Process Model for Mobile Application" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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Declaration by graduate student

I hereby confirm that:
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Declaration by Members of Supervisory Committee

This is to confirm that:
- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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LIST OF ABBREVIATIONS

3G	3rd Generation Mobile Phone Standard
AJAX	Asynchronous JavaScript And XML
APA-FUR	Additional Ported Application Functional User Requirements
API	Application Programming Interface
BF	Browser Functions
BREW	Binary Runtime Environment for Wireless
CSS	Cascade Style Sheet
DBMS	Database Management System
DDBMS	Dynamic Database Management System
DOM	Document Object Model
D-PMAR	Desired Ported Mobile Application Requirements
FR	Functional Requirements
FUR	Functional User Requirements
HCI	Human Computer Interaction
HP	Hewlett Packard
HTML5	Hyper Text Markup Language 5
IBM	International Business Machine
ICT	Information and Communication Technology
J2ME	Java 2 Platform Micro Edition
MAD	Mobile Application Development
MAP	Mobile Application Porting
MCPD	Mobile Cross Platform Development
MF	Middleware Functions
MOS	Mobile Operating System
MoSCoW	Mo – Must do, S – Should do, Co – Could do, W – Would do
NA-FUR	Native Application Functional User Requirements
NFR	Non-Functional Requirements
NMA	Native Mobile Application
OS	Operating System
OSF	Operating System Functions
PLVMF	Programming Language Virtual Machine Functions
PMA	Ported Mobile Application
PMADS	Ported Mobile Application Design Specifications
PMARS	Ported Mobile Application Requirement Specifications
QR Code	Quick Response Code
RDBMS	Relational Database Management System
SDLC	System Development Life Cycle
SMS	Small Message Service
StS	Storage Services
UI	User Interface
XMT	Cross-Platform Mobile Development Tool

CHAPTER 1

INTRODUCTION

1.1 Overview

The current trend of ICT is the convergence of communication, computing and the Internet. ICT operators and providers are keeping up these trends and becoming market leaders by opening data services as a unified services. The birth of 3G contributed to the development of smart mobile phones. 3G provides services such as SMS, email, Internet browsing, mobile TV, and games. Currently, WEB 2.0 has become an inevitable trend and the essence of mobile Internet development. Hence, the usage of smartphones and intelligent telecommunication devices have become essential in daily life.

In view of this trend, mobile development companies are developing different kinds and types of applications for these smartphones. As these smartphones have different brands and models, they have become an issue for the developers to develop an application that runs on all types of brands and models. Moreover, smartphones companies such as Samsung, Apple, and Windows Mobile have an installed base each of more than 25 million devices. On the other hand, not all platforms are made in the same way since every mobile devices has its own characteristics such as OS, power, processor, screen resolutions, memory size etc. Variety of mobile applications, diversity, and demand of OS, make porting an important process; that is, to guarantee an application that creates using one platform that can easily be implemented in some other platforms, to reach larger parts of the market (Johansson, A. & Svensson, J., 2009), (Madadipouya, K , 2015).

As reported by mobilestatistics.com (Mobilestatistics.com, 2016), that in 2016 alone 30 billion iPhone natives and third party applications were downloaded from Apple AppStore which lead to 209 million dollars. This situation becomes worst when every mobile communication company operator (e.g. Apple and Samsung) is provides specific operating system and launch its own proprietary applications. For example, Apple produces, publishes and sells all their applications through their own marketing platform called AppStore. Other mobile companies noticed the new momentum and followed suit by creating their own marketing platform (e.g. Android's Playstore) (Minelli, R., 2012).

To substantiate, DeviceAtlas (Deviceatlas.com, 2017) research, shows there will be over 4.9 billion mobile phone subscribers in 2018 who make up 87% of the world population have mobile phones and 2.9 billion of them will own smartphones and this number is increasing fast. As more and more people use smartphones, the necessity for mobile applications also increases. To meet the market demand, mobile application developers are struggling to develop more and more mobile applications. Currently, there are thousands of mobile applications in the market which were developed for a

single OS. Hence, developers are having difficulty to port these applications to other OS due to lack of disciplined porting process.

1.2 Porting Mobile Application

Porting is an engineering process of converting an object (i.e. Software or hardware) which was initially developed for a specific environment to a new environment. For example, a mobile application initially developed for android OS needs to convert for Apple OS. (RapidSoft Systems Inc., 2012)

The high demand of mobile applications in the market, has forced mobile developers to develop the product within a short period. Hence, the developers are struggling to meet the market demand within the short period and are forced to use short-cuts such as ad-hoc approaches. Moreover, porting approach for mobile applications are new (RapidSoft Systems Inc., 2012), where previously developers redeveloped by using general desktop development methodologies such as agile methodologies for their redevelopment (V. Rahimian and R. Ramsin, (2008). As these approaches take longer time, the mobile development companies are trying to adapt to a new approach call porting, where Native Mobile Applications (NMA) are directly transformed into Ported Mobile Application (PMA).   Since porting is new for mobile application developers, companies use ad-hoc development processes such as "hit or miss", "fire-fighting" techniques or desktop application development process models (Johansson, A. & Svensson, J. 2009), (Madadipouya, K., 2015). Owing to the ad-hoc process used, the products took longer than expected to develop and some customers' specific requirements could not be satisfied. Therefore formalizing a process for porting mobile application is essential to meet the customers' demand which is growing fast.

Although developers realize these issues, they are finding it difficult to cope with demand. These issues are severe because Mobile Application Porting (MAP) is not the same as desktop because mobile devices have some limited capabilities such as screen size, memory size and power. There are different variants of hardware, software, configuration of mobile application product and specific features supported by different mobile devices and operating systems. Mobile applications are developed using many different types of platforms such as J2ME and BREW. These platforms have the highest volumes of history of mobile software development (Rapid Soft Systems Inc., 2012). For example, a mobile application can be implemented using different platform and also the mobile application can be used for different mobile devices.

1.3 Problem Statement

Mobile technology is growing rapidly; everyday there are new mobile applications being developed and out in the market. However, these applications were developed for a particular mobile platform. It becomes a problem when the said mobile applications need to run in a different mobile platform. For example, an application that was natively developed for IOS platform, but then needed for Android platform. Thus, the

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developers will need to redevelop the application to suit the Android platform. However, developing the same application over and over significantly increases the effort, time and costs of the development team (Chaitanya Kaul and Saurav Verma, 2015). Currently, the developers are using re-development or rewrite approaches as there are lack of specific MAP process model, developers are using desktop application development process models (Johansson, A. & Svensson, J. 2009), (Madadipouya, K., 2015) or intuition. Following are the significant problems when using desktop application development approach for MAP;

- Developing the same application over and over significantly increases the **effort, time and costs** of the development team (Chaitanya Kaul and Saurav Verma, 2015).
- **Desktop application development and MAP are not the same**, because for MAP, developers need to consider porting platform specific functionalities such as OS functionality, middleware functionality, programming language virtual machine functionality and browser function. However, these are not required for desktop application (Abran, A., Al-Sarayreh, K. T. and Cuadrado-Gallego, J. J., 2013).
- **Generic development process model**, will only provide a general guideline for the developers to follow. As a result, the developers will tend to overlook certain aspect of specific activities which are necessary for the said mobile application porting.
- Despite the said understanding and the **immaturity of porting activities**, the developers are not paying much attention to develop a disciplined porting process (RapidSoft Systems Inc., 2012) as they are rushing to complete the product as soon as possible.
- **Current approaches were not executed systematically**, slowed down the porting activities, which made a number of mobile applications (13% for Windows phone market, 24% for Apple store and 37% for Android market) (Nimbalkar R. R, 2013) unable for launch on time and are forced out of the market every month.
- **Clients' special requests** are not included in the ported application, ported application requirements are not considered and inconsistency in design and development that make the integration difficult.
- **Inconsistent product design and development** as a consequence of undisciplined processes, product integration becomes complex and difficult where time will be wasted in the modification process.

Even though there are numerous on-going research by (Mooney, J.D,, 1997), (Johansson, A. and Svensson, J., 2009), (RapidSoft Systems Inc., 2012), (Damith C. Rajapakse, 2012), (Nimbalkar R. R, 2013), (Abran, A., Al-Sarayreh, K. T. and Cuadrado-Gallego, J. J., 2013), (Madadipouya, K., 2015) (Chaitanya Kaul and Saurav Verma, 2015) to cover certain aspects of mobile porting processes, a solution to the problems above is still missing. Realizing these gaps and weaknesses, it aspires to explore options for a porting process model that would focus on MAP projects.

1.4 Research Questions

To explore further this research was broken into manageable research questions (RQ) as follows:

RQ1.   What are the available MAD platforms?
RQ2.   What are the currently available porting strategies in general?
RQ3.   What are the common phases in mobile porting?
RQ4.   What are the important characteristics to be considered in each of the phases?

1.5 Research Objective

This research is focused on the porting of mobile applications. The aim of this research is to develop a process model that would be used by mobile application developers for their MAP purposes.

To achieve the aim, the following objectives are considered:

1. To provide with important phases, tools, techniques and characteristics needed for MAP.
2. To develop a process model for porting of mobile application.
3. To evaluate the effectiveness and efficiency of the proposed process model.

1.6 Scope of Study

This research focuses on porting of NMAs with concentration given to disciplined porting processes for MAP assuming that the hardware and the data remain constant.

1.7 Thesis Structure

This thesis is organized as follows: Chapter 2 presents the literature review that provides ideas for proposing the new process model. Chapter 3 explains the research methodology used for this research. Chapter 4 presents the analysis of the gathered data. Chapter 5 describes the design of the proposed process model. Chapter 6 elucidates the result along with the interpretation of the evaluation result. Finally, the conclusion and recommendation is presented in Chapter 7.

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