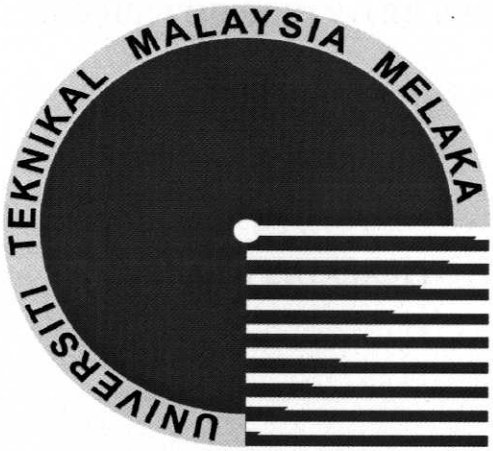

Faculty of Information And Communication Technology

ESTIMATION TECHNIQUE FOR SOFTWARE PROJECT PLANNING

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ESTIMATION TECHNIQUE FOR SOFTWARE PROJECT PLANNING

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RECOMMENDED READING MATERIALS

This thesis gives an account of the research undertaken by the author. Some of the material contained herein has been presented in the form of the following publications:

Periasamy S, Nanna S H (2007), Crystal Method for Accurate Software Duration Estimation, *International Conference Electrical Engineering ICEI2007, Malacca, Malaysia pp.563-569*

Periasamy S, Nanna S H (2007), Competency Measurement System for software developers, *Regional Conference on Computational Science and Technology, RCCST-2007, Sabah, Malaysia.*

Periasamy S, Nanna S H (2007), Effective Human Resource Leveling Model for IT Projects, *Regional Conference on Computational Science and Technology RCCST-2007, Sabah, Malaysia.*

Periasamy S, Nasina J, Mohammad I.D.,(2004), An Expert System for Human Resource Leveling in Information Technology Projects, *Journal of Technology Management and Enterpreneurship, KUTKM-2004, Melaka.*

DECLARATION

I declare that this thesis entitle " Estimation Technique for Software Project Planning" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name: SOBAH A/P PERIASAMY

Date : 01-04-10

DEDICATION

To Mr. Rama Chendra, thank you for showing me the many facets of scholarship. You were the light at the end of a long, dark tunnel. I would also like to dedicate this work to Mr. Kugen and Mr. Reelen, for all your support, without you two I could not have completed this research.

PREFACE

An effective estimation and resource allocation is important for the timely completion of projects, because of the difficulty in reducing project duration without reducing its components. Managers can have a large effect on resource utilization even when the total quantity of resources (e.g., the number of developers) is fixed. Resource competency improvement, policies for allocating and leveling resources among specific development activities can be used to speed up projects. The current work focuses on software project estimation, human resource allocation, human resource leveling, and developer competency measurement, as a means of reducing project duration.

In general the resource allocation and leveling policies associated with the dynamics of product development delay and the rework. How should project managers accurately measure development time and allocate resources or level resources to shorten project duration?

I hope that the user will share my excitement on the subject of new methods in software project planning on project estimation, resource allocation resource leveling, and competency measurement.

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I am deeply indebted to many individuals who, directly or indirectly, are responsible for this piece of work coming into being. I am most grateful to Dr. Abdul Samad Bin Shibghatulah, Prof. Dr. Shahrin Sahib, Prof. Dr. Mohammad Ishak Bin Desa, and Prof. Dr. Nanna Suryana Herman, for their continuous interaction with the result of the work and passing on comments and suggestions for further modifications and advancement in the work. I am also indebted to Dr. Vengatash for his constructive criticism of my research on project planning, and most of all for his friendship and support in all my endeavours.

I have derived considerable benefit and ideas from lecturers, students, consultants and practitioners willing to argue and discuss the application of software project planning, and in this regards, I convey my deep appreciation to them.

Last, but by no means least, I am truly grateful to Mr.Rama Chendra, Mr.Periasamy, Madam Muthmal, and thanks to Kugen and Reelen for their patience and understanding through many lost evenings and weekends.

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LIST OF ABBREVIATIONS

ACAP	Analyst Capability
AEXP	Applications Experience
AI	Artificial Intelligence
BOE	Basis of Estimate
CMM	Competency Measurement Model
COCOMO	Constructive Cost Model
CPLX	Product Complexity
CPM	Critical Path Method
DAI	Data Assimilation Initiative
DATA	Database Size
DET	Data Element Types
DFD	Data Flow Diagram
DSI	Delivered Source Instructions
EAF	Effort Adjustment Factor
EI	External Inputs
EIF	External Interface Files
EO	External Outputs
EQ	External Inquiry
FP	Function Point
FPA	Function Points Analysis
FTR	File Types Referenced
GSC	General System Characteristics
ILF	Internal Logical File
IT	Information Technology
KLOC	Kilos Line of Code
LEXP	Programming Language Experience
LOC	Line of Code
MM	Man-Months
MMRE	Mean Magnitude of Relative Error
MODP	Use of Modern Programming Practices
MRE	Magnitude of Relative Error
OBS	Organization Breakdown Structure
PCAP	Programmer Capability
PDF	Probability Density Function
PERT	Program Evaluation and Review Techniques
PM	Project Management
PMBOK	Project Management Body of Knowledge
RA	Resource Allocation

RAD	Rapid Application Development
RELY	Reliability Requirements
RET	Record Element Types
RL	Resource Leveling
RPN	Risk Priority Number
SCED	Required Development Schedule
SCTC	Software Technology Support Center
SDLC	Software Development Life Cycle
SLOC	Source Lines of Code
SPSS	Statistical Package for the Social Sciences
STOR	Main Storage Constraints
TCA	Technical Complexity Adjustment
TDEV	Time (months) to Develop
TIME	Execution Time Constraints
TOOL	Use of Software Tools
TURN	Computer Turnaround Time
UFC	Unadjusted Function Point Count
VAF	Value Adjustment Factor
VEXP	Virtual Machine Experience
VIRT	Virtual Machine Volatility
WBS	Work Breakdown Structures

ABSTRACT

Inaccurate estimations in software projects lead to several problems and even challenge the success of a project. Estimation error of software projects is high; it exceeds 25% of its actual development period and cost. The author conducted surveys on software project estimation, human resource allocation and human resource leveling in different projects in different software organizations in Singapore, Malacca, Kuala Lumpur, Petaling Jaya and Selangor. Based on the survey reports and literature reports, this study is focused on developing an EnhancedEste model for accurate estimation to optimize workflow efficiencies by integrating some existing systematic and scientific methods for software project planning. In remark, a model is developed which supports and integrating many of the techniques and methods for software project planning. This model is presented with new techniques for software project estimation; human resource allocation, human resource leveling, and developers competency assessment, making them easily accessible to project managers. In order to verify the EnhancedEste model, the author developed the prototype after interviewed many software project managers/software project leaders/personnel in charge of software project management, based on their response, found the model is efficient. This study suggests that, these techniques enable software developers closely resemble the milestone proposed for speeding up other forms of product development.

ABSTRAK

Jangkaan tidak tepat dalam sesuatu projek perisian akan menyebabkan beberapa masalah malahan penyebab kepada kegagalan sesuatu projek. Kesilapan dalam menjangkakan projek perisian adalah tinggi iaitu melebihi 25 peratus daripada jumlah projek. Penulis telah menjalankan tinjauan tentang jangkaan projek perisian, pembahagian dan penyamarataan sumber manusia dalam beberapa projek di beberapa organisasi pembangunan perisian di Singapura, Melaka, Kuala Lumpur, Petaling Jaya dan Selangor. Berdasarkan kepada laporan tinjauan dan kajian literatur, penyelidikan ini memfokus kepada pembangunan model EnhancedEste untuk jangkaan yang lebih tepat dalam mengoptimumkan keberkesanan aliran kerja dengan mengintegrasikan cara sistematik dan saintifik untuk jangkaan projek perisian. Model ini di bangunkan dengan beberapa teknik baru untuk jangkaan, pembahagian sumber manusia, penyamarataan sumber, penilaian kompetensi pembangun, dan pembahagiaan tempoh kepakaran membuatkan ianya mudah di akses oleh pengurus-pengurus projek.Untuk menilai model EnhancedEste penulis telah membangunkan prototaip selepas menemuduga ramai pengurus projek perisian / pemimpin projek perisian / pekerja yang bertanggungjawab dalam pengurusan projek perisian. Berdasarkan kepada maklumbalas mereka mengatakan model tersebut adalah berkesan. Daripada kajian ini mencadangkan teknik ini memudahkan pembangun perisian kerana ianya menyerupai batu tanda yang dicadangkan untuk mempercepatkan lain-lain bentuk pembangunan produk.

CHAPTER 1: INTRODUCTION

1.0 Introduction

Project Management (PM) is a specialized management technique to plan and control projects under a strong single point of responsibility. A project is generally deemed successful if it meets pre-defined targets set by the client, performs the job it was intended to do, or solves on identified problem within predetermine time-cost and quality constraints. To meet these targets the project manager uses project management technique to effectively plan and control the project. The next paragraphs explain briefly components of a project.

A project is a sequence of unique, complex, and connected activities having one goal or purpose and that must be completed by a specific time, within budget, and according to specification (Robert *et. al.*, 2000). A project comprises a number of activities that must be completed in some specified order, or sequence. An activity is a defined chunk of work (all project activities follows a specific sequence). The sequence of activities is based on technical requirement, not on management prerogatives. The whole project is broken into small activity. Specifying sequence based on resource constraints or constraints (Robert *et. al.*, 2000).

Project activities usually are connected (Bob and Mike, 2002). Connectedness implies that there is a logical or technical relationship between pairs of activities. There is an order to the sequence in which the activities that make up the project must be completed. They are considered connected because the output from one activity is the input to another activity. During the estimation process assigning activity connectedness is very important. Projects have a specified completion date. This date can be self-imposed by management or externally specified by a customer or government agency. The deadline is beyond the control of anyone working on the project.

Projects also have resource limits, such as a limited amount of people, money, or machines that are dedicated to the project. While these resources can be adjusted up or down by management, they are considered fixed resources to the project manager. Motivation for this research is explained in detail in the next section.

Project management in the business and industry field is defined as managing and directing time, material, personnel, and costs to complete a particular project in an orderly, economical manner; and to meet established objectives in time, dollars, and technical results. All projects share one common characteristic that is the projection of ideas and activities into new endeavors. No project is same as previous project, therefore it has some kind of risk. The ever-present element of risk and uncertainty means that the events and tasks leading to completion can never be foretold with absolute accuracy (Blum, 1992)

1.1 Background of Research Problem

Project failure refers to inability to meet the target set at the beginning. In a paper by Robert *et. al.*, (2000) reports a survey by Standish Group in 1995 involving 1000 IT (Information Technology) manager on reasons why a software project fails. They found ten top reasons. Those reasons are incomplete requirements, lack of user involvement, lack of resources, unrealistic expectations, lack of executive support, changing requirement and specification, lack of planning, elimination of need for the project, lack of IT management, and lastly technology illiteracy. The research work focuses on some of the ten top reasons, such as accurate estimation technique and good resource allocation based on engineer's expertise will overcome these drawbacks. The reasons for project failure is explained in the next paragraph.

A study by Rakos (1990) has identified some of the problems that cause projects to failure. Many project fails at the start. Many projects fail to estimate what the extent of the effort will be required and without an idea of requiring staff to complete, which is a major cost factor in the project. Unrealistic deadlines and budgets are often foisted on a project team by 'authorities' who are unaware of the importance of an accurate estimate, and the project team is locked into an impossible commitment. Some projects can fail at the development stage. This is due to analysis and design results which are not documented properly, which causes misinterpretation. Required human resources need to plan and schedule them ahead of time else will not available when needed. The management also needs to plan on key personnel or

people leaving the team or organization (Tinnirello, 2002; Todd, 2004). Importance of planning is explained next.

A good planning is knowing ahead of time where the project will be after some time, how it will achieve its objective, how to prove the project is achieved target. Activity duration is a random variable. Therefore the factor will be operative when work is underway on an activity, and precise activity duration cannot be determined at an early stage. Therefore a loose date line for activity completion gives higher chances to achieve its target as Parkinson's approach carried out in this study (Boehm, 1981; Richard 2001). Many techniques used for activity/ task estimation are discussed next.

At present many different estimation techniques are used. Software project usually delivered late (if they are not cancelled). This is due to the most common reason, which is under-estimation (i.e. too short a duration). Project managers are assisted by estimation techniques such as Work Breakdown Structures (WBS), Function Point (FP) Analysis, Delphi methods and COCOMO method. Most of the time, these methods are extremely difficult to use and confusing to interpret. They often require extensive amounts of data (such as the number of lines of code, or detailed system design documents) before producing even the most general estimates. In addition, these methods are so focused on being meticulous and precise that they often overlook the obvious advantage of intuitive reasoning. By being consumed in numbers and calculations (or boxes and charts, in the WBS technique), the obvious clues from the available documents are usually missed. Under estimation of a project leads to under staffing it

(resulting in staff burnout), under-scoping the quality assurance effort (running the risk of low quality deliverables), and setting too short a schedule (resulting in loss of credibility as deadlines are missed). The most obvious reason for underestimation is the software size in line of code. The size is often used in FP, COCOMO, and others (Boehm and Ross, 1989). Another root cause of failure is explained in the next paragraph.

The software size is the key input (i.e. cost driver) for most software parametric estimating models. However, software size is not always easy to determine, especially during the early stages of a project. According to Jones (1994) the severity of software sizing errors is extremely high. Its root of failure is to estimate the size of major software development components, such as specifications, source code, user documents, and test cases. The errors in estimating size for major software components, where the errors exceed 25 percent of the actual size (Moløkken-Østvold and Jorgensen, 2004). Estimation risk in developing environment (programming language) is explained in next paragraph.

A study by Pandian (2004) identified a few estimation risks. At present parametric models are used on estimation. The parametric models develop estimates through mathematical formulas that often use statistical relationships between the size and software characteristics that affect size (e.g., programming language). Some software requires many lines of code whereas others required a few lines of code only. The common estimation risks are inability to estimate size of the software project, inability to accurately specify a development environment that reflects reality would be another risk. Followed by improper assessment of staff skills, then lack of

well-defined objectives, requirements and specification during the software development life cycle (SDLC). Lastly the project management team needs tools or proven techniques to complete their project on time (Pandian, 2004). The effective estimation plan is explained in next paragraph.

For the project manager to effectively plan and control a project, accurate estimation is essential (Marchewka, 2003). The estimator's task is to predict the projects' parameters by building a model of the project on paper. The project manager estimate cost, development time, resource requirement, and development effort. The quality of the estimation should be seen as the best approximation based on available time, information available, techniques employed, expertise and experience of the estimation personnel. Therefore project estimation and resource allocation and leveling is treated as one process. The accuracy of the estimation will depend on the level of details it is based on (Milicic and Wohlin, 2004). This information will come from scope of work, the contract, the specification, and the extent of risk and uncertainty in the project. This information need to transfer to project management level for on time completion. The advantages of detail planning is explain in next paragraph.

Management of project is a method and a set of techniques based on the accepted principles of management used for planning, estimating, and controlling work activities to reach a desired end result on time within budget and according to specification. It is the interaction of time, resources and activity. Without a thorough understanding of this interaction, projects miss deadlines, run over budget or worse; fail altogether. The scope of project directly related to