Maintenance Effort and Cost Estimation
Using Software Functional Sizes

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Abstract

This paper presents two models for estimating software maintenance effort and cost using software size measured by COSMIC Full Function Points (FFP) as the independent variable. The proposed models are established experimentally using ten real software maintenance projects belonging to a large telecommunications company.

To establish the estimation models, the linear regression technique is used to analyze the historical data. This technique is also applied in combination with logarithm transformation of the collected data. Our results show that the correlation coefficients (or R^2) between size (FFP) and real effort and size (FFP) and cost are 89% and 88% respectively. With logarithm transformation, the correlation coefficients are 85% and 86% for effort and cost respectively. We recommend using the established models in combination with logarithm transformation because the prediction quality of these models (PRED) is better than that of the models established without it.

In addition, we verified the quality of our models by analyzing the Mean Magnitude of Relative Error (MMRE) on ten other maintenance projects which were carried out by the same company. The MMREs of the effort and cost estimation models obtained are 48% and 45% respectively.

We also tried to estimate maintenance effort using IFPUG 4.1 Function Points (FPA). Unfortunately, none of the three effort models we used, including the Albrecht and Gaffney model, the Kemerer model, and the Matson, Barnett and Mellichamp model, provides good results with our historical data.

Keywords: maintenance effort, maintenance cost, effort estimation, cost estimation, Function Point Analysis (FPA), COSMIC Full Function Points (FFP).

1. Introduction

Estimating software cost and effort for software development and software maintenance has been a research issue for over 25 years now. Many of the estimation models that have been proposed are regression-based, that is, the estimation model is derived using regression analysis on data collected from past software projects. Examples are the Walston Felix, Bailey-Basili, COCOMO Basic and Doty models (see Pressman 1997, p.121). Software size (in Lines of Code) is an independent variable of these models.

In the literature, there are some well-known methods for measuring software size, such as Lines of Code [CON86] and Function Point Analysis (FPA) [ALB79, 83]. Recently, a number of new methods have been proposed to adapt Albrecht's Function Point Analysis to new software characteristics such as real-time software, embedded software and scientific software [ABR01, WHI95, JON91, REI90, SYM88].

Some models have been proposed for estimating software development effort and cost using FPA [PRE97 p.121], but there are very few models that can be used to estimate maintenance effort and cost from the software size measured by these new sizing methods.

The main goal of this paper is to propose some estimation models for software maintenance using COSMIC Full Function Points (FFP) [ABR99]. Our models have been established experimentally on the historical data of ten software maintenance projects which were carried out by a large telecommunications company between 1999 and 2001. We use twelve other projects used by this company (hereinafter referred to as Company C) to verify our models by analyzing the Mean Magnitude of Relative Error (MMRE). All projects mentioned in this paper were maintenance projects of MIS software.

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