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# An Experimental Study of Individual Subjective Effort Estimations and Combinations of the Estimates

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## ABSTRACT

The required effort of a task can be estimated subjectively in interviews with experts in an organization in different ways. Interview techniques dealing with which type of questions to ask are evaluated and techniques for combining estimates from individuals into one estimate are compared in an experiment. The result shows that the interview technique is not as important as the combination technique. The estimate which is best with respect to mean value and standard deviation of the effort is based on an equal weighting of all individual estimates. The experiment is performed within the Personal Software Process (PSP).

## Keywords

Cost estimation, experimentation, measurement, metrics, project management.

## 1 INTRODUCTION

An important aspect of software engineering is the ability to do estimations of process and product attributes. Bad estimates result in that costs and deadlines are overrun. Some important attributes to estimate for projects are the cost of the project, the lead time of the project and the reliability of the delivered products. These attributes are of course not independent, but in most cases estimations are performed for the attributes one at a time, and this paper focuses on estimation with respect to cost, and specifically with respect to required effort. It has been decided to focus on required effort since this is one of the most important parts of the cost of a project.

Effort estimation is hard in general, but a number of methods for estimation exist in the literature, e.g., Boehm's COCOMO model [3] and methods based on Albrecht's function point approach [4]. These, and a number of other methods, rely on historical experience to predict required effort through a prediction relationship. This relationship can, for example, be derived by linear regression. This means that in order to predict the required effort for a certain task, the same or similar types of tasks must have

been performed before. It also means that the required effort must have been measured every time the tasks have been performed.

This paper deals with effort estimation techniques that are not based on quantitatively measured experience from former projects. Instead the methods rely on subjective estimations performed by experts in the organization. This can in many cases be a good complement to quantitative measurement. The advantage of this type of method is that it can be applied even if an extensive set of measurement has not been performed before. This is, for example, the case when the software development process recently has been changed or when the process should be changed for the project where the effort should be estimated. In the literature, only a few methods have been proposed for doing subjective estimations. Probably, the most well known method is the method described by Putnam [10] for subjective estimation of length of a program. In [6] six techniques for subjective estimation of effort are evaluated together with Putnam's method used for effort estimation.

In this paper, the above mentioned techniques are presented and compared in a controlled experiment. The experiment is focused towards the area of software engineering, and in particular process improvement when the gathered experience for the new process is limited. The same type of experiment can however be performed in other areas whenever a number of methods for estimation should be evaluated. The same applies to the usability of the proposed estimation techniques. The techniques could be used in any area where subjective estimations would be appropriate.

The experiment presented in this paper is the continuation of a pre-study experiment. The pre-study experiment was performed in retrospect with respect to the task for which the effort was estimated, but it did anyhow indicate that the proposed estimation techniques could be used for subjective estimations. The design of the pre-study experiment has been used as a basis for the design described in this paper. Since the pre-study experiment involved five participants and the experiment described in this paper involves 26 participants, the experiment described in this paper is substantially larger than the pre-study experiment.

In this paper a number of different alternative techniques