Success Factors and Motivators in SPI

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ABSTRACT
The authors report in this article from a survey of medium-sized and large software companies in Denmark where major variations were found in the practice of software process improvement (SPI). Many software companies intend to do SPI; but few companies invest the necessary effort in improvement, and few perform maturity assessments. In general, across the surveyed companies, the effects of SPI are very limited. The study also found that internal motivators are more frequent than external motivators. This article presents and discusses the survey and the results. It also discusses implications for IT organizations and professionals and recommends: (1) assessing the maturity level; (2) allocating sufficient resources to SPI; and (3) creating a positive feedback loop between SPI benefits and SPI efforts.

Keywords: Diffusion, Measurement, Motivators, Software Companies, Software Process Improvement

INTRODUCTION
Software process improvement (SPI) is a rather old idea – probably as old as the field of software engineering. With the advent of the Capability Maturity Model (Humphrey, 1989; Paulk, Curtis, Chrissis, & Weber, 1993; Curtis, 2000) and a little later Software Process Improvement and Capability Determination (El Emam, Drouin, & Melo, 1998) the concept of SPI took a more formal form. Later again there has been an increased focus on the competences of software engineers and in software companies (Colomo-Palacios, Tovar-Caro, García-Crespo, & Gómez-Berbis, 2010; Aramo-Immonen, Bikfalvi, Mancebo, & Vanharanta, 2011). Despite this there have been remarkable few studies of the diffusion of SPI.

A review of literature searched in high-level outlets through Web of Knowledge and Google Scholar shows few but important research contributions. The Process Maturity Profile compiled by SEI (Software Engineering Institute, 2009) summarizes data from organizations voluntarily reporting their maturity levels. Reporting an appraised CMMI level does not necessarily imply an ongoing SPI practice, but it is a reasonable assumption that reporting organizations are interested in SPI. Since the report gives no information on the size of the population from which the reporting organizations could be seen as a sample it is not possible to deduce the percentage of software organizations practicing SPI. However, the report does give

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a minimal absolute number of organizations. Since the report has been produced regularly for seven years, it can describe trends. In all 3906 organizations have reported their appraisals by July 2009. 92% of these are on levels 2-5. Of the 3863 organizations reporting size data, 85% have more than 26 employees in the area of the organization that was appraised. As the sample increases there is a trend towards more organizations being on level 3 and fewer on 5. Only a couple of Danish organizations have reported appraisals to SEI, and only one of these is in our population.

The research question we are pursuing in this paper is: How many software companies in Denmark are engaged in software process improvement, what is the effect, and how is the effect related to the companies’ situation?

The paper is structured as follows. The theories we build on are presented together with our model of SPI diffusion. We present the research method with a particular focus on determining the population and a reasonable sample. We then analyze the empirical data and discuss the findings. Finally, we conclude the paper.

**Models and Hypotheses**

A study of diffusion of SPI needs to start in the existing literature. Many have studied success in SPI and they have developed conceptual models and instruments.

Wilson et al. (2001) developed a quantitative measurement model based on in-depth group interviews in 7 UK software companies. They reached the conclusion that it is important for SPI success that: senior management is committed, SPI is staffed with highly respected people, initial processes are defined, and SPI is explained.

Rainer and Hall (2002) survey a sample of 84 SPI managers representing a response rate of 8.4%. In their study they find factors impacting SPI success, e.g., internal leadership, inspections, executive support, and ownership of internal processes. In a follow-up study (Rainer & Hall, 2003) they supplement the previous study with group interviews in 13 companies and identify 26 factors altogether that impacts SPI.

In another study of 13 UK software companies Baddoo and Hall (2002) analyze what motivates software developers and their managers to engage in SPI. It is concluded that practitioners’ ownership of processes is important and so is the evidence available on success as well as the resources provided. An almost reverse study of de-motivators was conducted through 49 focus group interviews involving 200 practitioners in 13 UK companies (Baddoo & Hall, 2003). This study shows that there are de-motivators specific to developers, project managers, and senior managers; e.g., de-motivators for project managers are: lack of measurement, fire-fighting, low process priority, and staff turnover.

Niazi et al. (2006) conduct a more comprehensive study of SPI implementation. Seven factors are identified based on interviews with 34 SPI managers. The factors are: high management support, training, awareness, allocation of resources, staff involvement, experienced staff, and a defined implementation strategy.

Dybå (2000) develop a measurement instrument to assess which factors are key in influencing or determining success in SPI programs. The instrument is validated in a study in Norway based on 120 respondents. On the same data he reaches the conclusion that small companies are just as effective as large companies and additionally that small companies gain higher performance measures than large companies (Dybå, 2003). A causal model for SPI success is developed alongside a set of hypotheses; these hypotheses are all confirmed with data from the survey of 120 Norwegian software companies (Dybå, 2005).

In continuation of the existing literature on SPI success we present a model for SPI to clarify the scope of our study. Our model of a SPI-performing organization is illustrated in Figure 1. It is basically an input-process-output model. The process is the SPI-related actions taken in the company. The output of the process is the organizational states that can be seen as
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