Social Capital as a Determinant Factor of Software Development Productivity: An Empirical Study Using Structural Equation Modeling

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ABSTRACT

Social capital is an important network based intangible asset with a potential for maximizing individual and team productivity in a social setting like software development. It is important to investigate intervening factors that challenge software development productivity. In this paper, the authors mixed method approach harnesses a structural equation model (SEM) for its quantitative part to establish a paradigm for understanding the effects of social factors for software development organizations. The proposed SEM model measures the correlations between several potential factors associated with productivity, social productivity, and social capital that are chosen as latent variables. For the qualitative phase, an industrial focus group is used to single out these factors and their association with potential social aspects. Quantitative data is gathered from a survey conducted at a university. The qualitative phase encompasses an industrial focus group, initially starting with the factors from the literature and refined through participants’ field experience. Findings indicate that a high correlation exists between several social factors that are reported by the focus group. Finally, initial results suggest that understanding the factors that affect social capital in software development is essential for building and sustaining highly productive development environments.

Keywords: Social Capital of Software Development, Software Development Productivity, Social Productivity Factors, Software Productivity Improvement, Structural Equation Modeling

INTRODUCTION

Social interactions and relationships matter for the well-being of a software development organization. These efforts work as a vehicle to convey the diffusion of information during the software development process. Therefore, software development is considered to be a human endeavor (i.e., intellectually intensive team effort) (Fairley, 2009). Consequently, the human and social aspect of software engineering has turned into an important topic to investigate for both scholars and practitioners who strive...
to improve organizational efficiency. Today, it is commonly accepted as the productivity of a software development team not only depends on the degree of its members’ experience, skills, and competences but also how well its members socially interact. In fact, it is not surprising to observe that experiencing greater production success heavily relies on how the teams socially communicate, and utilize their interactions. These interactions however, should be governed and coordinated to achieve the desired productivity levels both for an individual and a team. By understanding software development as a social activity (Dittrich, Floyd, & Klischewski, 2002), we begin to investigate social capital as a network-based shared norm or a value that supports collective outcomes and to explore the related factors for software development. The goal is to measure the socioeconomic constraints for organizations by exploring several social and productivity factors that are highlighted by software development participants. A software development organization should enable their teams to use their social capital (for example while creating optimal team configurations) and use this value to understand and measure the needs to improve its economically effective levels.

The process of forming a conceptual definition of social capital and customizing a method for its measurement are both very challenging tasks especially in applied settings. Nevertheless, we claim that social capital should be considered as an adequate value to be identified, measured and used for productivity improvement in a software development environment. There are several context specific definitions of the term social capital emerged and used within the empirical research. Social capital should be a factor to improve the productivity of social structure. It should be defined as a network based (hidden) resource identified by the size and the value of an individual’s social connections. Therefore, understanding the notion of social capital has a potential of improving social aspects of software development.

Our research agenda has two important objectives: First determining factors that are affecting productivity and second, investigating a method or a model to determine a way to measure the correlations among these factors. In our preliminary study (Yilmaz & O’Connor, 2011), we have analyzed the relationship between the social factors potentially affecting productivity and productivity based upon software productivity literature refined by our focus group studies. Consequently, we designed a SEM model to investigate productivity factors and sought empirical support for our proposed approach. Based on the selected data collected from a preliminary study, in this work, first we plan to revise our previous models, and second we design a new SEM model to examine the relationship between social productivity and social capital.

The rest of this paper is organized as follows: In the next section, we introduce several definitions for the social and value dynamics of software development landscapes such as software artifacts, productivity, the value, social capital, social productivity. The following section describes some of the techniques that are used in social network analysis (SNA). The next section describes the analysis models and methods proposed and used in this research. It presents some of our findings that validates our proposed model, and verifies our empirical approach. Finally, the last section concludes the paper with a brief summary of contributions and some directions for future research.

**SOCIAL AND VALUE DYNAMICS**

Social dynamics, also known as the dynamics of human interactions, is a multi-disciplinary field of science that is concerned with analyzing socialites or social systems formed by participants and their interactions. This section surveys several important concepts and definitions and the foundations of social and the value dynamics of a software organization. These concepts and definitions highlight the important points of the Social Aspects of Software Engineering (SASE) (Dittrich et al., 2002). Ultimately, SASE helps
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