Chapter 1

Identifying Technical Competences of IT Professionals: The Case of Software Engineers

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ABSTRACT

This paper aims to identify technical competency levels relevant to Software Engineering in a spectrum of professional profiles which are found in Spain’s main Software Development companies. The research work presents a combination of three initiatives. The first step constitutes a review of the literature related to the characterization of the labor force in the Software Engineering domain. The subsequent step consists of a qualitative study of the practices of a set of organizations, and lastly, this was followed by a quantitative analysis based on investigative surveys administered to a number of representative professionals. The professional career is established from seven consecutive profiles. The pyramidal model for professional careers, identifying one single professional track going from Junior Programmer to IT Director, is still present in the organisations subject to this study. Technical excellence is reached in a determined professional profile, in this case “D”. From this point onwards, other competencies which are not uniquely characteristic of Software Engineering gain importance, and stimulate professional development towards higher levels.

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1. INTRODUCTION

Human Factors represent one of the most important areas of improvement in Software Engineering (SE). Failure rates in software projects are high, and qualified software engineers pertaining to software development teams are key factors in the software development process and their shortcomings and caveats (Pressman, 2005). More precisely, Boehm points out that “After product size, people factors have the strongest influence in determining the amount of effort required to develop a software product” (Boehm, 1981), and “Personnel attributes and Human Resource activities provide by far the largest source of opportunity for improving software development productivity” (Boehm, Horowitz, Madachy, Reifer, Clark, Steece, Brown, Chulani, & Abts, 2000). Competence at the individual level is required for the creation of core competence, crucial for today's organizations at the organizational level. (Bassellier, Reich & Benbasat, 2001). Individual differences have been identified as one of the paradigms for the research of human factors in software development (Curtis, 2002). Research in this area goes back to the 1960s (Sackman, Erikson & Grant, 1968) and continued actively in the 1980s (De Marco & Lister, 1985). Since the 1990s, productive research investigating the role of human factors in software engineering has emerged (Sommerville & Rodden, 1995), (Turley & Bieman, 1995), (Humphrey, 1998), (De Marco & Lister, 1999), which has continued progressively since the beginning of the 21st century (van Solingen, Berghout, Kusters & Trienekens, 2000), (Constantine, 2001), (Tomayko & Hazzan, 2004).

In order to improve the capability of the workforce, several initiatives, such as SEI’s People-CMM (Curtis, Hefley & Miller, 2001), describe an evolutionary improvement path which starts from ad hoc, inconsistently performed workforce practices, and progresses to a mature infrastructure of practices for continuously elevating workforce capability. Level 3, "Defined," of the proposed People-CMM refers to a processing area called "Career Development", which implements the professional career to ensure that individuals are provided opportunities to develop workforce competencies that enable them to achieve career objectives. In order to reach level 3, organisations should determine which different professional careers their employees can undertake, specifying in an explicit way the professional profiles and their corresponding competency levels.

Moreover, competency levels for professional profiles represent one of the fundamental aspects of a professions' maturity level, namely "Professional Development" (Ford & Gibbs, 1996). SWEBOK (Abran, Bourque, Dupuis, Moore & Tripp, 2004), the Software Engineering Body of Knowledge, establishes cognitive levels for each of the components of the 10 knowledge areas. These levels are determined based on levels of apprenticeship described by Bloom's taxonomy (Bloom, 1956). The typology is made for one single profile, being a Software Engineer with four years of experience. In order to complement the capacity levels introduced by SWEBOK, Bourque, Buglione, Abran, & April (2004) have realised an additional competency description of skill levels which three different profiles of Software Engineers should correspond to at different stages of their professional career: at graduation, after four years of professional experience (already included in SWEBOK), and as an experienced Software Engineer. Nevertheless, the study is not complete, as it has been limited to four areas of knowledge: Maintenance, Management, Processing and Quality. Additionally some other efforts had developed recommendations of knowledge and skills required by software engineering professionals in software industry (Eg. Lethbridge, 2000; Turley & Bieman, 1995), the software engineering curricula (Kitchenham, Budgen, Brereton & Woodall, 2005) and the continuous education of IT professionals (Callahan & Perdigó, 2002). Other studies can be found about the competencies necessary for software project
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