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Remote Evaluation of Software Engineering Competences

Boriss Misnevs[a]*, Vacius Jusas[b], José Luis Fernández Alemán[c], Nadezhda Kafadarova[d]

[a]*Transport and Telecomunication Institute, Lomonosova str 1, Rīga, LV-1019, Latvia*
[b]*Kaunas University of Technology, Studentu 50, Kaunas, L7-51390, Lithuania*
[c]*University of Murcia, Avenida Teniente Flomesta S/N - Edificio Convalecencia, Murcia,30003, Spain*
[d]*University of Plovdiv, Tsar Assen Street 24, Plovdiv, 4000, Bulgaria*

Abstract

The paper focuses on and examines the issues and problems related to remote evaluation of software engineering competences using progressive competence representation model. Authors suggested original approach for Master Program in Software Engineering competence evaluation as a combination academic competences and professional competences from European Competence model (e-CF). Examples of competence description for 16 subjects from proposed a Joint Master Program in Software Engineering are developed. Several types of scoring rubrics for Software Engineering competences evaluation are reviewed and rubrics' templates created. The developed models and templates can be used by universities and IT enterprises for training results evaluation as well as for competence evaluation for Software Engineering Master program's graduates.

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Keywords: Software engineering; Competence evaluation; Scoring rubrics; e-CF

1. Introduction

Internet–based information flows play an important role in the development of modern society. Software Engineering (SE) is one of the cornerstones in developing new Internet-based technologies. Many universities prepare SE graduates. The common framework is needed to assess their acquired competence. In the context of increased workforce mobility and lifelong learning, the management and interoperability of data about competences in outcome-based learning are of high importance for both education and employment sectors.

* Corresponding author. Tel.: +371-67100594; fax: +371-67100535.
E-mail address: misnevs.b@tsi.lv

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In this paper we present the methodology for the common evaluation of SE graduates across the European Union. The methodology is based on the overall topic of The European e-Competence Framework (e-CF), which provides a reference of 40 competences. The key competences defined by e-CF form the basis for the employability of university graduates in the area of SE. We suggest to develop and to implement a new approach to the evaluation Master Programs learning outcome within e-CF. The methodology target groups are the following: academic staff active in education and training, master students and graduates from computer science programs, university executives (decision makers), IT sector's employers (e-jobs providers). The implementation of a unified metadata and service IT system for promoting the Open Educational Resource (OER)-based educational materials will help making key educational resources sharable, storable, findable and interoperable on a global scale. Using a common online format for describing, referencing and sharing the graduate learning outcome definitions defined in the Program will make it easier for educators to assess the compatibility of educational systems and employment sectors across national borders in the framework of creating the European High Education Area. By managing and sharing this data, students will be able to better plan their careers and enhance their employability potential.

2. Review of related work

The European Qualifications Framework (EQF)[1] is a common European reference system aimed to linking together different national qualification systems. In practice, it acts as a translation device by helping learners and workers to move or change job across Europe. Employees and employers can use the EQF for better understanding and comparing the qualifications levels of different countries. The EQF uses eight reference levels realized through stages of education and ranging from basic (Level 1) to advanced (Level 8). Level 6 is considered to be realized through a bachelor degree, level 7 through a master degree and level 8 through a PhD degree. The reference levels are based on learning outcomes defined in terms of knowledge, skills and competences.

The objective of the e-CF[2] is to provide a common, European tool to support organizations and training institutions in learning programs, competence needs analysis, assessment, and recruitment. The secondary goal is to provide a background to policy makers to define policies related to e-Skills development in education and in the work place. The e-CF is EQF compliant, it is a suitable reference framework for competences to be dealt with as learning outcomes.

The e-CF is structured into four dimensions. Dimension 1 contains five e-Competence areas derived from the Information and Communication Technology (ICT) business processes PLAN – BUILD – RUN – ENABLE – MANAGE. Dimension 2 refines e-Competence areas of dimension 1 into separate e-Competences. The general set consists of 40 e-Competences. These e-Competences are general customizable and applicable to any organization needs. Dimension 3 defines suitable proficiency level ranging between levels e-1 and e-5 for each e-competence. They relate to EQF levels 3 to 8. Dimension 4 lists examples of knowledge and skills embedded within e-Competences. They are not exhaustive but are examples of e-Competence content. These examples provide inputs for training institutions to aid in defining of learning outcomes. In addition, they are useful in defining specific outcomes to be assessed within an organization’s competence assessment programs. Dimension 4 components refer to dimension 2 but they are not related to specific competence levels in dimension 3.

The European Certification and Qualification Association (ECQA) was established as the result of a number of EU supported initiatives in the past years in the European Union Life Long Learning Program that is encouraged by EQF. A number of training and education bodies and organizations, together with industrial partners, decided to follow a joint process for the certification of people. Therefore, ECQA joined the experts and supported the definition and development of the knowledge (skill cards) required for job roles[3]. The skill card is the basis for the definition of each ECQA profession. It contains units with modular learning elements where the performance criteria are defined. The adoption of a common set of skill sets is needed to ensure convergence and facilitate the free mobility of workers. Some European countries have already established open universities which support Accreditation of Prior Learning (APL). In APL, the skills of students are assessed, already gained skills are recognized, and for the skill gaps a learning plan is established.

Johnson and Wang[4] presented a methodology to assess and design a curriculum. The methodology is centered around voice of the customer (VOC) input from both faculty and industry. The design structure matrix (DSM) was used to assess the order and prerequisite structure of the courses. The DSM was also used to determine which courses were critical. The suggested approach could be recommended to curriculum development based on desired