Evaluation of Occupational and Professional Profiles in Ecuadorian Context Based on Guide of Knowledge Swebok and Ontological Model

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***Abstract*— Bodies of Knowledge (BOK), contain the relevant knowledge for a discipline, and it is necessary for the development of the science, and application in the professional, and occupational profiles, and the possible incidence in the industry of Ecuador. In this paper, it is shown an evaluation of professional and occupational profiles based on standard Software Engineering Body of Knowledge SWEBOK 2004 (Spanish Version), and the development of ontological model, in order to obtain the necessary information to establish the relationship, and the criteria to evaluate the profiles based on the guide of knowledge.**

***Keywords*— Bodies of Knowledge; BOK; Evaluation; Guide; Ecuador; Model; Ontologies; Professional; Standard.**

I. Introduction

The emergence of the competencies approach worldwide, it is related to productive changes because of the ongoing global change; Ecuadorian industries have understood the need to prevail in the market creating competitive advantages. The human factor is one of the strongest strategic components, the contribution made people is linked fully with the strategies of competitiveness required to be part of an organization, forcing employers to make a careful selection of profiles professionals, depending on the occupational profiles requiring [16].

In Ecuador, the "Secretaría Técnica de Capacitación y Formación Profesional (SETEC)", execute some aggregators value processes. One of this process is the "Orientation of Competences and Certification", that "establish the methodological guidelines for the identification, uprising, and validation of occupational profiles, and a competence standards", the same work as the basis for the development of training and certification processes for occupational profiles [17].

BOK contains the relevant knowledge for a discipline. BOK must be embodying the consensus reached by the community; for this reason BOK will be of applicate. This consensus is a prerequisite for the adoption of the BOK by the community [9]. BOK may include technical terms and theoretical concepts as well as recommended practices [14]. BOK is a common intellectual ground .It is shared by everyone in the profession regardless of employment or engineering discipline; for this reason; in this paper shown the evaluation of occupational and professional profiles, based in the guide SWEBOK 2004 (Spanish Version), which is a popular guide in the field of Software Engineering (SE).

In order to evaluate occupational, and professional profiles, it was used the guide SWEBOK 2004 (Spanish Version) [3], and characterization of ontological model supported by Neon Methodology [10]. The purpose of this research, it was to establish a model to evaluate occupational and professional profiles taking as points of mediation de guide SWEBOK 2004 (Spanish Version) [3].

This paper has been structured as follows: Section I, contains the Introduction, section II introduces Related Works, section III describes the Research Methodology used; then Section IV introduces some conclusions, Section V contains the Acknowledgment, and the last section contains the references that support this research.

II. Related Works

The use of BOK has increased representatively; according to [2], and [13], the use for developing ontological models for BOK based in knowledge, and applied in the monitoring of networks around a community are explain; however in [5], used BOK for the conceptualization of shared knowledge between humans, and software. They also mention that the use of BOK in building ontologies for information systems and management development software. Moreover, BOK meets the set of skills, knowledge, and attitudes required for professional domain [1].

BOK is used as points of comparison mediation of powers between work, and academic contexts. For example in [8], a model using DISCO II is proposed for the creation, and comparison of profiles based on competencies. In [7], proposed a model for competence, and its components that is used as a point of mediation for the comparison of academic and occupational profiles. In [1], a useful model is proposed not only in academia but also in industry, where SWEBOK 2004 specifies the Knowledge Areas (KA) necessaries in this

context. In [2], extend the research [1], associating skill levels of Bloom's taxonomy of knowledge area, and SWEBOK profiles Guide Software Engineering: New Graduate, Graduate with four years of experience, and experienced software engineer working in a software engineering process group.

III. METHODOLOGY

In order to development the evaluation of occupational, and professional profiles in Ecuadorian context, based in guide SWEBOK 2004, (Spanish version), and ontological model it was necessary use NeOn scenarios.

A. *Step 1: Define ontological model.*

In recent years, it has increased the interest of professionals in the development, and management of ontologies to develop from scratch, with the aim of linking knowledge and providing a semantic sense. Some of the most widely used methods are as follows: METHONTOLOGY [18], On-To-Knowledge [19], and DILIGENT [20]. One of the methodologies used to for that development the ontological model is called NeOn. NeOn is based on nine stages, since there are several ways for building ontologies. NeOn scenarios are flexible, allowing combined scenarios, and allowing users to customize them. For the evaluation of the profiles, the following methodology of NeOn scenarios is used:

1) Scenario 1: From specification to implementation.

a) PURPOSE: To develop ontology based on BOK; it will serve as a vocabulary to describe the terms associated with that domain of application.

b) SCOPE: The ontology was focused on domain of BOK, it will be of general use to those interested in this field; with which greater knowledge will enhance on how they are structured BOK in the various disciplines such activity is related.

The proposal of this research is to study the structure of SWEBOK 2004 (Spanish Version) in order to evaluate the professional, and occupational profiles in Ecuadorian context.

c) EXPECTED END USERS: When a new ontology is designed, it is important to evaluate possible users. In table I, it is showed some examples of stakeholders.

TABLE I. EXPECTED END USERS

EXPECTED END USERS	
Engineers	People who study engineering [3].
Graduates	Person who acquire an academic degree after complete the studies [1].
Stakeholders	Many people, groups, companies, and other organizational or governmental entities have a stake in educational programs [9].

d) REQUIREMENTS

a. Functional Requirements:
   i. How is knowledge described?
   ii. How to evaluate Occupational and Professional profiles using SWEBOK 2004 (Spanish version)?
b. Non-functional Requirements
   i. The ontology will be developed in English.

2) Scenario 2: Reusing and re-engineering non-ontological resources (NORs).

The reuse of Non-ontological resources is the second activity of NeOn which is the same methodology for analyzing non-ontological resources. In table II, the non-ontological resources necessary for the evaluation of profiles are described.

TABLE II. NO-ONTOLOGYCAL RESOURCES

NO-ONTOLOGICCAL RESOURSES		
Class	***Class Description***	***Properties***
BOK Ontological Model with Standars	Name of Ontological Model	include
Body of Knowledge	Contain the relevant Knowledge for a discipline. BOK must embody the consensus reached by the community for which this BOK will be of application. This consensus is a prerequisite for the adoption of the BOK by the community [9].	id code levelsOfAbstraction context stricture_by
Knowledge Area	Structure of a body of knowledge which define what a professional needs to understand and the tasks a practitioner must be able to perform. [2].	require composed by
Unit	Each area is broken down into smaller divisions. [2].	id code description involve
Topics	Second level of knowledge structure. [2].	associate columnMatrix matriXTopicAndReference id code description
Subtopic	Description of each Topic [2].	id code description
Profiles	A set of characteristics that identify or are thought to identify a particular type of knowledge. [2].	need is part of id description code typeProfile
Skills	An ability and capacity acquired through deliberate, systematic, and sustained effort to smoothly and adaptively carryout complex activities or job functions involving ideas (cognitive skills), things (technical skills), and/or people (interpersonal skills). [1]	id code description
detail_Profiles	Specific characteristics of each profile [2].	id code description

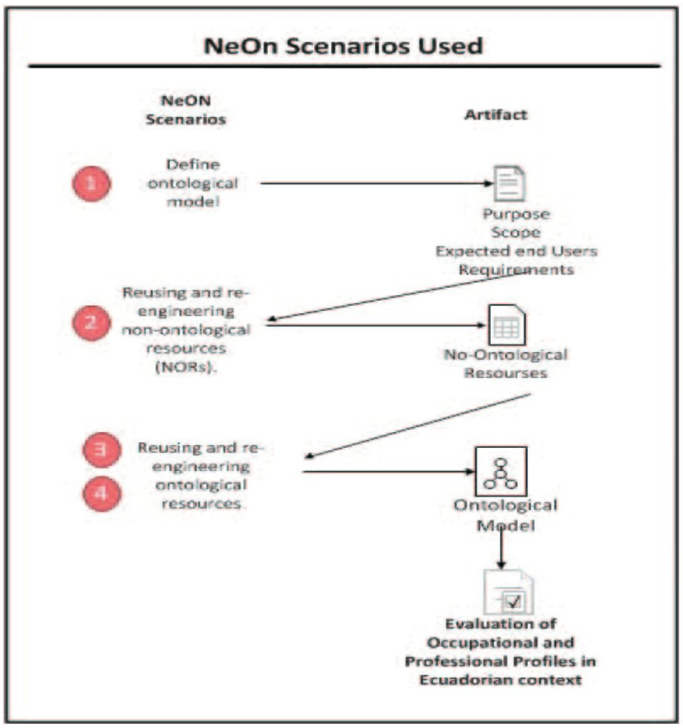

Fig. 1. NeON Scenarios

3) Scenario 3-4: Reusing and re-engineering ontological resources.

For the definition of the ontological model of BOK, the basis was it SWEBOK 2004 (Spanish version) are the same that are structured by KAS, which have several elements such as: knowledge Unit (KU), including a hierarchy of knowledge Topic (KT), and within knowledge subtopics (KST): List of further reading, References, taxonomies, List of acronyms, and labor profiles, and professionals requiring skills to define the knowledge professional levels [3].

The following ontological model has been developed using the scenarios of NeOn methodology, which were taking for building scenarios 1 to 4 that is showed in the figure 1.

In the figure 2, the model is supported by the structure of the SWEBOK, with which it was possible to define the terminology of a domain of knowledge: the concepts that constitute the domain, and relationships between concepts. [15].

B. *Step 2: Evaluation of profiles through ontological models.*

The ontology proposal it was used to evaluate the occupational and professional profiles in the area of software engineering. General ontology concepts, and properties described in Scenario 2 were development, as these are needed for evaluation.

To evaluate profiles it was used SWEBOK 2004 (Spanish version), where only the Quality KA was used. The area is divided into KU, and KT, in order to deepen the concepts of knowledge and identify the sub- topics.

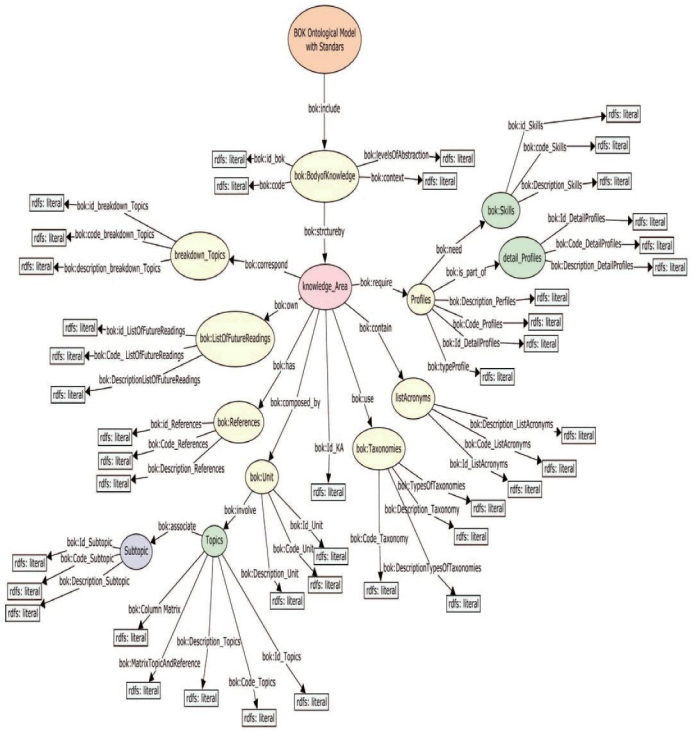

Fig. 2. Ontological Model to Describe BOK.

In a same way, it is necessary to consider another level in the structure of BOK, where the topics will be more detailed knowledge subtopics. These knowledge subtopics have addressed different knowledge, and skills. In the same way, to develop a BOK it is necessary to take into account: Process Model, Deliverables, Organization, Technology focus, Tools, Assignment focus, and Exercise domain [6].

The KST were extracted by experts of SE, each KST considered the breakdown of KT. Table III, shows the breakdown of the subtopics found in the KT of quality area.

TABLE III. BOK COMPONENTS SWEBOK 2004 (SPANISH VERSION) [3].

DESGLOSE SWEBOK (AREA DE CONOCIMIENTO - CALIDAD DEL SOFTWARE)			
Area de Conocimiento	***Unidades***	***Tópicos***	***Subtopics***
Calidad del Software	Fundamentos de Calidad de Software	Ingeniería del Software Cultura y Ética.	Características y Conceptos de calidad de software
			Desarrollo de software
			Mantenimiento de Software
			Requisitos de Software
			Métodos de medición y criterios de aceptación para evaluar la calidad
		Valor y coste de la calidad	Producto de Software
			Exigencias de producto
			Coste de prevención
			Coste de apreciación
			Coste de fracaso interno
			Coste de fracaso externo

			Proyectos de software
			Alcance del proyecto de software
			Requisitos de Software
			Ciclo de vida de software
		Modelos y Características de Calidad	Calidad de software
			Taxonomía o modelo de calidad de software
			Atributos de calidad de software
			Modelos de características de calidad de software
			Negociación de la calidad del producto de software
			Planificación de la calidad del producto de software
			Transación de la calidad del producto de software
			Producto de Software
			Modelos de Calidad del producto de Software (Calidad interna, externa y de empleo)
			La calidad del proceso en la ingeniería del software
			Calidad de producto software
		Mejora de calidad	Producto de Software
			Procesos de ciclo de vida de software
			Proceso de detección de error/defecto
			Proceso de mejora de calidad
			Construcción en calidad, mediante la prevención y detección temprana de errores
			Proceso de Ingeniería de Software
			Evaluación del producto
			Alcance del proyecto de software
			Gerencia de proyectos
	Consideraciones Prácticas	Aseguramiento de la Calidad del Software	Producto de Software
			Procesos de ciclo de vida de software
			Requisitos de Software
			Planificación de la calidad del producto de software
			Desarrollo de software
			Plan de calidad
			Mantenimiento de Software
			Planes de gestión, desarrollo, y mantenimiento para el software
			Estándares de calidad
			Actividades y tareas específicas de calidad
			Gestión de configuración de software
			Proyectos de software
		Verificaciones & Validación	Planificación de la verificación y validación del producto
			Procesos del ciclo de vida del software
			Desarrollo de software
			Mantenimiento de Software
			Verificación y validación del producto
			Técnicas y herramientas para la verificación y validación del producto
		Revisiones y Auditorías	Revisiones de gestión
			Revisiones técnicas
			Inspecciones
			Walk-throughs
			Auditorias
	Procesos de Gestión de Calidad del Software	Requerimientos de calidad del software	Factores de influencia
			Confiabilidad
			Niveles de integridad del software
			Proceso de la calidad del software
			Métodos de diseño
			Lenguajes de Programación
			Tecnologías de software
			Desarrollo de software
			Mantenimiento de Software
			Taxonomía o modelo de calidad de software
		Caracterización de defectos	Modelos de fiabilidad construidos en base a fallos recogidos
			Pruebas de software
			Proceso de Ingeniería de Software
			Implementación de técnicas de gestión de la calidad del software
		Técnicas de Gestión de Calidad del Software	Técnicas Estáticas
			Técnicas Intensivas de personal
			Técnicas Analíticas
			Técnicas Dinámicas
			Pruebas de calidad
		Técnicas Dinámicas	Modelos de calidad del software
			Métricas de la calidad del software
			Producto de Software
			Calidad de software
			Procesos de ciclo de vida de software
			Procesos de calidad y mejora del software
			Coste de los procesos de calidad
			Modelos genéricos de coste de calidad
			Procesos de desarrollo
			Proceso de Ingeniería de Software
			Gestión en Ingeniería del Software
			Informes de la gestión de calidad de software
			Métricas de calidad de software
			Procesos del ciclo de vida del software
			Proceso de Ingeniería de Software
			Gestión en Ingeniería del Software
			Procesos de desarrollo y mantenimiento

C. *Step 3: Selection of occupational and professional profiles*

Given a corpus of both occupational and professional profiles, it was obtained from of universities and employment platforms of Ecuador, two samples were taken for evaluation with SWEBOK profiles, considering among them the naked eye that may have greater alignment with a possible minor alignment with the samples to be worked are:

1) Possibly aligned

a) Engineering in Computer Systems and Computer.

b) Computer Engineering and Computer Science.

2) Not aligned

a) Career Computer Education.

b) Electronic and Computer Engineering.

EXPERIMENTATION:

To test our theory, we made an experiment in which 2 profiles were used. It is based on a macro algorithm that includes the following steps:

Manual description experimentation: Manual testing is performed based on the SWEBOK 2004 guide (Spanish Version), using knowledge Quality subtopic. To obtain the result 1 (R1), the following comparisons were performed using a matrix intersection:

C1=KQST vs PP
C2= (KQST vs OP)
C3= (C1 + C2/2)

R1 = C3
C1 = ∑comparations/nro. Total of comparations Professional profile
C2 = ∑ comparations/nro. Total of comparations Occupational profiles
C3 = (∑C1 + ∑C2)/nro total of KQST

Where,

R1 = evaluation between professional and occupational profiles
C1 = Quality Profiles (Skills)
C2= Quality Subtopic and Occupational profiles
C3 = Results de C1 and C2
KQST = Knowledge Quality Subtopic
PP = Professional Profile
OP = Occupational Profile

In both crosses (C1 and C2), in order to obtain numerical data, if there is any similarity it is assigned the value of one, otherwise, the field being analyzed is left in blank. Upon completion of the comparison result C1 and C2 in percentages for each subtopic, versus the professional profiles and occupational, respectively bids are obtained. Once the percentages obtained, we proceed to C3, which consisted on comparing the total percentages of the C1 and C2.

TABLE IV. EXPERIMENTATION AND APPLICATION OF FORMULA (SPANISH DATA)

ALINEACION DE CONOCIMIENTO (OFERTA LABORAL VS SKILL DE CARRERA)				
skill / ***Of.lab***	Carrera de ingeniería en sistemas computacionales e informáticos	Ingeniería informática y ciencias de la computación	Carrera de informática educativa	Ingeniería electrónica y computación
Multitrabajos-Arquitecto de Soluciones Informáticas	42%	49%	32%	28%
Multitrabajos-Ingeniero de Sistemas	35%	43%	26%	21%
Multitrabajos-Desarrollador .Net	28%	36%	19%	14%
Desarrollador de Software, Web y/o Aplicaciones Móviles	32%	40%	23%	18%

IV. CONCLUSIONS

The definition of BOK in the context of software engineering is important to respond the training needs of future professionals, so they in order to they acquire the competencies in the social, business, educational, and industrial.

The professional profiles in Ecuador must be located within a single level of competition, according to the classification established, and validated internationally; the same as described in general terms the knowledge and skills needed to perform within an occupation, the alignment of the profiles compared to job allows industries to identify the basic skills required for the evaluation of professional profiles.

A general structure of BOK in the software engineering was established. This structure begins with the set of KA, continues with KU, KT and ends with KST according to the research area.

The knowledge description for BOK allows a validated classification of the bounds of the discipline and topical access that will support the discipline, it is subdivided into a set of

Knowledge Areas allowing readers to find their way quickly to subjects of interest and create its professional profiles.

A BOK can fulfill to stakeholders role in supporting education, certification, professional stature, professional development, and organizational improvement.

ACKNOWLEDGMENT

The authors express their gratitude to the Technical University of Madrid (UPM) ,in particular to the Doctoral Program of Science and Technology of Computing for Smart Cites, the Department of Information Systems UPM CITSEM, and PhD. Santiago Acosta Aide Vice-Chancellor of the Technical University of Loja for their constantly support.

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