Development of Ontology Based Competence Management Process Model for Non-Formal Education

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Abstract. The demand for constantly higher competences of employees nowadays is growing permanently. One of the main challenges of implementation of competence management processes is that, as a rule, they are based on the experts' implicit knowledge that practically limits possibilities to transform the already existing knowledge about competences from one organization to another. The paper describes the ontology based competence management process model that is useful for non-formal education service providers in their efforts to use different competence management frameworks together instead of forcing organizations to change their routine competence management processes. The proposed model is based on the previously developed ontology based competence management model which defines more accurately the concept of competence. The competence management process is divided into three main steps – competence identification, competence assessment and competence development. The description of the first step is extended by including the concepts of goal and task to be achieved and performed correspondingly, as well as by adding the concept of creation of competence profile. The conceptual architecture of competence management system based on the prototype with a limited functionality for supporting competence management processes is presented.

Keywords: Competence Management Process, Competence Management Model, Ontology.

1   Introduction

A competence-based approach to education has gained popularity in recent years in Latvia. As a consequence, one can observe a growing need for competence management services that, in principle, can be provided both by formal and non-formal education service providers to their customers.

Non-formal education is an alternative to formal education that provides institutionalized, intentional and planned form of education [1]. Non-formal education enables a faster response to changes providing employees with competences needed for work [2]. Non-formal education benefits from competence-based education [3] because that enables relevant know-how for work situations. Non-formal education is acknowledged by the organisations [1]. It is forecasted that currently there is a need

for development of new competences or "human skills" [4] but the involvement in non-formal education is lagging behind the expected numbers [5] because training solutions do not correspond to organisation requirements.

Three reasons make providing competence management services difficult. First, organisations in contact with a non-formal education service provider (NFESP) have different concepts of competence. Second, there exist organisation specific competence frameworks that are hard to integrate between themselves. Third, NFESPs may need to simultaneously use and reuse parts of existing competence frameworks and integrate several frameworks into one competence management process (CMP). In order to address the issue a novel ontology-based approach for simultaneous use of different competence frameworks needs to be developed to facilitate the interaction between NFESP and customer organisations. This will also help the development of appropriate competence management support tools [6].

The goal of this paper is to present a competence management process model for a non-formal education service provider that: describes competence-based training that is an accepted form of non-formal training, is based on formal ontological model of competence management process in order to provide relevant and uniform service to participants of training, can be used as a basis for development of IT tools that support the CMP.

The rest of the paper gives an overview of related work (section 2), presents the results of modelling of CMP (section 3), and proposes the conceptual architecture of competence management system for the support of a CMP at an NFESP and is based on the prototype with a limited functionality (section 4). At the end of the paper conclusions and the outline of the future work are presented.

2 Related Work

The CMP is the process that guides the organisations in managing the competences of their employees. When an NFESP offers a service of assessment and development of the competences of its customer organisations, it gets involved in a CMP. It is beneficial for an NFESP to adapt a competence-based approach to training [3]. When adapting a competence-based approach to training NFESPs get involved in CMP and would benefit from clearly defined concept of CMP.

A precise definition of CMP is difficult to devise. The concept of competence is fuzzy [7] and uses different definitions including concepts of the ability to complete the assigned task [8, 9] and elements like knowledge, skills and attitude and sometimes other elements, too [10-13]. Concept of competence may be specific to the organisation [12] or the industry [14]. To avoid the need to adjust to customer specific understanding of competence, NFESPs need to have a new competence management model (CMM) that briefly is described in the next section (for details see [6]).

Ontology helps to gain common understanding of a domain specific knowledge that needs to be analysed, shared and reused, and needs to be represented in an explicit form [15]. The used ontology should facilitate common understanding between ex-

perts [16], the parties involved in non-formal education, and between the people and software agents [17].

The competence management systems (CMSs) must be based on a competence model [11]. Ontology based approaches to competence modelling have been presented in [18]. Competence management support tools can be organisation specific [19] but basing the tools on common understanding of competence can facilitate common understanding of the CMP as a whole [20].

3   Competence Management Process Description

The ontology-based competence management model (CMM) defining relationships between various concepts of competence management is presented in [6]. The model uses Competence as the main concept and describes the parts and properties of Competence, how Competence is related to Organisation and Employee and their goals. The CMP also describes the link between CompetenceGap, AssessmentMethod and DevelopmentMethod. This model is used to describe the CMP which would allow the identification of all steps that would be performed in this process by an NFESP when managing competences of their customer organisations.

Based on the CMM the CMP can be divided in 3 main subprocesses: competence identification (divided in definition of the competence and creation of competence profile), competence assessment and competence development. The same subprocesses have also been used for CMP in formal education [21].

Other process steps are identified in the scientific literature, for example, use of competence [22] and goal and task management in relation to CMP [23]. The use of competence is outside of scope of CMP for NFESPs. The goal and task management are addressed in the process description. The competence development goal is interpreted as one of the relevant goals to manage in CMP [24].

Further on, the individual steps of CMP are described using UML activity diagrams. The following symbols have been used in the figure: a rounded rectangle for separate process steps, an arrow for transition between steps, a diamond for decision choice, black bars for start and end of parallel process steps, a full circle for start of the process, a double full circle for end of the process.

Fig. 1 shows that a competence identification subprocess starts with DefineGoal and DefineTask steps that provide a reason for competence identification. IdentifyRequiredCompetence step consists of several simultaneously performed steps: definition of the parts of Competence (Knowledge, Skill and Attitude) and definition of properties of competence (CompetenceTitle, CompetenceDescription and CompetenceLevel). At the end of this part of CMP a competence is added to a repository that contains all competences used to build CompetenceProfiles.

Creation of competence profiles is a part of competence identification which requires feedback information from competence assessment and competence development steps. The main purpose of the CompetenceProfiles is to compare required and acquired CompetenceLevel and to identify a CompetenceGap.
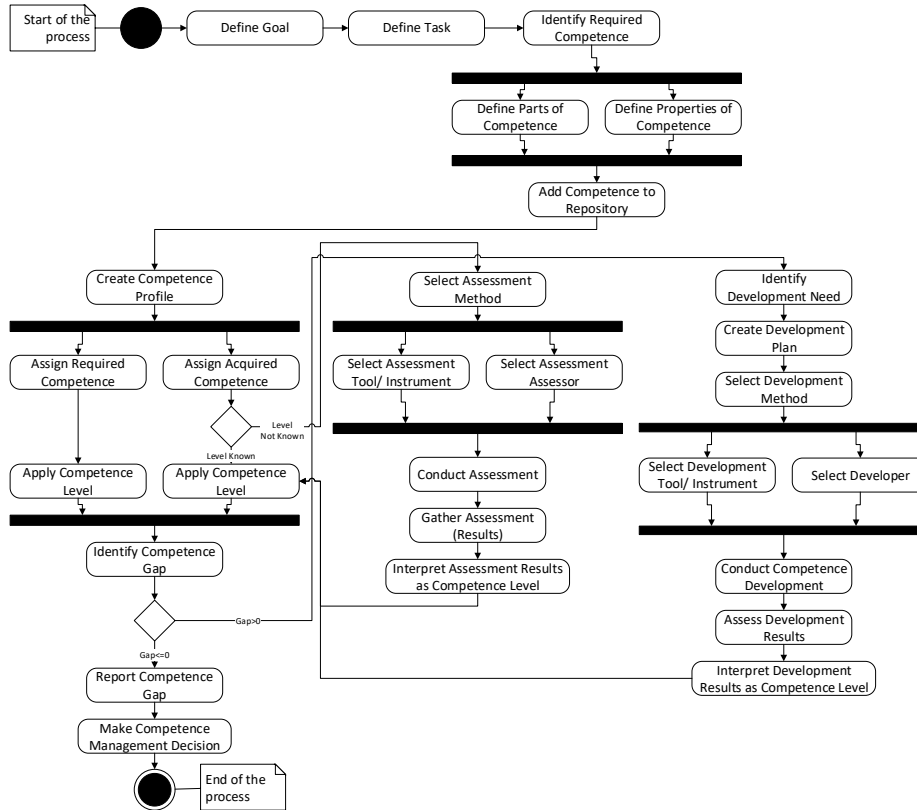
Fig. 1. Competence management process.

The competence assessment subprocess provides the information of acquired CompetenceLevel of an employee within an organisation. This combined with the required CompetenceLevel (described as the property of Competence during a competence identification step) provides the basis for a CompetenceGap.

The competence assessment step starts with a recognized need to assess a CompetenceLevel for specific competence that is included in a CompetenceProfile by a CompetenceAssessmentMethod. There can be several CompetenceAssessmentInstruments and Assessors (in this case, persons who participate in a competence assessment) involved in these steps. By using ontology for the definition of the concept of Competence it is possible to create competence assessment instruments that are automated and thus decrease the required workload for an assessment [25]. The results of competence assessment are interpreted as acquired competence level that can be used as a basis for decision making, for example, what kind of competence development is needed by the employee.

The competence development subprocess starts with identification of DevelopmentNeed that is based on a CompetenceGap. A CompetenceGap is a signal that the acquired CompetenceLevel is lower than the required. Creation of DevelopmentPlan

involves the identification of missing competences. If a competence DevelopmentNeed represents a theoretical need to develop a competence, a DevelopmentPlan represents a proposed intent to decrease the CompetenceGap and improve the acquired CompetenceLevel.

Selection of competence development methods is based on the required competences and their levels. Scientific literature suggests that specific competences require different development methods and the same is true for competence assessment methods [26]. The selection of the most appropriate method is out of the scope of this paper. The process description enables the selection of a DevelopmentMethod that consists of DevelopmentInstrument and a Developer (in this case a person who is involved in developing a competence). It is worth to stress that there is a potential to use computer-based competence development instruments [27] but it is not the only option available.

4 Conceptual Architecture of CMS

The CMP described above can be conducted at an NFESP without the use of additional support tools other than already mentioned competence assessment and competence development instruments. However, there is a benefit from introducing a CMS that can support a CMP. Such CMS may improve the ability to process data gathered during a CMP and decrease time spent on individual steps of this process.
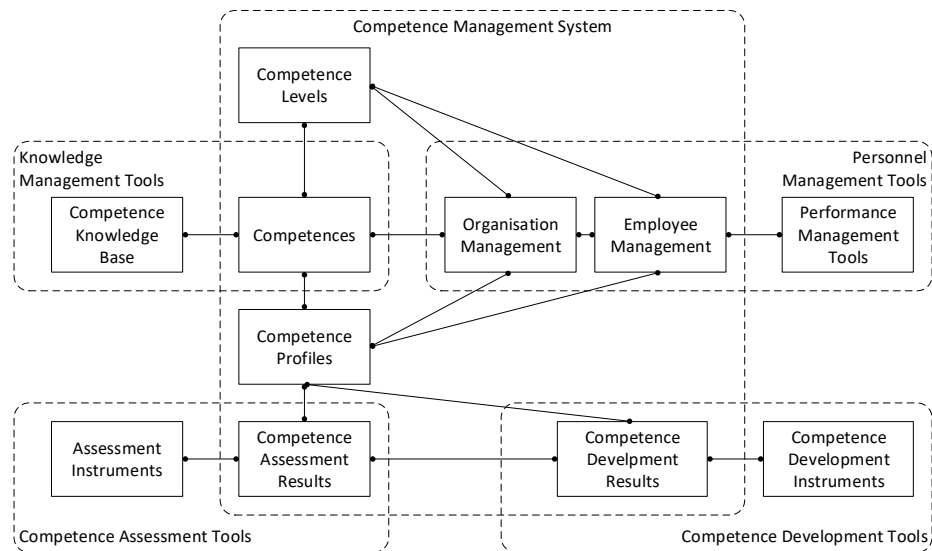

Fig. 2. Conceptual architecture of competence management system.

In Fig. 2 the conceptual architecture of CMS is proposed. It consists of several functional blocks some of which are directly related to CMP and other tools used in the organization. A CMS could be linked to personnel management tools and knowledge

management processes and tools [18]. In this paper the competence assessment tools and competence development tools are considered to be parts of CMP but there are already existing instruments that can be selected for the use. Fig. 2 only includes competence assessment results and competence development results as the proposed functional blocks for the CMS leaving assessment instruments and competence development instruments outside the CMS with the possibility to create the interface between them.

The main concepts of CMP that need to be managed by the CMS are Competence, CompetenceLevel and CompetenceProfile. Previously in the paper the environment of an NFESP has been described stating that there is a need to manage competences that are used by different customer organizations preferably without forcing these organizations to change their understanding about competences. This is the reason why there is a challenge to manage competence data in CMSs that are company specific. That is why an organization management and an employee management are included as functional blocks in the conceptual architecture of CMS.

For such a CMS to work for an NFESP that can be involved in managing competences that are stored in competence profiles relevant for employees and the customer organisations, the links between data tables should be defined. CompetenceTitle, CompetenceDescription and CompetenceLevel should be linked with Organisation and Employee, and organisation specific information should be stored in CMS.

Based on the CMM, the conceptual architecture of the CMS and the links between data tables, the CMS prototype was developed for the support of competence management process at an NFESP (due to limited volume of the paper the prototype is not described).

5   Conclusions and Future Work

The paper proposes a competence management process description and system's conceptual architecture that is based on the ontology-based CMM and can be used by NFESPs to manage competences of their customer organizations. A common CMP is beneficial for an NFESP as it decreases the need to necessarily adjust to each individual customer organization.

Ontology based approach for competence modelling is used in the CMP description. It establishes a common understanding of the concepts of competence and the CMP, allows an NFESP to manage competences of different customer organisations and develop IT support tools for CMP. The conceptual architecture of the CMS proposed in this paper addresses the need for IT support tools for competence management. Such system may be linked to the existing tools that are already used by the organizations for competence management. The CMS prototype has been developed based on the CMM that can be used for the support of CMP.

The application of the CMS prototype with extended functionality to several CMPs at the NFESP to support the management of customer competences, as well as the investigation of options how to use the existing resource and knowledge management

systems and to establish interfaces between them and the CMS prototype are foreseen as the future work.

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