Model for Adding Context to Competence

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ABSTRACT: Higher education needs to be conveyed through a certain proper context and presented correctly to students of forthcoming generations. They will have the possibility to choose the faculty/college based on personal preferences and desires such as: quality, tradition, location, general and specifically particularized conditions. The model proposes adding the context to the competences. Competence management and construction is an arduous task and implies high costs. In domains as higher education and companies / establishments recruiting employees are requisite the elevated degree of competence. In literature some specific models were developed for competence construction. Numerous products had been developed for managing and constructing ontology. Also there are some tools that allow the mapping of ontologies, which offer competence management. Based on similarities between the ontology and competence management, we proposed the usage of adequate models in our previous work, a model that manages and allows competence construction in a similar fashion as tools for ontology management. Specific user interface will allow the construction and management of the competence context in order to enrich the capabilities of the model. The proposed model ameliorates competence construction and management by describing the context in which the competence is acquired. Users (the future students) will be able to make a more accurate choice. The work is done under the project PNII 91-047/2007-2010.

Introduction

All the activities of a work process are performed in a specified context. Also the competences are acquired in a specified context. Numerous works and papers deal with the context in that an activity is performed.

Effective execution of an activity depends on the abilities of the individual, being cognizant of what is happening with the artifact at hand and of the constant changes taking place. In [DA99] the context is defined as: any information that can be used to characterize the situation of entities that are considered relevant to the interaction between a user and an application, including the user and the application themselves. The work process context is dynamic: new events appear and new decisions are taken, modifying the process flow. For actions and events to be fully understood, all relevant contextual information involved in those circumstances should be available to stakeholders according [KB03, B+05]. Other contemplations on the context were done in [Bre02] resulting in the definition: the context is a set of information used to characterize a situation in which human and computational agents interact. Competences are characterized by sets of cognition, know-how and behavior associated to a context and linked to individual actors. Based on a classical evaluation of the knowledge, know-how and behavior characteristics, a mathematical aggregation is advised to provide a quantitative evaluation of competences. Databases describing formal competence are used in order to provide a mapping between required and acquired competence in an enterprise re-engineering context ([Har00]). In the Computer Supported Cooperative Work (CSCW), the investigation of contextual knowledge pinpoints the need to recognize different types of contexts and different levels existing between them ([B+07]). The competence management can be organized according to four kinds of processes: identification, assessment, acquisition and knowledge usage. Based on the ontology management we propose the same management tools for our model. The goal of the paper consists in giving a model for enriching the knowledge on the competences in order to give a clear image on the competence acquirement. The proposed Knowledge management model aims to add to the competence the context in which it is acquired and suggest some techniques that allow capturing the appropriate information. In our model the term competence is used in a dissimilar meaning than the usual, in the sense that it constitutes the environment in which the competence in higher education is acquired. So the context for competence in higher education contains information that shows the conditions, the material conditions (labs, etc.), education quality, tradition, exigency, teacher's performances, campus qualities, cultural traditions of the town, etc.

1 Competence in industrial engineering

The competence can be considered as a valuable asset and needs to be properly managed. Competences are the capacity for a group of resources and capabilities to perform a certain task or activity. Competence is the capacity of combining and coordinating resources and capabilities in a way that leads to a desired outcome ([Pam08]). There are many interpretations concerning the competence, resource and activity. In [Lor07] resources are engaged in activities; activities produce valuable outputs; knowledge is a resource; competence is a dual view of activity. Figure 1 from [Lor07] illustrates such an interpretation. Competences are defined as abilities of an actor (a firm) to achieve an activity using a resource and are characterized by the activity they can contribute to, by the resource(s) they require, by a level of expertise and also by a learning mechanism considered to have an impact on the level of expertise (in [HBC03]). Firm competences are considered as dependent on the three components: the methods deployed in the firms, the skills of employees and the technological context from [BL05].

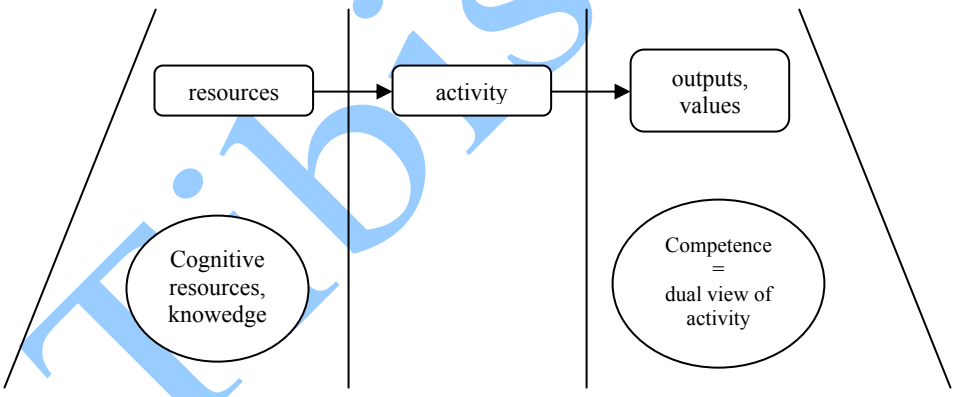

Figure 1. Relations between resource, activity and competence

This leads to a structural model where the competence is formalized as the interaction between three components: actors, material resources and professional situations. These three components imply three types of basic actions to constitute plans of action for competence development: actions on the methods, on the skills or on technological resources. The dynamics of competences within distributed organizations are often linked with the development of a collective competence. The management of distributed organizations and processes implies a broader view of the competence,

focusing on coordination mechanisms of global actors representing organizations as a whole. Two research itineraries were identified concerning the competence and process performance according [BBG07]: the configuration of distributed processes, based on competence mapping and the management of competence dynamics to enhance long term performance of stable networks. Great interest must be bestowed to the similarities of competences. In [BB04] an algorithm had been proposed to generate clusters of partners based on the similarities of competences and on the complementarily of activities. An important step in competence standardization is required. Any competence is characterized by a quantified level of expertise. The standardization makes the competency sets comparable and thus allows for a definition of similarity to exist between them. The model from [BB04] is formalized using the subset theory and the similarity measure is a generalized Hamming distance between two competency sets. Similarity of competencies is completed by complementarily of activities in order to elaborate a complete clustering approach. In [BBG07], were presented the concepts of competence and performance within industrial processes. The topical issue of how to integrate competence-oriented concepts within enterprise information systems and decision systems had been analyzed, so as to provide managers the support of taking beneficial decisions. In that context, the central issue becomes how to deal with internal and external competencies in an efficient and reactive way, so as to determine where in the organization people can be the best sources of performance enhancement. The enterprise can be considered either as a goods-and-services -, or as a competence production system. The performance of the goods-and-services production system is generated by the competences available, depending on the degree of competencies available and the ability to allocate and coordinate competences along business processes according [BBG07].

A better use of competences in order to enhance performance can be achieved in many ways and we delineate two of them: a descriptive and static view of the competencies available at a given moment where the performance improvement is based on a better use of available competencies; account a dynamic view of the competences, and the performance improvement can be based on an increase of the available potential of competences. An important step towards the implementation of the competence paradigm within performance management systems is to define the concepts and models required to introduce competence in companies' information and decision systems.

In [BBG07] was also analyzed the impact of competencies on the performance of processes. The causal link between competence and performance remains simple at the level of basic activities. It is represented as a dependency relation between an efficacy factor and the competence levels.

The competence can be considered as being one dimension of the performance among others. An advantage of teamwork over individual work should be that a greater number and variety of concepts and knowledge are generated and taken into consideration. The collaborative work requires appropriate communication to share concepts and knowledge, as well as the use of ontologies. Large industrial companies have undertaken deep transformations of their organizations to structure coordinate and facilitate design activities along with knowledge and competence development, in [Lar03].

The core competence can be defined in [PH06]: as key ability or strength that an organization has acquired and differentiates it from others, gives it competitive advantage and contributes to its long-term success, or as fundamental knowledge, ability or excel in a specific subject area or skill set. The core competence (as something that a firm can do well) meets the following conditions: it provides consumer benefits; it is not easy for competitors to imitate; it can be leveraged widely too many products and markets. It is obvious differentiate between identification of acquired competencies and the evaluation of competences: the first one is about when and how to identify competences acquired (potentially held by some individuals); the second one is about how to perform evaluation of individuals along identified (acquired and required) competences. Within the competence assessment, knowledge techniques play an important role because both the identification and evaluation of (acquired or required) competences are very heavy tasks in term of dynamics, volume and heterogeneity. In [Ost97] the competence is considered as an essential resource and the author intends to manage competence transfer and development, trying to establish links between effective organization and core competences building. A major problem consists in the assignment of people to perform roles. In [AJ04], was proposed a qualitative model and a procedure to assign people to perform roles in software development projects, depending on their capabilities and the capabilities required by the role. Their capabilities-oriented process model includes traditional elements (activities, products, techniques, people and roles) and an original element: capability in order to add behavioral competencies to the process model.

2 Need for competence management

Numerous works and papers deal with competence management. As an illustration concerning the competence management in industrial engineering Figure 2 from [ZB07] presents a framework for it.

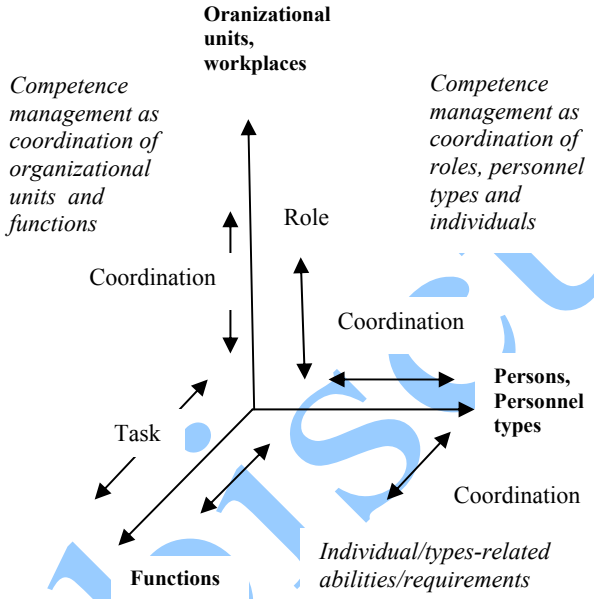

Figure 2. Areas and fields of competence management

Finding a member who possess suitable competence for a required task can be a laborious, time-consuming process: developing and maintaining a competence management system can significantly reduce the time; linking such a competence management system to key decision points and frequent problems can further enhance effectiveness of the production network. In [T+07] an approach had been proposed that applies ontology engineering to model competences of potential team members. The conceptual model of the proposed ontology-based competence management is based on the ideas of knowledge logistics and competence modeling. Ontologies are used to describe competence profiles of enterprises and their employees. The context represents additional information that helps identifying specifics of the current situation and defines a narrow domain for the user of the competence management platform. For the Individual Competence Profile it is important to be known the

competence of the company's human resources in order to choose a qualified member for a team. The individual competence profile aims at representing abilities and skills of a specialist who could take part in carrying out the defined task. An individual competence profile consists of: general and special abilities, cultural competence, educational background, work experience.

In [T+07] were used ontologies to represent competence profiles. The proposed method allows capturing the rich semantics of competence and accommodation of the results obtained in the areas of human resource management and statistics. The General Competence part includes general competences for that it represents abilities general in nature and applicable to any task and the more specific abilities, which are needed for performing tasks related to collaborative design, encompass design skills and teamwork abilities. In industry the Occupational Competence Part shows what knowledge and skills the person has acquired during his/her employment and education. These skills reflect competences in the field of expertise in question and various technical competences in the area. The domain competence ontology has a principal importance. The competence ontology can reuse any domain ontology for a domain of competence and then define a specific ontology (also known as application ontology comprising specific concepts/ relationships/ properties closely related to the enterprise).

3 The proposed model

Our previous works dialed with the competence construction. It was proposed a multi-agent system that is able to construct competences, to search similar competences and compare them. Concerning the industry presented in [T+07], as in our previous works, the competence profiles for each company and its specialists are represented as an ontology: competence profiles are subdivided into enterprise and individual ones and they contain such information as the production network member's capabilities and capacities, preferred ways of interaction, skills of staff members, etc. Competences required from companies or specialists are described as sub-parts of the BTO (build-to-order) ontology. The system can search for potential team members by matching the identified parts to ontologies representing competence profiles. Competence can be enriched with specific information like: capabilities that are production capabilities of a facility and rights that determine knowledge area, to which a facility has access to. In [LH04] was presented a Competence Manager in the context of a company based on Semantic Web. The competence manager allows tracking down competent persons within the company; to be used as a

tool during development discussions between superiors and their employees; the current competencies and the competence areas needing improvement can be identified and a development path can be established; to serve as a tool for company management in strategic coordination activities. The Competence Manager can be used in order to identify the areas requiring more or less competence.

The users access the Competence Manager through a front-end server, which takes care rendering the user interface. The front-end server uses a Web service interface in order to access the ontology server, which maintains the competence ontologies and implements the inference engine operating on those ontologies. Due to the complexity of real systems the competences are used in different ways. As we've seen in the above analysis in the enterprises the competences are connected with the performances. Every competence needs an environment in which it is acquired and in which it is used. Concerning the details of the environment it also needs to be defined in a clearly fashion. As an example for competences that are acquired in computer science, these require: labs with computers and computer networks and also an appropriate set of software. The department belongs to a Faculty, the Faculty belongs to a university, the university has a campus and this is located in a town. These details are given in Figure 3.

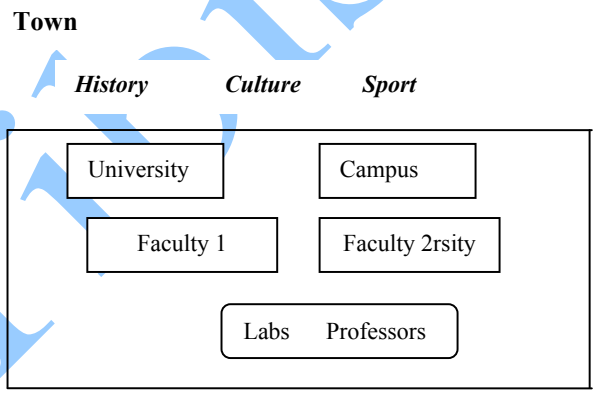

Figure 3. The context for computer science competences

Conclusions

Context management allows the competence management proposed model to take into account specific information about the current situation that is usually highly dynamic. Ontologies were used as the representation

technique for competence components; it is possible to identify potential candidates for a required team by ontology matching that make a comparison of their competence profiles (components) to a specific production task represented by parts of an appropriate ontology. By ontology matching, we rather mean matching of different sub-parts of the same ontology.

Another possible extension consists in developing the collective and individual competence into an organization (company).

References

[AJ04] **S. T. Acuna, N. Juristo** (2004) - *Assigning people to roles in software projects",* Software, Practice and Experience Vol. 34, Iss. 7, 2004, pp. 675–696.

[BB04] **M. Benali, P. Burlat** (2004) - *Methodology to analyze organizational trajectories of SMEs networks,* in: Proceedings of the Management Control and Production Logistics (MCPL 04) Conference, Santiago, Chile, November 3–5, 2004, pp. 25–32.

[B+05] **M. R. S. Borges, P. Brézillon, J. A. Pino, J. Ch. Pomerol** (2005) - *Groupware system design and the context concept,* in: Computer Supported Cooperative Work in Design I, Lecture Notes in Computer Sciences, vol. 3168, 2005, pp. 45–54.

[B+07] **M. R. S. Borges, P. Brezillon, J. A. Pino, J. Ch. Pomerol** - *Dealing with the effects of context mismatch in group work (2007),* Decision Support Systems 43 (2007), pp. 1692–1706.

[BL05] **X. Boucher, E. Lebureau** (2005) - *Coordination of competencies development within networks of SMEs,* in: Proceedings of the Sixth IFIP Working Conference on Virtual Enterprises, Virtual Enterprise and Collaborative Network, Valencia, Spain, Sept. 2005.

[BBG07] **X. Boucher, E. Bonjour, B. Grabot** (2007) - *Formalisation and use of competencies for industrial performance*

optimization: A survey Computers in Industry, Volume 58, Issue 2, pp. 98-117.

[Bre02] **P. Brezillon** (2002) - *Making context explicit in communicating objects,* in: C. Kintzig, G. Poulain, G. Privat, P.-N. Favennec (Eds.), Communicating Objects, Hermes Science Editions, Lavoisier, 2002.

[DA99] **A. K. Dey, G. D. Abowd** (1999) - *Towards a Better Understanding of Context and Context-Awareness,* Technical Report GIT-GVU-99-22, Georgia Institute of Technology, College of Computing, June 1999.

[HBC03] **A. Hammami, A. Burlat, J. P. Campagne** (2003) - *Evaluationg orders allocation within networks of firms,* International Journal of Production Economics, Vol.86, pp. 233–249.

[Har00] **M. Harzallah** (2000) - *Modelisation des aspects organisationnels et des competences pour la reorganisation d'entreprises industrielles,* Ph.D. Thesis, University of Metz, France.

[KB03] **M. Kwan, P. Balasubramanian** - *KnowledgeScope: managing knowledge in context,* Decision Support Systems Vol. 35, 2003, pp. 467–486.

[Lar03] **N. Lartigue** (2003) - *Knowledge and design,* in: Proceedings of the International Congress-SIA-Pois sy, France, September 17–18, 2003.

[LH04] **M. Laukkanen, H. Helin** (2004) - *Competence Manager-Applying the Semantic Web in Practice,* ISWC 2004.

[Lor07] **P. Lorino** (2007) - *Competence-based Competence Management: a Pragmatic and Interpretive Approach. The Case of a Telecommunications Company,* DR07012, ESSEC Research Center

[Ost97] **J. Osterlund** (1997) - *Competence management by informatics in R&D: the corporate level,* IEEE Transactions on Engineering Management Vol. 44, Iss. 2, 1997, pp. 135–145.

[Pam08] **M. Pamkowska** (2008) - *Autopoiesis in Virtual Organizations,* Revista Informatica Economica nr. 1(45), pp. 33-39.

[PH06] **C. K. Prahalad, G. Hamel** (2006) - *The core competence of the Corporation in Strategische Unternehmungsplanung,* Strategische Unternehmungsführung, Springer, 2006, pp. 275-292.

[T+07] **V. Tarasov, T. Albertsen, A. Kashevnik, K. Sandkuhl, N. Shilov, A. Smirnov** (2007) - *Ontology-Based Competence Management for Team Configuration,* LNCS, Vol. 4659/2007, pp. 401-410.

[ZB07] **G. Zulch, M. Beker** (2007) - *Computer-supported competence management: Evolution of industrial processes as life cycles of organizations,* Computers in Industry, Vol. 58, 2007, pp. 143–150