People Tagging & Ontology Maturing: Towards Collaborative Competence Management

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Abstract. Competence Management approaches suggest promising instruments for more effective resource allocation, knowledge management, learning support, and human resource development in general. However, especially on the level of individual employees, such approaches have so far not been able to show sustainable success on a larger scale. Piloting applications like expert finders have often failed in the long run because of incomplete and outdated data, apart from social and organizational barriers. To overcome these problems, we propose a collaborative competence management approach. In this approach, we combine Web 2.0-style bottom-up processes with organizational top-down processes. We addressed this problem as a collaborative ontology construction problem of which the conceptual foundation is the Ontology Maturing Process Model. In order to realize the Ontology Maturing Process Model for competence management, we have built the AJAX-based semantic social bookmarking application SOBOLEO that offers task-embedded competence ontology development and an easy-to-use interface.

Keywords: ontology maturing, people tagging, collaborative competence management, semantic social bookmarking, SOBOLEO

1 Introduction

Competence management approaches suggest promising instruments for more effective resource allocation, knowledge management, learning support, and human resource development in general. They aim at making transparent individual competencies and their relationship to organizational goals. However, especially on the level of individual employees, such approaches have so far not been able to show sustainable success on a larger scale [1]. Piloting applications like expert finder or expert locator systems have often failed in the long run because of incomplete and outdated data, apart from social and organizational barriers. This affects both competency profiles of the individual employee and non-adequate and often also outdated competency catalogs used as a vocabulary for the profiles.

Traditionally, these competence management approaches are conceived as top-down instruments. Typically, a small expert group models such competency catalogs at irregular intervals (usually well more than yearly) or even as a one-time activity

without scheduled updates [1]. For competency profiles, you can observe two approaches [2]: (1) self-assessment approaches in which employees themselves are asked to provide their competencies, sometimes mediated in a second step by their superior, and (2) external assessment approaches done by superiors or through formal assessment procedures.

While the latter approach is very expensive and cumbersome and thus can only be observed in limited areas, the first approach often fails because of missing motivation. This lack of motivation can be traced back to no immediate benefit for the employees. For instance, systems are hardly embedded into everyday work activities and have not proven their usefulness there. Or it can be even traced back to negative incentives; for instance, if you disclose your competencies, others will contact and perhaps disturb you or you will fear to appear not competent enough. As a result, employees might downplay or exaggerate their competencies as Becerra-Fernandez reports [3]. Often, these competency profiles also do not contain information that is of high relevance to colleagues; for instance manually-updated repositories become particularly outdated [4]. Thus, recent and usually very specialized topics are not yet contained in the competency catalog because of the long update intervals.

Several studies address this problem by automatically extracting profile information from data the user generates in her daily work; e.g. from publications [5], documents [6] or community contents [7, 8]. Ley et al. [9] propose a competence performance approach that derives competencies from executed tasks. In this approach, a task competency matrix is created together with domain experts. This matrix relates a set of tasks, e.g. required for a position, to a set of competencies needed to fulfill these tasks successfully. Based on this model, the system can infer a user's competency from her successful performance of a task in her daily work.

Recent Web 2.0 developments, mostly on the basis of social networking approaches, have also brought forth solutions for expert finding, e.g. LinkedIn [9] or Xing [11]. People can represent themselves with a profile and indicate their connections to other users. Further, in some of these approaches, the principle of social tagging and bookmarking is transferred to people (cf. [12]); for instance Xing [11] or theNTSH [13] allow organizing your contacts with tags. Within IBM's Fringe Contacts [14], each employee can describe their colleagues by tagging them with key words on their expertise and interests. Thus, step by step, a publicly visible tag cloud grows characterizing the individual employee. This leverages network effects for setting up some sort of profile of the individual, and improves usefulness for the individual user of the system which, in turn, motivates to contribute. For instance, Farell et al. [15] could state that tagging people was used to create communities.

However, the resulting profiles lack legitimation and commitment by the organization, especially with respect to the vocabulary used. The approaches do not provide support to overcome the gap and leverage the bottom-up topics to an organizational competences vocabulary. But that is a prerequisite for organizational competence management – ranging from team staffing, via human resource development to organizational competence portfolios.

2 Approach

2.1 General Considerations

To overcome these problems, we propose a collaborative competence management approach. In this approach, we combine Web 2.0-style bottom-up processes with organizational top-down processes: Web 2.0 oriented bottom-up processes allow every employee to participate and contribute with low usage barriers; i.e. by tagging colleagues; the organizational processes take up and guide these bottom-up developments towards organizational goals.

This requires bringing together the following elements:

- *Bottom-up collection of opinions about individual competencies.* Instead of cumbersome (top-down) processes to assess an employee's competencies, we make use of the "wisdom of the crowd" effect and collect the collective view of the community of employees on the competencies of the individual. Therefore, we need to empower the employees to describe each others' competencies in an easy and task-embedded way.
- *Freedom to evolve competence vocabulary.* Employees need to be able not only to state their opinion on who has which competency, but they have to be able to modify the vocabulary for stating those opinions as well. Otherwise, we do not exploit the ability of bottom-up processes to detect new trends.
- *Shared vocabulary for comparability.* Competencies usually have an integrating function in the enterprise, bringing together strategic and operational levels, and human resources, and performance management aspects. This means that competencies are not limited to an individual or to a group, but these notions have to be shared by the whole organization (in the ideal case): in consequence we cannot do without a shared vocabulary.
- *Legitimation and commitment by the organization.* If competencies are to play an important role in diverse organizational processes, ranging from team staffing, via human resource development process, up to organizational competence portfolio management, it is important that resulting competency profiles and competency cataloges are not only derived from the "wisdom of crowd", but have also the commitment of the organization. This is a main difference to the open world of the web of individuals. Major decisions depend on the appropriate identification of competencies and competency profiles so that the organization must *decide* at some point to which extent it relies on the result of collective bottom up processes and to which extents it defines certain binding aspects.

As a summary: the key idea is that we cannot do competence management completely without an agreed vocabulary (or ontology), i.e. the competency catalog. But we have to make the process of evolving this catalog more collaborative and embedded into its actual usage (e.g., while tagging other employees). Likewise, we do not conceive competency profiles as self-descriptions, but rather as results of collective judgments of others (cf. [14]).

2.2 Ontology Maturing Process for Evolving Competence Catalogs

We approached this problem as a collaborative ontology construction problem. The conceptual foundation is the Ontology Maturing Process Model [16] (based on a more general Knowledge Maturing Process [17]). The Ontology Maturing Process Model (see Fig. 1) is based on the assumption that ontologies, i.e. competency catalogs, cannot be formalized in a single activity. They are rather the result of continuous negotiation and collaborative learning processes that take place when applying the ontologies. The model structures the process of evolving competence ontologies into four phases:

1. **Emergence of ideas.** By employees annotating each other with any topic tag, new topic ideas emerge. For instance, they describe a recent or very specialized topic. These topic tags are individually used and informally communicated.
2. **Consolidation in Communities.** A common topic terminology evolves through the collaborative (re-)usage of the topic tags within the community of employees. The topic tags are defined and refined, useless or incorrect ones are rejected.
3. **Formalization.** Within the third phase, the special members of the community (usually legitimated by the organization by assigning "gardening" tasks) begin to organize the topic terminology into competencies by introducing relations between the topic tags. These relations can be taxonomical (hierarchical) ones as well as arbitrary ad-hoc relations, expressing similarity (e.g., Java Programming and C# Programming). That results in new or updated competency notion, i.e. lightweight ontologies, which allow primarily for inferencing based on subconcept relations.
4. **Axiomatization.** In the last phase, modeling experts add axioms for exploiting relationships for reasoning. This includes especially precise composition relationships. This allows and improves for complex inferencing processes, e.g. subsumtion of competencies for the purpose of competency gap analysis, or competency-based selection of learning opportunities (cf. [1]).

It is important to note that ontology maturing does not assume that the competence ontologies are built from scratch. It can be equally applied to already existent core competency catalogs that might be further developed and can be used for seeding.

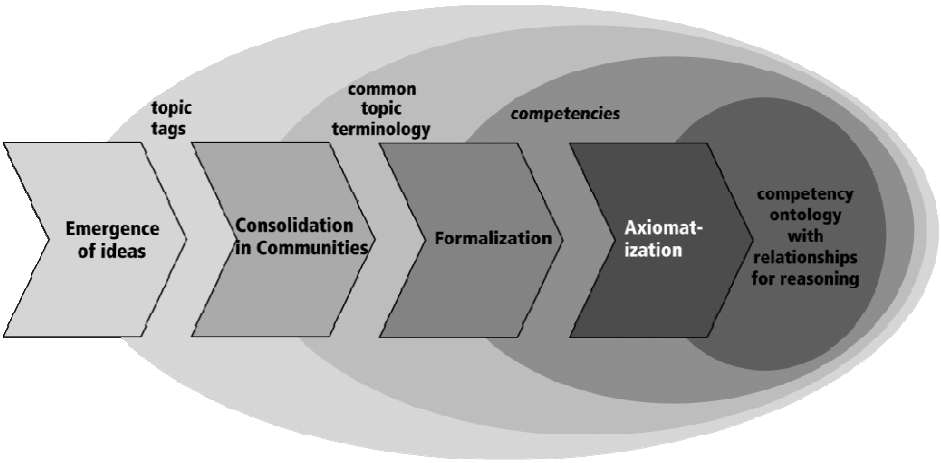

Fig. 1. Ontology Maturing for Competence Ontologies.

2.3 Different levels of Formality for different Use Cases

One important conclusion from the ontology maturing model is that the different phases result in different levels of formality. These different levels of formality co-exist within a single competence model. But how can we represent these different levels of formality so that we can also exploit the information?

As part of the Professional Learning Ontology, we have developed a conceptualization of competencies that has three basic levels: topics (as weak notions), competency types (without differentiation) and competencies (with levels). These relate to each other as shown in Fig. 2.

In this way, we can (1) represent all four phases of the ontology maturing process and (2) degrade the semantics of more formal statements if needed. Especially, the latter is important for the different use cases of competence models [1]:

- *Topic tags.* As many Web 2.0 sites show or [14], tags are sufficient to provide a basic level of useful search and retrieval functionality and similarity between the tagged resources. Precise tag definition would help, but are not needed.
- *Competence types.* For basic profile matching, we need well-defined competency notions and taxonomic relationships to allow for different levels of abstraction by using broader-narrower relationships. We can also perform basic competency gap analysis (by exact matching).
- *Competencies (with levels).* This allows for a more extended version of profile matching as you can have different degrees of fulfillment for individual competencies. This can also form the basis for describing the objectives of learning opportunities (trainings, learning objects).

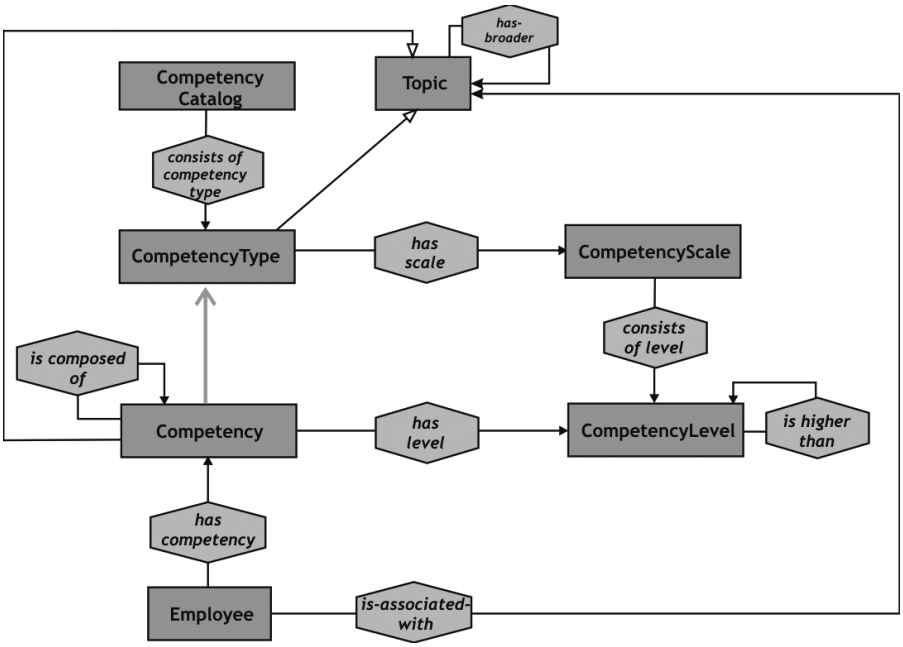

Fig. 2. Core part of the Professional Learning Ontology.

- *Competency relationships.* If we have precise is-a semantics, or composition of competencies in the competence model, we can introduce the notion of competence subsumtion (see [21]), e.g., if competency X is part of competency Y, X subsumes Y. This allows for more sophisticated competency gap analysis (as in [20]), and competency-based selection of learning opportunities.

3 Tool Support

In order to realize the Ontology Maturing Process Model for competence management, we have built the AJAX-based semantic social bookmarking application SOBOLEO that offers task-embedded competence ontology development and an easy-to-use interface. SOBOLEO [18] is the acronym for **So**cial **Bo**okmarking and **L**ightweight **E**ngineering of **O**ntologies. It supports the collaborative development of a shared bookmark collection (e.g., of people's web pages in an intranet) and of a shared competence ontology that is used to organize the bookmarks. That means users can tag the people's web page with ontology concepts, and at the same time they can modify and adapt the competence ontology.

Fig. 3. Collaborative Competence Ontology Editor.

SOBOLEO consists of four major parts: (1) a collaborative real time editor for changing the competence ontology (see Fig. 3), (2) a tool for the annotation of web pages (see Fig. 4), (3) a semantic search engine for the annotated bookmarks, and (4) an ontology browser for navigating the competence ontology and the content of the bookmark collection.

With SOBOLEO, all users create and maintain one competence ontology and one shared bookmark collection collaboratively. If the users encounter a resource, e.g. a colleague's profile or homepage, they can add it to the bookmark collection and tag it with concepts from the competence ontology (see Fig. 4). In the case they want to tag the resource with a topic the existing ontology concepts do not cover (e.g. because the topic is too new or specific), the users can adapt an existing concept (second phase of the ontology maturing process) or just use new topic tags, without an agreed meaning (first process phase). These new topic tags are automatically added to the ontology as "prototypical concepts".

SOBOLEO further provides consolidation support for the gradual formalization of these new topic tags to competence types and competencies with levels. By providing

an easy-to-use and easy-to-access collaborative real time editor, the users can refine and correct concepts when they apply the competence ontology within their everyday activities. In this way, the users can easily bring topic tags to competence types and competencies with levels.

As standard and formal language we use the SKOS Core Vocabulary [19]. By its lightweight and intuitive language it supports to handle the tradeoff of having different levels of formality and an easy understandability for non-modelling experts. In this way, users can structure the concepts within SOBOLEO with hierarchical relations (broader and narrower) or indicate that concepts are "related" which supports the third process phase. These relations are also considered by the semantic search engine. That means the user can improve the retrieval of the annotated bookmarks by adding and refining ontology structures.

Fig. 4. Annotating an Employees Personal Web Page.

4 Conclusion

Our approach of collaborative competence management provides a solution to overcome the hitherto strictly top-down competence management approaches. In this way, competence ontologies can be developed that also cover less formalized topic tags and structures. This guarantees usefulness and timeliness when being applied.

With SOBOLEO's embeddedness into everyday work activities and easy usage, employees are motivated to contribute. If users discover that a topic is missed within the ontology, they can simply add it. If they cannot find a colleague under the estimated topic or not at all, they can just add a new bookmark and tag it appropriately. These annotations we want to use in a next step for automatic profile generation.

Currently, SOBOLEO does not support the fourth phase of the ontology maturing process. Therefore, we are extending SOBOLEO's functionality for subsumtion and composition support by introducing is-a and is-part-of relations as subproperties of the broader relation. As this also introduces higher complexity for the users, we are evaluating within the projects Im Wissensnetz[1] and MATURE[2] how the users deal with this.

Moreover, the early inclusion of recent or specific topics can help disclosing hidden competences or new trends within the organization. One of our next steps will be how to visualize these trends from an organizational perspective.

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