An Ontological Representation of Competencies as Codified Knowledge

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Abstract

In current organizations, the models of knowledge creation include specific processes and elements that drive the production of knowledge aimed at satisfying organizational objectives. The Knowledge Life Cycle (KLC) model of the Knowledge Management Consortium International (KMCI) provides a comprehensive framework for situating competencies as part of the organizational context. Recent work on the use of ontologies for the explicit description of competency-related terms and relations can be used as the basis for an study on the ontological representation of competencies as codified knowledge, situating those definitions in the KMCI lifecycle model. In this paper, we discuss about the similarities between the life cycle of KM and the processes in which competencies are identified and assessed. The concept of competency, as well as the standard definitions for this term that coexist nowadays, will then be connected to existing KLC models in order to provide a more comprehensive framework for competency management in a wider KM framework. This paper also depicts the framework's integration into the KLC of the KMCI in the form of ontological definitions.

INTRODUCTION

Models of knowledge creation inside organizations are considered as dynamic processes of development that evolve over time (Cavaleri & Reed, 2000). These models provide a breakdown of the creation process in terms of concrete processes and elements that drive the overall production of knowledge as targeted to satisfy organizational expectations. For example, the Knowledge Life Cycle (KLC) model of the Knowledge Management Consortium International (KMCI, http://www.kmci.org) distinguishes the Knowledge Processing Environment (KPE) from the Business Processing Environment (BPE), describing the latter as the context of actual usage and field assessment of the claims formulated, produced and evaluated in the former. As the KPE is divided into two sub-processes, namely Knowledge Production (KP) and Knowledge Integration, the existence of a BPE emphasizes the fact that knowledge codified in artefacts as part of KP processes and disseminated as part of KI processes will be subject to further validation in actual business experience.

Previous work has shown KLC models as a comprehensive framework for situating learning-oriented artefacts in an organizational context (Sanchez-Alonso & Frosch-Wilke, 2005; Sicilia, 2005). The work of Sicilia (2005) has demonstrated that the design and creation of learning resources as described by Downes (2004), is not essentially different from knowledge production. The integration processes, in particular, might be considered to subsume programmed organizational learning activities. Thinking about learning as an outcome of the need to acquire new competencies, learning activities inside the organization can be considered as enablers of knowledge acquisition activities. In this context, the concept of competency becomes essential in the KLC model, both as a prerequisite to perform knowledge acquisition activities, and as an outcome of this kind of activities. Furthermore, meta-claims about the knowledge produced – in the case of competencies – may be interpreted as the recording of usage conditions, hypotheses and assumptions on the acquisition of the competencies evaluated. In consequence, the concepts related with competency management can be put in connection with existing KLC models, in an attempt to provide a comprehensive framework for reuse-oriented competency management and KM. In this paper, we approach the integration of concepts related to competencies into the framework of the KLC. This would clarify the relationships between Knowledge Management and competency definition standard efforts. The method to develop the conceptual integration is that of engineering an initial ontological description for the main concepts, connecting them to existing ontological databases. This continues existing work described by Sicilia, Lytras, Rodríguez and García (2006) regarding the ontological description of learning activities as an extension of the ontology of KM described recently by Holsapple and Joshi (2004).

Formal ontologies (Baader et al., 2003) are a vehicle for the representation of shared conceptualizations that is useful for technology-intensive organizations. Ontologies based on description logics (Gruber, 1995) or related formalisms provide the added benefit of enabling certain kinds of reasoning over the terms, relations and axioms that describe the domain. A pragmatic benefit of the use of formal ontologies is that it is accompanied by a growing body of Semantic Web (Berners-Lee, Lassila & Hendler, 2001) tools, techniques and knowledge. Previous work considered here as a point of departure (Sicilia, García, Sánchez-Alonso & Rodríguez, 2004) has described the integration e-learning technology concepts with the *OpenCyc* knowledge base, the open source version of the *Cyc* system (Lenat, 1995).

The rest of this chapter is structured as follows. The second section describes the Knowledge Life Cycle of the KMCI, as this is the framework for the subsequent discussion. The third section includes a brief discussion on some current definitions of the term competency, and details the most interesting efforts in the standardization of competency definitions. Section 4 shows how competencies can be integrated in the knowledge life cycle (KLC) of the KMCI, while section 5 provides a preliminary mapping of competency-related concepts to terms in upper ontologies. Finally, conclusions are provided in the last section.

THE KNOWLEDGE LIFE CYCLE OF THE KMCI

Knowledge Management (KM) is an area build on the assumption that each and every organization has a certain amount of “valuable knowledge” that is worth to be captured, catalogued and preserved with the main aim of sharing it whenever it is necessary. However, first generation KM, as it is referred by McElroy (1999) has not been considered fully satisfactory, which is probably due to an excessive emphasis on both knowledge integration and on the technology side as the answer to most questions. To many, this first generation of knowledge management has supposed little more than document management and imaging becoming the reason why some feel that KM is “an idea that amounts to little more than yesterday’s information technologies trotted out in today’s more fashionable clothes”. Hopefully, a second generation of KM has emerged. This second generation of knowledge management is not so focused on the technology side, but instead on the participants, the processes involved and the social interactions and initiatives among them. The arrival of this second generation has introduced a number of new concepts and ideas, such as The Knowledge Life Cycle, Nested Knowledge Domains, Containers of Knowledge, Organizational Learning, the Open Enterprise, Social Innovation Capital, and Sustainable Innovation, among others. While an in-depth discussion of this and other key ideas of this second generation of KM is out of the scope of this chapter, the interested readers are directed to the book by McElroy (2003).

The knowledge life cycle (KLC), one of the previously mentioned ideas introduced as part of the second generation of KM, is a new view of KM that emphasizes knowledge production in detriment of the knowledge integration. The following explanation by McElroy points out the differences between the first and the second generation of KM taking as a criteria of comparison the KLC:

> *While practitioners of first-generation KM tend to begin with the rather convenient assumption that valuable knowledge already exists, practitioners of second generation KM do not. Instead, they –or we– take the position that knowledge is something that we produce in human social systems, and that we do so through individual and shared processes that have regularity to them. We can describe this process at an organizational level in the form of what is now being referred to as the knowledge life cycle, or KLC. (McElroy, 2003)*

From this perspective, the Knowledge Management Consortium International (KMCI), a non-profit association of knowledge and innovation management professionals from around the world (www.kmci.org) based in the U.S., has developed a model of KLC that is shown in Figure 1 taken from McElroy (n.d.).

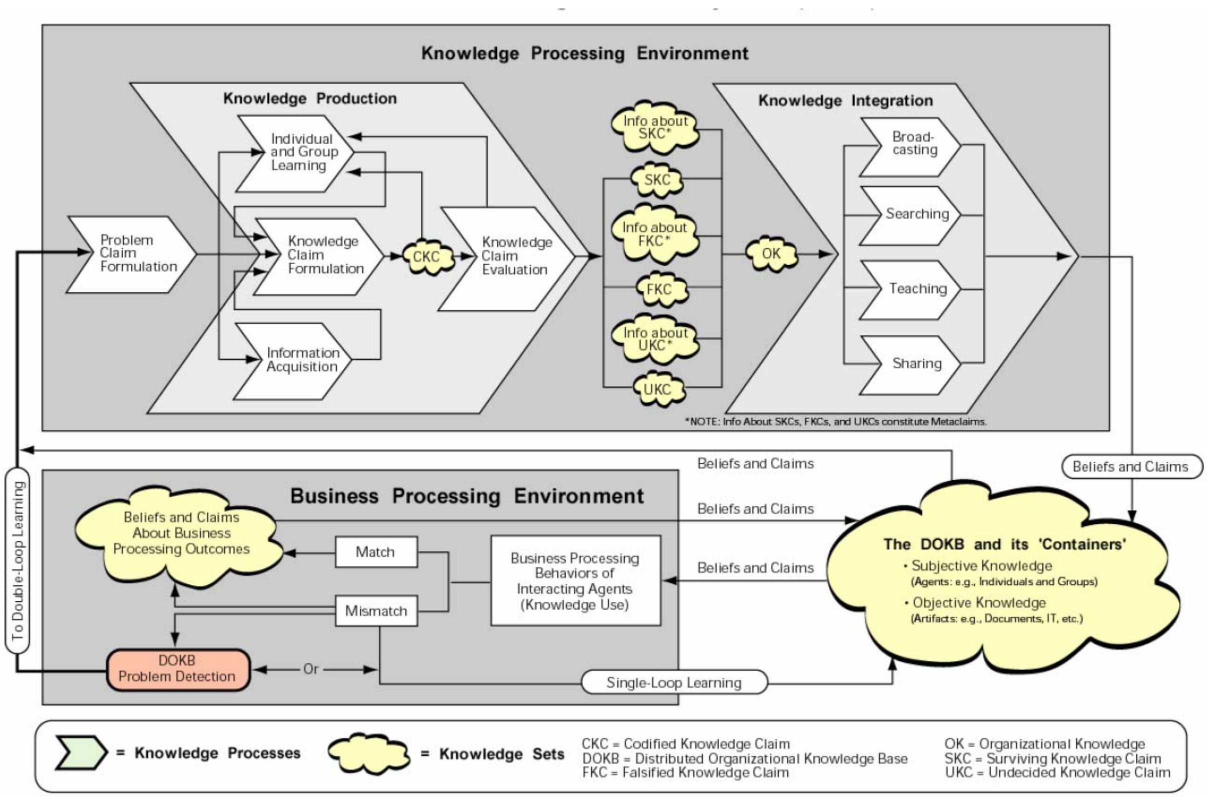

Figure 1. The Knowledge Life Cycle (KLC) model of the KMCI.

This model shows how the knowledge of an organization is held both subjectively in the minds of individuals and groups, and objectively in recorded or expressed form, shaping what is known as the Distributed Organizational Knowledge Base (DOKB) of the organization. The use of this knowledge in specific business environments can lead to outcomes that either satisfy expectations, or fail to do so. The former outcomes, known as matches, reinforce knowledge previously used, thereby leading to its re-use, whereas the later ones, known as mismatches, lead to adjustments in a Business Processing Environment. Adjustments triggered by a mismatch introduce what is known as the Single-Loop Learning. This Single-Loop Learning means that the assumptions, or choices made from within a range of pre-existing knowledge in the DOKB should be studied and probably corrected in the light of the results of the revision. Successive failures from single-loop learning to produce matches in expected or desired outcomes is understood as a problem, and could lead to doubt about and probably reject pre-existing knowledge. Problems like these trigger knowledge processing efforts to produce and integrate new knowledge, in what is known as the Double-Loop Learning (Argyris & Schon, 1996). Double-Loop Learning starts with a Problem Claim Formulation, an attempt to learn and state the specific nature of the detected knowledge gap (or "problem"), followed by a process of Knowledge Production. The outcome of this process is a Knowledge Claim Evaluation, which leads to Surviving Knowledge Claims, Falsified Knowledge Claims, or Undecided Knowledge Claims, as well as additional information about each of these outcomes (this information is known as *metaclaims*). The record of all the previously mentioned outcomes, will be part of the DOKB after a number of activities in a process of Knowledge Integration. When the knowledge has successfully been integrated in the DOKB, the new claims and metaclaims are ready to be used in new Business Processing.

The life cycle described is the framework for all the subsequent discussion. The following section will provide a brief introduction to the concept of competency, as well as detailed information on current efforts of standardization (IMS-RDCEO and HR-XML) intended to make it easier to integrate competency management into workflow and decision-support frameworks such as the KLC of the KMCI.

COMPETENCY: DEFINITION AND STANDARDS

At present, several different definitions of the concept of "competency" coexist. Although most agree on a few core characteristics, it is interesting to provide a brief discussion about some of the most closely related to this work.

The notion of competency is often considered as a "placeholder" for knowledge, skill, abilities, and "other characteristics" (Sicilia, 2005). However, this view can be judged as an excessive oversimplification of the many facets of the use of the term (Hoffman, 1999). In a general sense, a competency can be defined as “an underlying characteristic that leads to successful performance, which may include knowledge and skills as well as bodies of knowledge and levels of motivation“ (Rothwell, n.d.). Another broad definition is that included in the IMS-RDCEO Best Practices and Implementation Guide (Cooper & Ostyn, 2002c): “All classes of things that someone, or potentially something, can be competent in”.

Some authors believe that competencies encompass more than just knowledge and skill, as they “focus on what is unique about individuals doing the work rather than what people must know or do to perform the work alone” (Rothwell, n.d.). In this sense, the definition included in the HR-XML seems to cope with this approach, as this is a much more inclusive definition: “A specific, identifiable, definable, and measurable knowledge, skill, ability and/or other deployment-related characteristic (e.g. attitude, behaviour, physical ability) which a human resource may possess and which is necessary for, or material to, the performance of an activity within a specific business context”.

In the rest of this section, the most prominent approaches to competency standardization are studied. It should be remarked that, as it has been stated earlier, most agree on the core characteristics of competencies, even though all include their own definitions and consequently refer to the term competency from their own perspective.

IMS-RDCEO

The IMS consortium (http://www.imsglobal.org) provides a specification for competencies called “Reusable Definition of Competency or Educational Objective (RDCEO)”. IMS-RDCEO defines an information model for describing, referencing, and exchanging definitions of competencies, primarily in the context of online and distributed learning. This specification allows to formally represent the most important characteristics of a competency, and its main aim is to enable interoperability among learning systems that deal with competency information. The complete specification consists of three documents:

- IMS-RDCEO Information Model (Cooper & Ostyn, 2002a), that includes the complete description of the main elements of the specification: semantics, structure, data types, value spaces, multiplicity, and obligation. This information model is purposely extensible, minimalist and model-neutral.
- IMS-RDCEO XML Binding (Cooper & Ostyn, 2002b), that constitutes only one example of the possible bindings that might use the information model, is a binding of the Information Model to XML version 1.0.
- IMS-RDCEO Best Practices and Implementation Guide (Cooper & Ostyn, 2002c), a non-normative set of rules about the application of both the Information Model and the XML Binding, as well as examples to e.g. illustrate how the conceptual framework maps to practical uses.

The information model defines a set of elements of information, in 5 different categories, that can be used to define a competency. Hence, competency data may include a definition of the competency, evidences of the competency, information about its context and, the scale (i.e. proficiency on a predetermined scale). Following this schema, a competency can be described by stating information in the following 5 main categories:

1. Identifier, subdivided into *catalog* and *entry*.
2. Title.
3. Description.
4. Description, subdivided into *model source* and *statement*.
5. Metadata, subdivided into *RDCEO schema*, *RDCEO schema version* and *additional metadata*.

The definition of a competency, according to this schema, is shown in the following example, a simplification of a broader example taken from Cooper & Ostyn (2002c):

```
<?xml version="1.0" encoding="utf-8"?>

<rdceo xsi:schemaLocation="http://www.w3.org/XML/1998/namespace xml.xsd"
xmlns="http://www.imsglobal.org/xsd/imsrdceo_rootv1p0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

<identifier>http://www.imsglobal.org/fictional/rdceo_cat1.xml#pass_eg
</identifier>
   <title>
      <langstring xml:lang="en-US">Reading IMS specifications</langstring>
   </title>
   <description>
       <langstring xml:lang="en-US">
              Reads and understands IMS Global Learning specifications
       </langstring>
   </description>
   <definition>
      <model>IMS Competency WG</model>
      <statement statementname="Performance">
         <statementtext>
            <langstring xml:lang="en-US">
               Reads and understands IMS Global Learning specifications
            </langstring>
         </statementtext>
      </statement>
   </definition>
   <metadata>
      <rdceoschema> IMS RDCEO </rdceoschema>
      <rdceoschemaversion> 1.0 </rdceoschemaversion>
   </metadata>
</rdceo>
```

However, although IMS-RDCEO is explicitly intended to be integrated in the description of “learner profiles” and “learning objects” (Polsani, 2003), its underlying model provides similar capabilities to that of HR-XML, a general-purpose competency schema that will be detailed in the next section.

HR-XML

The HR-XML (http://www.hr-xml.org/) is an independent, non-profit consortium, whose main aim is to enforce e-commerce and inter-company exchange of human resources data within a variety of business contexts. Represented by its membership in 22 countries, the main effort supported by this consortium is the development of standardized XML vocabularies for Human Resources, as well as standards for staffing and recruiting, compensation and benefits, and training and work force management. Major companies such as Addeco, Cisco Systems, PeopleSoft GmbH, IBM, Microsoft, and many others are currently members of the HR-XML Consortium.

Up to the present, the HR-XML Consortium has produced a library of more than 100 interdependent XML Schemas that define the data elements for particular HR transactions, as well as options and constraints governing the use of those elements. It has also produced schemas covering major processes, as well as component schemas, used across multiple business processes. For example, the Assessments Standard, facilitates employers to leverage the assessment tests, tools, and expertise offered by assessment service providers.

One of the schemas provided by the HR-XML Consortium is the Competencies Recommendation. This set of recommendations about competencies allows “the capture of information about evidence used to substantiate a competency and ratings and weights that can be used to rank, compare, and otherwise evaluate of the sufficiency or desirability of a competency” (Allen, 2006). The competencies schema is particularly relevant to processes involving the rating, measuring, comparing, or matching an asserted competency (for example, a skill claimed in a resume) against one that is demanded (for example, a skill required in a job description). This fact, added to the fact that this schema is intended as a module that can be incorporated within broader process-specific schemas, facilitates its use outside the HR domain as a general-purpose competency schema, and makes it possible its integration in diverse frameworks. The only requirement for those frameworks is, of course, the use of some kind of competency management.

Figure 2, taken from Allen (2006), depicts the components of a competency after what is stated in the HR-XML recommendation. This standard defines a number of elements of information for each competency, as well as the structure and information of the competency evidences and weights, among other information.

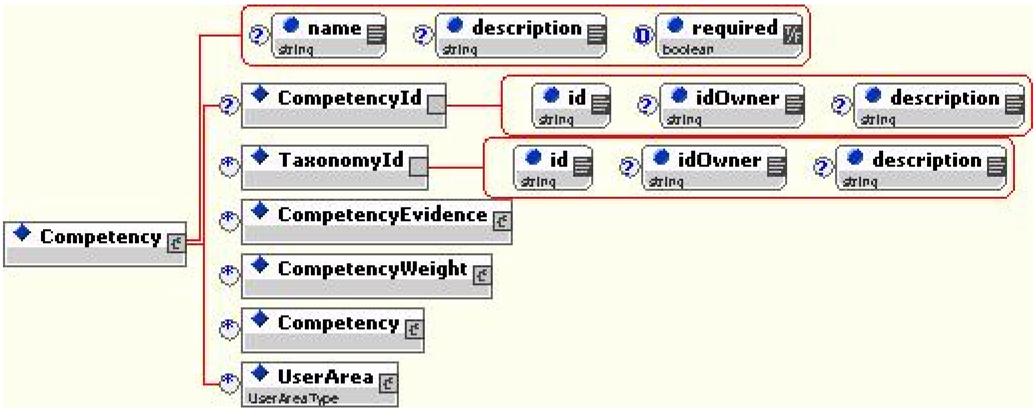

Figure 2. Components of a competency after the HR-XML recommendation

The definition of a competency, according to this schema, is shown in the following example, again taken from Allen (2006):

```
<Competency name = "Reading Comprehension"
            description = "Understanding written sentences and paragraphs
            in work related documents">

   <CompetencyId id = "2.A.1.a"/>

   <TaxonomyId    id = "O*NET"
                  idOwner = "National O*Net Consortium"
                  description = "Occupational Information Network"/>

   <CompetencyWeight type = "x:Importance">
            <NumericValue maxValue = "100" minValue="1">85</NumericValue>
   </CompetencyWeight>

   <CompetencyWeight type = "x:Level">
            <NumericValue maxValue = "100" minValue="1"> 57 </NumericValue>
   </CompetencyWeight>

</Competency>
```

HR-XML can also be used as a wrapper of an RDCEO record by using a URN, as shown in the following example taken from (2006):

```
<Competency description="Can read and understand W3C Schema Language 1.0"
      name="Reads and Understands W3C Schema"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:noNamespaceSchemaLocation="Competencies-1_0.xsd">

   <CompetencyId description="IMS Global Example Competency Catalogue"
         id="URN:X-IMS-PLIRID-V0::6ba7b8149dad11d180b400c04fd430c8"/>

   <!-- omitted evidence data etc. -->
</Competency>
```

INTEGRATING COMPETENCIES IN THE KNOWLEDGE LIFE CYCLE (KLC)

In this section, the related concepts of competencies are described as the main elements to be integrated as resources in the KLC. Then, their integration inside the KLC model of the KMCI is described.

The process of acquisition of a competency (or knowledge in a broader sense) usually starts from a business need originated in the context of the organization. This need triggers a process of assessing whether the organization can deal with the given need or not, which is commonly referred to as knowledge gap analysis (Sunassee & Sewry, 2002). This assessment process essentially consists on matching the competencies required for the newly appointed needs with the available ones. When the result of this process is not satisfactory, a process of acquiring the competencies identified begins. After this process is considered finished, some kind of assessment would take place and, later on, an update of the registry of available competencies should be carried out. The newly acquired competencies might change the position of the organization to offer services or products, closing in this manner the so-called "knowledge acquisition loop".

As a knowledge acquisition endeavour, the just described cycle can be expressed in terms of knowledge management activities and products. According to the ontology of knowledge management by Holsapple and Joshi (2004), competences can be considered as capabilities attributable to processors of knowledge representations (KR), and the final learning activities carried out to obtain the competencies needed can be seen as specific types of knowledge manipulation activities (KMA), consisting on knowledge acquisition or eventually, transformation. Furthermore, processors are considered to have some capabilities as analysed by Sicilia (2005). This latter author identifies the terms (or as it is called in the original work, *abstract elements*) related to competency management as a previous step to integrating them in the KLC.

- *Competency registry*: Not a term, but instead a set of terms related to the description of competencies in detail, particularly those of the existing employees.
- *Needs*: an expression of the required competencies, that can be represented in the form of triples (C: competency_description, L: level, I: intensity). According to Sicilia (2005), the level desired for the competency is expressed as an overall aggregate level which maps to the levels of individuals inside the organization, whereas the intensity is an estimation of the part of the workforce that is needed to have the competency.
- *Available competencies*: A detailed record of employee's competencies.
- *Required competencies*: a subset of the needs after matching them with the competency registry. Aimed at describing needs not covered by the existing competencies.

- *Competency gap analysis*: A process used to obtain the required competencies. This process has a collection of needs and a competency registry as inputs and the required competencies as outputs.

- *Competencies update*: The process of creation or update of competency instances, aimed at keeping the competency registry updated.

The main elements of the integration of the above listed terms to the KML model are depicted in Figure 3, which has been elaborated from the original KLC of the KMCI by including mappings to concrete competency usage points.

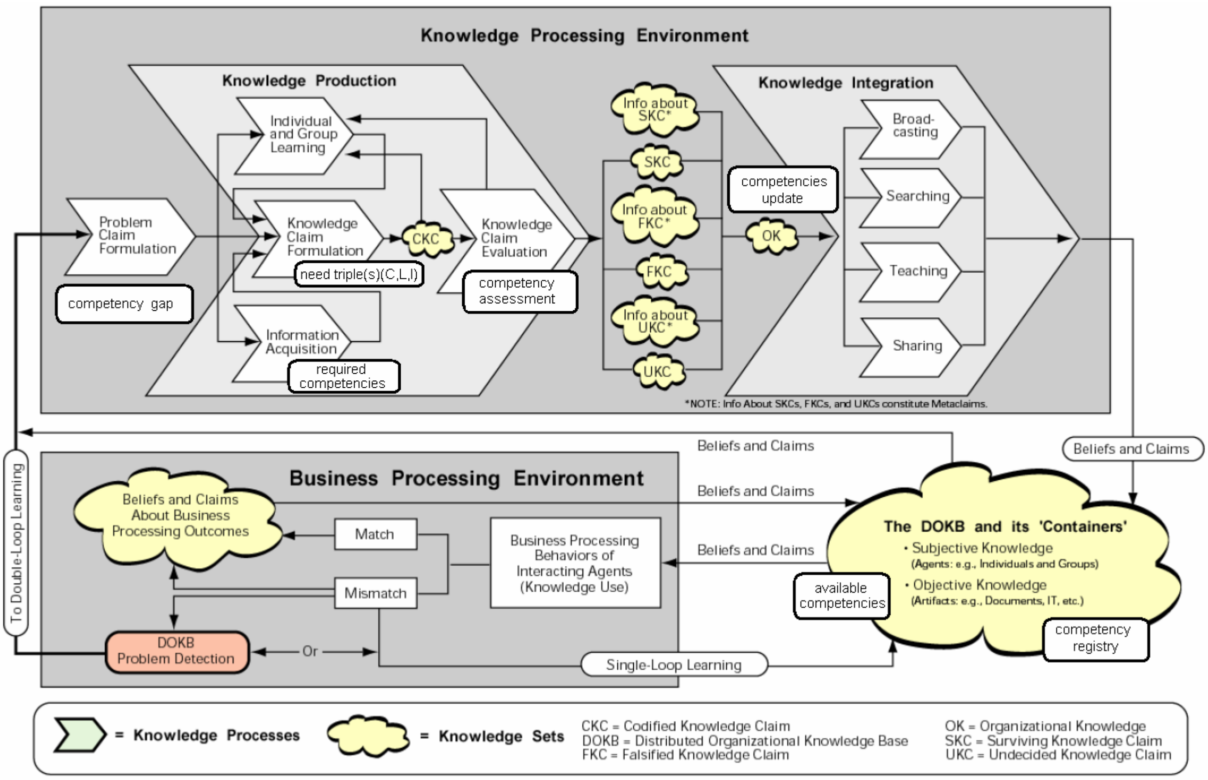

Figure 3. Mapping of the main terms of competency management to the KLC model

MAPPING COMPETENCY-RELATED CONCEPTS TO TERMS IN UPPER ONTOLOGIES

Competency management can be integrated in the broader framework of a Knowledge Management Lifecycle to provide guidance for Information System development and insights into notions of organizational value of competencies, among others. However, even though current standards for the description of competencies are intended to provide data aimed at being interchanged by machines, the information they contain is currently intended for human interpretation. Present practices result in data lacking machine-understandable characteristics, which seriously hampers their use in Semantic Web environments. Ontologies can be used to improve the quality of competency descriptions, but “translating” current competency descriptions that conform to a given standard (such as HR-XML) to an ontology language is not enough by itself to provide computational semantics to those descriptions. The right step in this direction is the integration of competency terms with high-level terms and definitions in upper ontologies, as this constitutes an interesting direction for bringing explicit semantics to competency descriptions.

An upper ontology is a large general knowledge base that include definitions of concepts, relations, properties, constraints, and instances, as well as reasoning capabilities on these elements. Limited to generic, high-level, abstract concepts, general enough to address a broad range of domains, upper ontologies do not include concepts specific to given domains, or do not focus on them. Opencyc (http://www.opencyc.org), an upper ontology “for all of human consensus reality”, includes more than 47,000 concepts, 306,000 assertions about them, an inference engine, a browser for the knowledge base and other useful tools, what makes it one of the major efforts in the field. It is the open source version of the larger *Cyc* knowledge base (Lenat, 1995), a huge representation of the fundamentals of human knowledge made up of facts, rules, and heuristics for reasoning about objects and events.

The rest of this section sketches the main integration points of the KLC with competencies in the framework of existing work in formally conceptualizing KM. The direct mapping of the essential concepts described in this chapter and the terms in the Holsapple and Joshi (2004) ontology of KM, enables an effective integration of ontology-based KM and organizational competency management in existing upper ontologies such as OpenCyc.

The ontology of Knowledge Management by Holsapple and Joshi (2004) describes fundamental KM concepts and axioms. In this ontology, the term KM is defined as “an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity [..]”. This requires the early definition of “entities” capable of engaging in KM, which are considered to include at least individuals, organizations, collaborating organizations and nations. The term `Organization` in OpenCyc covers all such entities. Accordingly, the concept of knowledge processor as a member of an entity can be modelled by the concept of `IntelligentAgent`, which is by definition “capable of knowing and acting, and of employing its knowledge in its actions”. Humans are by logical definition intelligent agents and certain software pieces may also be, since they are not restricted to not being able to know. The subtype `MultiIndividualAgent` fits the definition of collective agents. According to Cavalieri and Reed (2000), knowledge creation is “the result of efforts by agents, acting either as individuals, or collaboratively, as an element of a system, to make sense of their environment”. This definition focuses on the identity of the organization as a key driver of its learning behaviour, and is complemented by a concrete view on creation as a process in which agents apply rules to perceived sets of circumstances to attain desired outcomes.

The definition of Knowledge as “that which is conveyed by usable representations” can be integrated in OpenCyc by considering usable representations as information bearing things, i.e. ”Each instance of `InformationBearingThing` (or `IBT`) is an item that contains information (for an agent who knows how to interpret it)”. This is appropriate at least for CKC that are tangible outcomes of the production process. Nevertheless, the KLC emphasizes the evaluation of information as tentative Knowledge Claims, so that terms subsumed by `IBT` are required to adequately fit in the KLC, including the following:

- `EvaluatedKnowledgeClaim` representing the “surviving” claims, which are required to have been `subjectTo` at least one `KnowledgeClaimEvaluation` process with a positive outcome.
- `FalsifiedKnowledgeClaims`, with the opposite definition.
- The rest of the `KnowledgeClaim` instances are subsumed by `UndecidedKnowledgeClaim`, representing different states before or after claim evaluation.

`KnowledgeClaimEvaluation` instances are a concrete kind of knowledge manipulation. The recognizable kinds of knowledge manipulation are referred to as Knowledge Manipulation Activities (KMA), and thus, `CompetencyAssessment` may be considered a subtype of KMA. In OpenCyc, activities are represented as `Actions`, collections of `Events` carried out (`doneBy`) a “doer”. This generic concept of action can be specialized to represent KMA executions by restricting them to be carried out by intelligent agents. The predicate `ibtUsed` (subsuming the above mentioned `subjectTo`) can be used to represent the knowledge representations manipulated by KMAs. In addition, since KM activities are deliberate, it is preferable to use the subclass `PurposefulAction`. Each of the processes in Figure 3 can be considered as KMAs.

Competencies are represented in OpenCyc. However, the attribute `Competence`, subsumed by `Quantity-ScriptPerformance` (aimed at describing the manner in which an actor performs an action) and `ScriptPerformanceAttributeType` (aimed at describing the manner in which an action is performed), is defined as “a general attribute to define the level of skill with which an agent performs some task”. For that reason, this notion of competency is considered too general and thus inadequate to define the concept competency as it has been used in this work.

The most accurate way to define competencies is that of defining OpenCyc `Actions`. Accordingly, predicates related to the definition, description and use of competencies would be derived from the predicate `SkillLevel`. This OpenCyc predicate, as stated in the OpenCyc knowledge base, defines a relation between performers and types of actions in the following manner: some performer (probably, but not necessarily, an `Agent`) has the ability to play a given role in a specific type of `Event` with a certain level of `PerformanceAttribute`. For example:

```
(skillLevel MagicJohnson PlayingBasket performedBy Creativity #$High)
```

Meaning that, in general, Magic Johnson can play basket with great creativity. If these behaviour is translated to competency management, the knowledge about the fact that the employee `Angela` has a particular competence should be stated like this:

```
(skillLevel Angela SpeakingInPublic performedBy Competence #$VeryHigh)
```

In this example, the competency is represented by the action `SpeakingInPublic`, whereas the attribute `Competence` is just one qualifier to describe the manner in which the competency `SpeakingInPublic` is performed by the employee (others might be

`Charisma`, `Precision`, `Dexterity` or `Gracefulness`). This form of modelling competencies is similar to the manner in which competencies are defined in HR-XML, and opens the door to a full description of other concepts related as the triples (competency, level and intensity), easy to model in OpenCyc through a specifically-designed ternary predicate.

CONCLUSIONS

Competency management can be integrated in the broader framework of a Knowledge Management Lifecycle to provide guidance for Information System development and insights into notions of organizational value of competencies. Concretely, a feasible integration of such concepts into the KMCI KLC model has been described.

Current standards for the definition, sharing and exchange of competencies, as well as the information about competencies that conform to this specification included in the DOKB of the organizations, are intended for interchange by machines, but instead they are currently intended for human interpretation only. Their main aim is to enable interoperability among systems that deal with competency information by providing a means for them to refer to common definitions with common meanings. However, these efforts insist in the construction of models of competencies but do not focus on semantic interoperability. The resulting ontological schemes shown in this chapter are intended as a foundation for further research and standardization activities.

The authors consider that an additional effort of integrating current standards in commonsense knowledge bases, such as OpenCyc, through formalizing concepts in ontology languages, can be particularly rewarding as it would provide competency management with the benefits of the Semantic Web vision.

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