ITC irst

CENTRO PER LA RICERCA
SCIENTIFICA E TECNOLOGICA

38050 Povo (Trento), Italy
Tel.: +39 0461 314312
Fax: +39 0461 302040
e−mail: prdoc@itc.it − url: http://www.itc.it

THE ROLE OF CLASSIFICATION(S) IN DISTRIBUTED KNOWLEDGE MANAGEMENT

Bonifacio M., Bouquet P., Cuel R.

December 2002

Technical Report # 0212−19

The role of classification(s) in distributed knowledge management

Matteo Bonifacio[1], Paolo Bouquet[1], and Roberta Cuel[2]
[1]*Department of Information and Communication Technology*
[2]*Department of Computer and Management Science*
University of Trento (Italy)
bonifaci@science.unitn.it bouquet@cs.unitn.it rcuel@cs.unitn.it

Abstract. Most knowledge management (KM) projects aim at creating a knowledge base system in which all corporate knowledge is organized according to a single, supposedly shared and objective classification. The underlying assumption is that knowledge can be made objective refining it of all its subjective, contextual, and social aspects. However, a lot of work in disciplines like artificial intelligence, cognitive science, philosophy, linguistics, show that such an objectivistic epistemology is incompatible with the very nature of knowledge, and it is, therefore, one reason why KM systems are often deserted by users. Another approach, called *D*istributed Knowledge Management (DKM), is proposed in which subjective and social aspect are seriously token into account. Using this approach, we discuss a high level technological architecture, in which we introduce the idea of *local classification*, namely a classification created and maintained by a single organizational unit (e.g., a community or a division), which we call knowledge nodes (KNs). A system for DKM becomes a tool that supports two qualitatively different processes: the autonomous management of local classifications within each knowledge node (*principle of autonomy*), and the coordination of the different KNs via a process of an agent-mediated meaning negotiation/coordination across different classifications (*principle of coordination*).

1 Introduction

Knowledge, in its different forms, is increasingly recognized as a crucial asset in modern organizations. Knowledge management (KM) refers to the process of creating, codifying, and disseminating knowledge within organizations. We are particularly interested in complex organizations, such as organizations structured into many, heterogeneous unities, both formally (e.g., departments, divisions, national branches) and informally (e.g., communities, interest groups). Indeed, complex organizations pose an interesting research challenge for designers of KM systems, as they require to find a difficult balance between the autonomy of each unit, and their necessary coordination to achieve corporate goals.

Our work starts from the observation (discussed in [5]) that most KM projects share the goal of creating large and homogeneous knowledge-based systems (KBSs), in which corporate knowledge is first made explicit, codified, organized according to a single and coherent schema, and then made available through a single access point, typically an Enterprise Knowledge Portal. For many applications (for example, document publication, sharing, and retrieval), the single schema is some type of classification, whose purpose is to provide a shared and

objective conceptualizations of corporate knowledge, and to enable knowledge sharing across the organizational units.

In [4], it was argued that this approach (called "God's Eye Approach" for the attempt of creating objective, context-independent conceptualizations) doesn't work. Using the case of a worldwide consulting firm, it was shown that people refuse to use such an objective classification of knowledge, as they consider it either as an imposition (for example, of a knowledge manager) or inappropriate (unsuited to the daily practices of the unit)[6]. The result is that many KM systems based on a single schema are deserted by users, who continue to use the systems already applied in their local unit. In the same paper, the failure of this approach was partially explained by arguing that it is based on a wrong epistemological assumption, in other words that knowledge can be refined of all its subjective and social aspects, and transformed into an "object" that can be shared and reused in different contexts without any loss of meaningfulness. Therefore, a different approach, called *Distributed Knowledge Management* (DKM) was proposed, in which a truly subjective epistemology was adopted, and a coherent technological architecture for KM systems was described.

In this paper, we show how the same architecture can be applied to solve problems of managing multiple classifications within KM systems of complex organizations, and argue why this variety of classifications is an important source of value for organizations. In the architecture we propose, an organization is viewed as a "constellation" of *knowledge nodes* (KNs), namely of autonomous, locally managed knowledge sources, which represent organizational and social units at a technological level[3]. A crucial part of a KN is a *local classification*, which represents the unit's perspective in the system. In this view, a system for DKM becomes a tool that supports two qualitatively different processes: the autonomous management of local classifications within each KN (*principle of autonomy*), and the coordination of the different KNs via a process of an agent-mediated meaning negotiation/coordination across different classifications (*principle of coordination*). We briefly discuss the advantages of such an architecture.

2 Local classifications in DKM

The substantial failure of many KM projects does not originate from technological problems, but from an objectivistic epistemology, in which subjective, contextual, and social aspects of knowledge are in fact considered as "noise", features of knowledge in its "raw" state which have to be abstracted away.

In [5], the success of such an objectivistic epistemological view in KM is explained by noticing that it fits very well with a traditional, centralized paradigm of managerial control. However, a large number of researchers, working in different disciplines, convincingly argued against this objectivistic view. The basic argument is that what we know cannot be viewed simply as a "picture" of the world, as it always presupposes some degree of interpretation. Moreover no ideal language exists which simply depicts the world as it is. Indeed, depending on different interpretation schemas, people may use the same word with different meaning, or different words to mean the same thing; two groups of people may observes the same phenomenon, but still see different problems, different opportunities, and different challenges. This essential feature of knowledge was studied from different perspectives, and the interpretation schemas were given various names, for example paradigms [11], frames [10], thought worlds [7], context [9], mental spaces [8], cognitive path [12].

This epistemological view, in which the explicit part of what we know gets its meaning from a (typically implicit, or taken for granted) interpretation schema leads to some important consequences regarding the use of classifications (and other conceptualizations) in KM systems. Indeed, it follows from what we said above, that a classification is not a neutral organization of a collection of items (e.g., documents in a database), but is the emergence of some interpretation schema, according to which it makes sense to classify things in that way. In short, a classification is always the result of a sense-making process, and represents the point of view of those who took part in that process (see [1] for a in-depth discussion of the dimensions along which any representation – including a classification – can vary depending on contextual factors).

If this is true, then there are at least three good reasons for allowing multiple classifications within the KM system of a complex organization:

- first of all, by working at its local classification, each organizational unit makes explicit and stronger a common perspective, and this helps in making sense of its daily practices and local know how (see the notion of *perspective making* in [2]);
- second, the outcome of such a sense making effort is an important source of value for the organization, as it allows each unit to access a different viewpoint on the organization, and to get an intuition of how the world would look like from a different perspective (see the notion of *perspective taking* in [2]);
- third, the continuous interplay of multiple local perspectives is the key factor in triggering innovation. In analogy to what happens in scientific research, the exposure to different perspectives (i.e., cross-fertilization) is at least as important for innovation as the fact that a researcher belongs to a strong scientific community, and is perhaps the most important trigger of original intellectual enterprises.

Therefore, we need to rethink the way KM systems are designed in KM projects. Indeed, a KM system has to support two qualitatively different processes: the autonomous management of local classifications, and their coordination to support cross-fertilization and knowledge sharing. This is the goal of what we call *Distributed Knowledge Management* (DKM), whose technological implications are described in the next section.

3 An architecture for DKM systems

What we said above has relevant consequences on the way we design KM systems for complex organizations. The requirements of a system for DKM are summarized in the following two principles:

- *principle of autonomy*: each organizational unit should be allowed a high degree of autonomy to manage its local knowledge. Autonomy can be allowed at different levels (e.g., technology, formats, contribution process). Here we are mainly concerned with semantic autonomy, such as the possibility of choosing the most appropriate perspective (including, of course, a classification) on what is locally known;
- *principle of coordination*: different units should be enabled to exchange knowledge through mechanisms of interoperation between autonomous perspectives (e.g., by supporting the creation of directed mappings from a local classification to other local classifications).

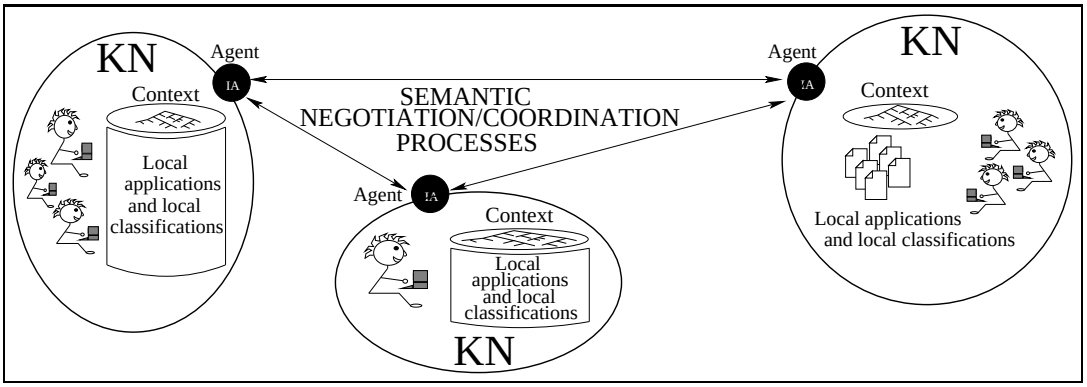

Figure 1: DKM architecture

Despite current KM systems do not satisfy these principles, as they tend to support the creation of general, shared classifications (against the first principle), and to implement coordination by erasing perspectives (rather than interoperate them), in figure 1, we propose an architecture for DKM[1] which is designed using the following building blocks:

Knowledge Node (KN). An organization is thought of as a constellation of KNs, where a KN is any organizational unit, either formal (e.g., a division) or informal (e.g., an interest group), which is granted some form of semantic autonomy. The identification of KN within an organization requires an analysis that goes beyond the scope of this paper. We only mention that in complex organizations we often find units (identified by KN) that use personalized tools (typically some unofficial tools, which are different from tools officially adopted at the organizational level) for managing the documents or the data they locally produce;

Context. A context is the translation in a common format (e.g., XML, XML-schema, or RDF-schema) of a local perspective, for example the local classification used by some local application to organize documents or other resources. A context is the "reification" of a KN perspective, and its continuous, autonomous management is a powerful way of keeping a unit's perspective alive and productive;

Agents. Agents constitute the social level of the system. Each KN gets an agent associated with it. Such an agent has the task of mapping the local context with the other contexts available in the system. At this level, we will not discuss how this happens from a technical point of view. However, we stress that this mapping can only be a social process in which each agent, knowing the context of its KN, tries to find useful mappings with other contexts via a process of communication with other agents. We call this process as *meaning coordination/negotiation*[2] process.

[1]This architecture is under development as part of a project called EDAMOK (*Enabling Distributed and Autonomous Management of Knowlege*), a joined effort of the Institute for Scientific and Technological Research (ITC-Irst, Trento) and of the University of Trento, in which the authors of this paper are involved.

[2]Meaning coordination/negotiation process is a communication protocol between software agents which is meant to replace the linguistic interaction between humans when they try to determine (and agree on) the meaning of a word/term/proposition in a conversation. This protocol is typically a query-answer, in which an agent explores the other agent's context and tries to establish a justified mapping with some categories of its own context.

4 Conclusions

In our view, the architecture for DKM we propose has many advantages.

At a social level, the technological architecture reproduces the actual social form of organizations (through KNs), and the dynamic of social interaction of communities (through semantic negotiation/coordination processes). At an organizational level, DKM supports the growth of multiple perspectives, which are a resource for sense-making and a trigger for continuous innovation.

At a technological level, DKM is a scalable architecture which does not impose a single technology for all units, or a single interface, but allows organizational units to use the tools and interface they prefer to manage local knowledge (considering the huge investments required, centralised solutions manifest a high degree of irreversibility and a lack both in maintainability – for example a change in classification schemas issued by a local group requires a change in the overall structure – and scalability – platforms are scalable to the extent that the same platform is assumed to be used). Moreover this architecture allows a rich form of knowledge sharing.

In this big picture, classifications acquire a new crucial role. Instead of functioning as objective, shared conceptualizations, they provide a powerful tool for supporting the growth of each unit's contextual perspective, and for allowing the interoperation between autonomous perspectives. Autonomy and coordination are also the trigger of innovation, which occurs when different perspectives meet, generating a discontinuity in traditional and incremental organizational learning paths.

References

[1] M. Benerecetti, P. Bouquet, and C. Ghidini. Contextual Reasoning Distilled. *Journal of Theoretical and Experimental Artificial Intelligence*, 12(3):279–305, July 2000.

[2] J.R. Boland and R.V.Tenkasi. Perspective making and perspective taking in communities of knowing. *Organization Science*, 6(4):350–372, 1995.

[3] M. Bonifacio, P. Bouquet, and R. Cuel. Knowledge Nodes: the Building Blocks of a Distributed Approach to Knowledge Management. To appear in a special issue of the Journal for Universal Computer Science, and in the Proceedings of I-KNOW '02 - 2nd International Conference on Knowledge Management., Gratz (Austria), July 11-12, 2002. Springer Pub. & Co.

[4] M. Bonifacio, P. Bouquet, and A. Manzardo. A distributed intelligence paradigm for knowledge management. In *AAAI Spring Symposium Series 2000 on Bringing Knowledge to Business Processes*. AAAI, 2000. Submitted.

[5] M. Bonifacio, P. Bouquet, and P. Traverso. Enabling distributed knowledge management. managerial and technological implications. *Novatica and Informatik/Informatique*, III(1), 2002.

[6] G. C. Bowker and S. L. Star. *Sorting things out: classification and its consequences*. MIT Press., 1999.

[7] D. Dougherty. Interpretative barriers to successfull product innovation in large firms. *Organization Science*, 3(2), 1992.

[8] G. Fauconnier. *Mental Spaces: aspects of meaning construction in natural language*. MIT Press, 1985.

[9] C. Ghidini and F. Giunchiglia. Local Models Semantics, or Contextual Reasoning = Locality + Compatibility. *Artificial Intelligence*, 127(2):221–259, April 2001.

[10] I. Goffamn. *Frame Analisys*. Harper & Row, New York, 1974.

[11] T. Kuhn. *The structure of Scientific Revolutions*. University of Chicago Press, 1979.

[12] E.K. Weick. *The social psychology of organizing*. McGraw-Hill, Inc., 1979.