Unifying or reconciling when constructing Organizational Memory? Some open issues.

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Abstract. In the paper surveying tools and methods for Corporate Knowledge Management [1], Distributed Corporate Memory (DCM) is listed among the possible materializations of knowledge and CSCW among the techniques possibly used to realized it. In this paper we want to accept this challenge and try to reinforce the bridge between DCM and CSCW. Despite the apparently natural connection between them, this attempt is still a challenge since the two frameworks rarely meet in integrated proposals where each side provides its results to improve the other one. As in any challenging attempts, results are often more about open issues than coherent solutions.

1. ABOUT THE ORGANIZATION MODEL

Knowledge Management (KM) can be seen as the definition of a producer/consumer process that can take different forms in relation to the organizational structure it is based upon. The latter shows in general a distributed structure for what concerns the producers. In fact, it is well accepted that the sources of information are spread around in the organization. The same holds for the consumers. They can access the Organizational Memory (OM) at any granularity of organizational units. The main point distinguishing the above structures is the possible presence of a central node with a distinguished role. Typically, this node is where locally produced knowledge is collected, filtered, "normalized" before becoming available, with the status of Corporate Knowledge (CK), to the other nodes. Often, within sufficiently big organizations, a dedicated office is envisaged where people's job is to elaborate the collected knowledge, and organize it for future use. This is for example a solution reported by a world wide spread consulting company (in a workshop held in Torino in November 1999). At the opposite extreme, there are fully distributed structures where each producer is responsible of the collection and publication of locally generated knowledge. This case applies in general to organizations showing a highly flat structure where is difficult, if not impossible, to assign distinguished roles in KM. Consider, for example, the typical cases of WEB-based communities of knowledge workers or virtual enterprises. In between the two extremes, there could be all possible mixes of the two above mentioned structures. However, in our experience with companies planning or realizing forms of KM, the intermediate structures are not so frequent. What can be recognized is the presence of loosely coupled subnetworks, either centralized or fully distributed.
In any case, the structure is determined by both the organizational culture and the type of knowledge under concern.

The awareness that knowledge is an important component of the everyday work is not a new phenomenon: knowledge management did already exist before OM/KM. What is new is the fact that companies are increasingly realizing it, pushed by very pressing and well known motivations. To respond to this pressure, their culture can lead them to approach the solution according to the following idea: recognize a new problem and construct a new structure to solve it. Or according to the alternative view: see the problem as diffused in the organization and enhance existing solutions. The first approach naturally leads to the identification of a centralized ad hoc structure, the second one naturally to a more distributed one on top of what already exists. Accordingly, the use of the technology is interpreted in a different way: to propose new functionality and information flows vs. better supporting the existing ones.
Also the type of knowledge plays a role in the definition of the structure. What is perceived as 'objective' or 'commonly interpretable' knowledge easily reaches the status of CK: for example, part of what in [1] refers to Profession or Technical Knowledge. The related contents are likely to be considered as universals that have to be collected and maintained in a coherent heap, more easily achieved by a centralized organization. (Parts of) Other types of knowledge can be less naturally interpreted as universals since they are more dependent on the context in which they are generated (local universal [2]). A typical example is the part of knowledge related to the experience (successful cases, best practices, and so on). This part of knowledge is either lost or (informally) maintained close to where it makes sense.

2. THE SOURCES OF KNOWLEDGE

By considering the structure from the point of view of the nodes providing information, one can make similar considerations as in the previous section. Again, providing knowledge can be seen as an activity which is fully immersed in everyday work or as an additional one occurring asynchronously in relation to it.
This distinction has implications on different policies an organization can apply to promote this activity: for example, incentives, personnel management, and so on. The point we want to take in this paper is the one of work content and supporting technology. The asynchronous view leads to the well known problem of doing something in an episodic way so that it is likely that more pressing, interesting or rewarding activities are done in place. The opposite point of view does not deny the necessity to spend additional effort to produce knowledge but it incorporates this effort as part of the normal work. The advantage is twofold: the produced knowledge is likely to cover both a greater part of the activities potentially generating it and

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a greater amount of detailed knowledge from each single activity on the other one, since it is recorded in a easier way. In this situation the technology plays a relevant role. In fact the degree by which the effort to produce knowledge is smoothly meshed with the normal work depends on the degree by which the technological support of both of them is integrated. Hence,words, a supportive technology for normal work should to be designed so that knowledge production is part of its basic functionality.

Despite the increasing attention to KM this is not yet the general case. More often KM technology is a specialized one which is put aside the other ones supporting other activities. This view has as obvious consequences not only the possibility that some knowledge is lost because of the technological hiatus but also the possibility that some activities are considered as not producing knowledge. This however contrasts with the common experience that knowledge is produced by the combined and continuous effect of a variety of apparently not knowledge generating activities. Knowledge is produced when people write documents, communicate through e-mail, surf the web and so on. Now, how many applications supporting these 'simple' actions do contain knowledge oriented functionality? Knowledge workers are claimed to be the only ones surviving the evolution of the current organizations but knowledge is rarely taken into account when technology supporting work is designed. There are of course some exceptions (e.g., [3]).

Generally the most widely applied idea is to consider that a common repository, possibly populated and accessed in a distributed way, through the WEB, can be a good solution to the problem without paying attention on the problems raised by its usage. The metaphor of OM as a repository has been thoroughly criticized in [4] by deconstructing the common interpretation of OM based on it. To simplify their argument, we can say that memory metaphor is misused since instead of bringing in the technology features drawn from human memory, it interprets human memory in term of the technological counterpart, thus reducing later usage of the collected information to a simple retrieval. This brings to the argument of how to select the knowledge to be recorded, in which form to record it and how to organize it in the memory.

3. DE-CONTEXTUALIZING AND RE-CONTEXTUALIZING

The answers of the questions at the end of the previous section has to deal with the issue that can be called de-contextualization and (re-)contextualization. This is, in our opinion, the core problem of KM.

Recording calls for a degree of de-contextualization of the collected knowledge for reasons that go from feasibility and efficiency up to the necessity to extract the true "universal" from it. Re-use calls for a degree of (re-)contextualization to make possible the act of interpreting the retrieved information. Interpretation is the fundamental component of organizational "remembering" as a creative act of organization members [4].

The appropriate balance of two above 'degrees' is difficult to reach since they do not necessarily match. In full agreement with [5], we can rephrase this point by saying that the pyramid proposed there (going from Explanation, through Experience up to Classification) has to be gone along up and down to support the whole KM life-cycle and that in any case not all the knowledge about the various ladder can be adequately covered by a technological support.

The tension between de-contextualization and (re-)contextualization can be dealt with by means of different, hopefully complementary, strategies. First, the recording process can build and maintain different descriptions of the same piece of reality, at different levels of simplification and abstraction. This idea is again similar to the one proposed in [5]. Our emphasis is however more on the possibility of having different level of visibility of the same type of knowledge while there the emphasis is on different types of knowledge related to the same group of experiences). We will come back to this point in Section 5.

Second, informal knowledge or organizational behaviors that cannot be easily consolidated can be captured and made available by building kinds of 'knowledge maps' like: who knows what, who is expert of, who had similar experiences as, who did or is likely to be helpful in this case, and so on. If human beings play an unavoidable role in KM, then information on them becomes a fundamental part of CK. Of course, this view contrasts with the idea to record things that will be used far away in the future when people could no more be there. However, this is in our view a goal which applies to very particular types of knowledge and situations. More often, the past experience is no more applicable because the context (organization, culture, technology, and the like) did change in a way that makes it useless. In any case, still being able to use in an appropriate way the existing knowledge for current situations would be an invaluable benefit for the organization and people working in it. Maintaining 'knowledge maps' in presence of (high) turn-over should become an action , among others, in charge of the organization itself. The relevance of these 'knowledge maps' has been recognized for example in [6, 7]. The two approaches show a basic difference: the first one derives the map directly from computational features incrementing the functionality of a communication support based on Speech Act theory, while the second one treats (as implicitly do many other proposals) the management of this type of knowledge in an asynchronous way with respect to the processes producing it.

The third strategy makes KM a more distributed process in terms of both the collected knowledge and its maintenance. In this view OM becomes a network of local memories managed by distributed organizational units. Local memories can serve people acting in the different units who are then more motivated to spend effort in maintaining them, as well as people outside these units, especially when the 'knowledge map' mentioned in the previous point is realized. Hence, KM becomes not only more distributed but also more 'cooperative': in terms of [8] KM constructs communities of people actively and consciously sharing interests and experiences. In this scenario, re-contextualization becomes a cooperative learning process that helps both the providers and the consumers of the knowledge itself. The former can validate the quality of the knowledge they are providing and improve it, the latter are adequately supported in interpreting it and will be more motivated in being supportive when the roles will be exchanged in the future. To be sustainable, cooperative KM has to be supported by adequate tools, organizational and technological. This is where KM and CSCW could meet and positively influence each other. Following the above idea that knowledge oriented functionality should be embedded in applications, KM could suggest how to enhance CSCW applications and the principles leading the latter could support cooperative KM.

Recently, the relevance of contextual information was recognized as a fundamental means for improving communication and coordination. The keyword "awareness" was introduced to denote this specific type of knowledge: awareness is far from being univocally defined within CSCW [9]. However, it is common opinion that it is about knowledge on what is going on 'around' a specific activity performed by single or groups of individuals. In the framework of KM this idea was put at work in [8]: "Research on digital libraries are dominated by indexing and retrieval mechanisms. The usefulness of such tools is not in dispute, however this is not the whole picture of what libraries can and should be about. ... The observed behavior of others in a situation contributes to a sense of the situation's ambience, or social atmosphere". What is needed is to enlarge this view to additional functionality which fully takes into account that cooperative KM is a distributed process (as any other form of cooperation does [10]).

Hereafter, we will focus on two issues we are working on. They can be considered as examples of an exercise that could lead to a possibly quite long list of additional functionality.

4. MANAGING ONTOLOGIES

Ontologies play a central role in almost all approaches to KM. Motivations for their introduction and use can be found in [11]. One of the most relevant aspect that matters in the context of KM is that ontologies can be shared (possibly together with the knowledge they help to organize). In this view, identifying a single 'organization' ontology or merging different ontologies into a common one, or translating an ontology into another one are considered as feasible goals to achieve uniformity, sharing and re-use. In addition, formal definitions of concepts and relations linking them is seen as a factor improving portability.

This optimistic view contrasts with other experiences in the use of classification schemes [12, 13]. The latter share with f ontologies some basic aspects, like: the decision of what matters, the relations among categories/concepts used to classify or capture the essence of a reality.

In [13] is reported the experience of adopting a 'universal' classification scheme in a big civil engineering company in order to organize the documentation of large projects, like bridge design. The standard was systematically circumvented not because it was recognized poor; rather, because it was impossible to define one (or classes of) scheme(s) serving the different needs. The supportive technology had to be designed taking local adaptability as primary goal to become accepted and used to enhance knowledge circulation about projects.

In [12], again on the basis of empirical evidence, the emphasis is put on how subtle cultural, social and political factors play a role in the choices of basic concepts and relations to capture the essence of work activities, and the consequence they bring along. It is impossible to give a satisfactory account of all the arguments discussed in the book. However, the point we borough from them is that any type of ontology/classification should be seen as a "boundary infrastructure" serving the purpose of a mediation space among different local communities. "What we gain with the concept of boundary infrastructure over the more traditional unitary vision of infrastructure is the explicit recognition of the different constitution of information objects within the different communities of practice that share a given infrastructure (p. 314)". In addition, ontologies/classifications "always represent multiple constituencies. They can do so most effectively through the incorporation of ambiguity... Designers should recognize these zones of ambiguity, protecting them where necessary to leave the schemes to play their organizational work. (p. 324)".

Now, why to spend an effort in trying to enforce standardization when "the history to attempt to standardize information systems " shows that "standards do not remain standard for very long, and one person's standard" can easly become "another's confuson and mess (p. 293)", as shown for example by the experience reported in [13]? Instead, the same effort could be spent in supporting people to live with the degrees of ambiguity and partiality the boundary infrastructure encompasses, and to actively participate in the maintenance of such ambiguity and partiality in a continuous learning process triggered by "interruptions of expectations". As stressed in [12], ontologies/classifications do matter for lots of reasons. We agree, and would emphasize that they make sense within communities of practice where their existence is part of cooperation: the latter is not only based in articulation work [14] but also in categorical work ("distribution of work, and its different meanings in different communities, must be managed for cooperation to occurr. The juggling of meanings .... is what we call categorical work. ([12], pag. 310). Across communities, more flexible links can better take into account the inherent differences. In this view, unification of concepts and relations into a common shared framework should smoothly coexists with the reconciliation of concepts and relations that reflect local culture and work organization.

In our research effort to enhance articulation work through the design of CSCW applications supporting communication and coordination among cooperating people we met the problem of different ways by which these groups look at their reality and organize the related information. Specifically, we designed two frameworks aimed to support local activities and actions that cross groups in order to achieve coordination in organizations that can be conceived of as autonomous interacting communities constructed around shared objectives and work modalities. To this aim we introduced the notion of coordination mechanism: in our terminology, they are dyads of coordinative protocols and artifacts. Moreover, a language (Ariadne) has been developed for defining, specifying, and executing them [15]. Its elemental categories and composition laws, which have been identified empirically and can be modified at any time [14], capture how actors identify the basic units of work and information for articulating their activities and the relations between these units. For this to be feasible requires a degree of expressiveness such that no specific modelling approach is imposed: that is, any type of flow of work up to the light-most shared working space should be representable. Moreover, since classification schemes and coordinative artifacts play an important role in articulation work, the basic categories and relations must allow for their definition as well.

The second framework is based on a software component (called Reconciler [16]) that supports the interoperability of different 'coordination mechanisms' in terms of the mutual alignment of their boundary objects and events. The problem of managing mutual alignment of such applications becomes a crucial part of coordination and can be formulated in terms of 'interoperability raised at the semantic level of articulation work', in contrast to current research efforts that aim at the interoperability of applications at the system level. The Reconciler provides a means for managing the tension between the requisite local perspective and the shared meaning required to interpret the boundary objects and intersecting events that characterize inter-group cooperation. This is achieved by recording the conventions users establish to maintain the correspondence between the different definitions and views of the boundary objects and crossing events. The recorded conventions are then used to improve inter-group cooperation in terms of 'naturalization' of concepts and relations ("naturalization means stripping away the contingency of their creation and their situated nature" by taking them for granted ([12] p. 299); 'translation' when possible: that is when contingency has to be maintained but correspondences can be established; or, when impossible, to support the related learning process by highlighting discrepancies and increase mutual awareness of ambiguities and partiality generated by local conventions.

Although not specifically oriented to KM, this experience led us to reflect on how knowledge is created and used in communication and cooperation. In the light of the claimed integration of supports of cooperative work and KM, we believe that the principles underpinning the above mentioned prototypes could be helpful in avoiding approaches that create a hiatus between KM and everyday activities, between pieces of knowledge that can be 'shared' and pieces of knowledge that make sense only in context, and last but not least in making publicly visible information structures that materialize the relevant knowledge on the work organization and the information resources on which it is based. Specifically, we refer to the coordinative artifacts that in Ariadne are taken as primary category in cooperation and constitute a privileged source of knowledge to enhance sharing and reuse of experience in supporting coordination.

5. DIFFERENT DESCRIPTIONS AS ABSTRACTIONS

In discussing the tension between de-contextualization and (re)-contextualization (Section 3) we mentioned the need of having different descriptions of the same piece of information. This redundancy can be achieved by identifying different aspects. For example, different perspectives have been taken to organize knowledge, and are there illustrated mainly in relation to textual information. There are however sources of knowledge that provide descriptions that are based on objects and relations between them. This is the case when the target organization makes use of applications supporting the coordination of activities, typically workflow systems, which, as constitutive part of their usage, presuppose the definition of causal relations among activities and the record of their actual executions in specific instances. In [15] we discussed the role of these descriptions as a constituent part of CK.

The description of processes managed by workflow systems is increasingly based on formal theories that allow for the definition of tools to control process modifications, both at definition and execution time. The point we want to make here is that these tools can be viewed as means to provide the above different descriptions in the specific case of processes, that is, when the knowledge is about how activities are conceived of and combined to achieve a result, and actualized in concrete experiences (instances). In most of the cases, tools controlling process modifications are based on a hierarchical description of the target process, where the links between nodes of the hierarchy are expressed in terms of refinements of behavior (as in classical top-down approaches) preserving behavioral properties. Although this approach produced nice results and applications, it is problematic in respect to its potential application in KM. First, top-down approaches naturally lead to a global view of the system and are not suited to represent the partiality and openness characterizing distributed (workflow) systems. Secondly, intermediate nodes of the hierarchy carry symbolic names that make sense for the community supported by that system but raise the obvious problem when they have to be re-interpreted by members outside the community.

An approach that is more suited to avoid these problems is based on a different interpretation of the hierarchy that we have drawn from [17]). Leaves contain the most detailed description of system components together with the most abstract view of the rest of the system, as perceived from the point of view of the component itself. This abstract view accounts for partial visibility of the 'world' by, and openness of, the component itself. Intermediate nodes contain abstractions of the children ones and, again, of the of the rest of the system in relation to this node. Hence, each node contains different abstractions of the whole system, at different level of detail, up to the root which mainly contains the description of the interface of the system with the rest of the organization. The second key point is that abstraction is based on the notions of aggregation of states and observability of actions [18].

Leaving aside the technical details (that can be found in [19]), the basic idea is that aggregations are defined by the point of view the observer wants to take on the system. For example, the root does not account for the number and structure of the components but only on the external interface. So, it can be interpreted as the protocol the specific system wants to offer to its environment and therefore expresses the constraints it has to follow or is able to impose when interacting with it. Going down the hierarchy, more detailed information can be obtained about the children of the considered node, while the rest of the system is still at the most abstract level, and plays recursively the role of constraint for those components.

Obviously, the way in which components are organized in a partial order within the hierarchy is 'context dependent', in principle as the 'names' assigned to intermediate nodes in standard refinement. However, unlike refinements, the underlying theory allows for an easy specification, on the fly, of the shape of the hierarchy. In fact, the latter can be constructed starting from the information contained in the leaves (or possibly in any intermediate node if one wants to reduce the level of detail of the most concrete descriptions). It is sufficient to specify which components one wants to see at which level of aggregation. Observability of actions, irrespective of the level of aggregation of the considered components, can be defined by the observer too. Usually the choice falls on actions that represent communications with the environment of the (aggregated) component. However, nothing prevents the observer from choosing different actions and to specify the level of control of the abstraction process, in traversing the hierarchy nodes. For example, if actions are classified according to some criteria (e.g., control actions, communications, check-points, and the like) the observer can just specify the type of actions s/he is interested in, and the resulting abstraction is automatically done (by algorithms that take away the other ones). Abstraction keeps the consistency level specified by the observer too: for example, a strict maintenance of the causality induced by the language of the observed actions or other (theoretically defined) weaker notions of consistency.

Reading the above (very condensed) description of the approach from the point of view of KM in the case of processes, we can say that from knowledge constructed in the normal course of action within the organization one can record some basic knowledge (e.g., the components or some abstraction of them) and then make this knowledge available, at the different levels of detail that make sense to its reader. If, as we advocate, a KM informed definition of the actions used to define the distributed workflow as well as of the hierarchy nodes specifies additional information (referring to explanation, administrative aspects and so on) they can be organized accordingly and shown following the visibility policy defined by the reader. A similar reasoning can be done for executions of processes. Meaningful case histories can be recorded and read in different ways, using the observability approach. This goes in the same direction of what was proposed in [20].The above presentation sketches what we would like to see as an integration of KM and CSCW.

6. CONCLUSIONS

As mentioned in the foreword, the attempt to reinforce the links between KM and CSCW did not lead us to the identification of solutions. The previous sections discussed issues that can be seen as the starting point of a rich research agenda. The contribution CSCW can provide to this topic is not only technological but also about the experience that within this area has been accumulated on how people work, both individually and cooperatively, in a smooth way. One of our biggest concerns is about the risk to make KM a fragmented process, because it uses a loosely integrated technology and is conceived of as an asynchronous activity with respect to the other ones. Fragmentation has been recognized as one of the main sources of problems in communication and cooperation. Having infrastructures able to support integrated applications is one of the main research efforts in CSCW as a means to make available to the cooperating actors supports to different modes and means of cooperation, to be used flexibly in different situations. In the view of KM as a fundamentally communication and cooperation process, fragmentation risks to make any effort to achieve it less effective than expected, in relation to the organizational and technological effort put in it. On the other hand, all applications, and CSCW applications among them, should be designed to contain functionality that makes them as a portion of the overall technological support to KM and OM. This implies that the two areas share many research issues where their specialized methodologies and techniques can be used in a combined way. In particular, we see the maximum benefit to solve the conflict between de-contextualization and re-contextualization. In fact, as we have sketched, the latter require enhanced representation capabilities, for both static and dynamic knowledge, and in particular rich and flexible abstractions tools that go beyond the current capabilities. Cooperative KM necessitates the same proactive support as other cooperative applications, to trigger and enhance organizational learning as a fundamental part of KM. In other words, how much the 'pull' approach has to be combined with a 'push' one in dealing with KM? In this framework, in order to achieve the above claimed joint effort, the recent experience gained in dealing with 'awareness' management (which is mainly 'push'-based) needs to be extended to knowledge concerning past experiences. In any case, both awareness information and CK require support for their interpretation in contexts different from where they have been generated. Last but not least, up to now KM is based on the metaphor of a "memory" and focuses the core of the attention on the action of 'remembering'. What about the second action typical of a memory, that is 'forgetting'? In [12] there is a chapter on this subject which is stimulating reflections on the necessity to have tools supporting this too. Our everyday experience is that people remember and forget in a mixed way, at different depths which are functional to improve the effectiveness of their memory. Now, one could ask: how can the technology support this combined action? Which methods and tools are needed to make it feasible? An intriguing interdisciplinary research topic which requires both field research and innovative knowledge representation and management capabilities.

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