Towards Personalized, Socially Aware and Active Knowledge Management Systems

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Abstract. This paper proposes to extend current Knowledge Management Systems with functionalities that (1) support the organization in better managing its tacit knowledge; (2) help engage users in a continuous and dynamic knowledge exchange; (3) provide more tailored and active support to the users and in particular take into account their competence, their role in the organization, their social network, or their cognitive style.

This approach is operationalized by (1) providing mechanisms that support social processes (trust building, group formation and coordination); (2) using proactive software agents to increase the level of interactivity and to stimulate knowledge exchange; (3) personalizing as much as possible the interaction (in the selection and in the presentation of the content) in order to maximize the impact of the knowledge delivered.

Different examples help to illustrate how this approach can be applied in a variety of application contexts.

1. Introduction

Many of the existing Knowledge Management Systems do not seem to take full advantage of the possibilities offered by current technologies essentially because they are designed to reflect the classic, "document-centered" approach for managing knowledge. Such classic approaches have some advantages, as for instance providing users with powerful means to access and manipulate the huge amount of "formalized & formalizable" knowledge of the organization. They also present some major limitations such as (1) they do not take sufficiently into account all the knowledge that is not present in documents; (2) the knowledge delivered is static, frequently represented in a form difficult to apply, often obsolete, incomplete and is also disconnected from the context of use [1]; (3) the mode of delivery does not take into account the specificity of each user such as his/her current activity, his/her role in the organization or his/her working style (leading to inefficiency and frustration). These limitations are particularly annoying in the context of modern organizations, which need to be flexible and adaptable and for which a large amount of knowledge (experiences, social knowledge, or know-how) is not formalized in repositories but is present in people's heads.

The objective of this paper is to propose a model of knowledge management systems that extends the traditional models with mechanisms supporting the less formalized management of knowledge, and in particular the knowledge related-activities involving a strong human and social dimension which represent some of the key elements of performance of modern organizations.

The first part of this paper will present the challenges of the knowledge management approach in the context of the modern organization, and the limitations of the document-

their flexibility and their ability to provide their employees with an environment supporting the many dimensions of their activities). The second part of this paper will propose our vision of the next generation knowledge management approach which tries to address these needs by providing an infrastructure that supports the social process of the organization, provides an active interaction and a high level of personalization. This part will also indicate how this approach can be operationalized with different mechanisms (social components, agents and personalization components). The paper will finally illustrate how this approach is being applied to the design of knowledge management & learning systems in a variety of application contexts.

2. The challenges of knowledge management & the limitations of the current document-centered approaches

Private and public organizations, and the environment in which they operate, have considerably changed in the last few decades. These organizations have to renew themselves more rapidly to adapt to a more competitive and changing environment, be much more flexible than in the past and also need more sophisticated ways of managing their knowledge assets ([1]). They have to manage efficiently the whole knowledge cycle (such as identification, creation, reformulation, capitalization, sharing of knowledge) and in particular have to better support social related processes. Modern organizations (1) are aware that a major part of their knowledge assets (for instance in people know-how experience) is available in the form of tacit knowledge that they need to better support; (2) need to integrate mechanisms (social and active mechanisms) which contribute to the dynamics of the circulation & exchange of the knowledge of the organization; (3) need to adapt the organizational work processes to the specific characteristics of the corporate users (such as his/her position in the organization, competence, cognitive style, interest and motivation) in order to maximize the quality of their work.

As a consequence, Knowledge Management Systems have to be defined to support these new settings and in particular the knowledge related activities of knowledge workers which have considerably evolved in this last decade.

Whilst a plethora of knowledge management systems have been and are being developed (which take advantage of the available technologies), they fall short of fulfilling these needs. Most of these systems have emerged from document-centric approaches and are able to support (very efficiently) only a fraction of the whole knowledge cycle (classifying, storing, and retrieving knowledge).

These systems have three main limitations:
- Limitation related to the management of tacit knowledge.
- Limitation related to the capability to engage users in a continuous, active and dynamic knowledge exchange.
- Limitation related to the support of the specificity of each user, taking into account the interaction of their particular role in the organization, their competency, cognitive style, interest, desires and motivation.

2.1. The need to support the management of tacit knowledge

Most of the traditional Knowledge Management Systems rely on the assumption that knowledge can be assimilated to objects that can be identified, separated from their initial context, and handled in information systems. This definition of knowledge is too restrictive

structured and made explicit. This "tacit" knowledge, which includes all the experience, practices, skills and know-how that people acquire without being really aware while they are working, represents, however, one of the most important forms of knowledge for modern organizations ([3]).

Why is managing tacit knowledge increasingly important for organizations? Firstly, modern organizations are continuously changing and do not have the time to codify all this tacit knowledge into explicit knowledge (which anyway becomes too rapidly obsolete to justify the cost). Secondly, this knowledge can be very difficult to codify, in particular the one that involves intangible factors such as subjective insights, beliefs, perspectives and emotions. Thirdly, this process of elicitation may raise some strong resistance from the people themselves (because they consider this knowledge as personal strategic assets that guarantee their position in the organization). Finally, tacit knowledge represents a critical element of the capacity of the organization to learn: for instance Nonaka and Takeuchi ([4]) show that a firm's learning efficiency critically depends on an institutional set-up that facilitates a spiral-type interaction between tacit and codified knowledge.

As we will see later in this paper, the management of the tacit knowledge does not only consist in providing the members of a community communication means (such as e-mail, bulletin board, etc) but also in supporting the dynamics of social interaction (including trust, motivation, and social behaviors/attitudes). Indeed, and as pointed out by [5], it is erroneous to assume that people automatically participate in online communities (and engage in some social exchange) without some reason to do so. For instance, social exchanges theories [6] are based on the premise that voluntary relationships depend on receiving satisfactory outcomes, and that a person's commitment to an existing relationship is proportional to his/her satisfaction in this relationship and to the investment he/she has already put in this relationship and it is inversely proportional to potential alternative relationships. The establishment of a sustainable social exchange process in a group (real or virtual) is complex, takes time, and involves many factors (such as reaching a minimum level of trust) to be successful (see [7][8][9]) and therefore needs to be explicitly supported.

2.2. The need to provide active support for the dynamics of exchange and for the knowledge-related activity

Most of the conventional Knowledge Management Systems are passive, both in the processes used to manage the knowledge, and by the knowledge that they deliver (static documents). Usually, document-centered Knowledge Management Systems propose two modes of interaction: (1) in the first mode the user specifies his search in a query form (in the form of key words, categories or domains), and the system returns a set of documents which match his/her query. The search algorithm can be very sophisticated, and for instance take into account word synonymy or exploit some automatic clustering techniques; (2) in the second mode, the user is able to locate knowledge by browsing a pseudo tree-like categorization of the knowledge (the Yahoo or the Open Directory project system classification illustrates this second mode). These two modes are complementary, the first one being used when the user knows precisely in advance what he/she is looking for (and that he/she can express with a set of keywords) while the second one is used when the user has a less precise idea. In the latter case, the navigation in the structure of the classification helps him/her to progressively formulate and discover knowledge (serendipity).

We believe that knowledge management systems should support more actively the work processes of the user and in particular propose to him/her knowledge, guidance and assistance in all his/her knowledge-related activities proactively (both in an individual and social context).

In addition, the knowledge should also be delivered in a richer and lively form than static documents which rapidly become obsolete and require a lot of effort to be adapted to the context and to be made actionable. Knowledge (and in particular tacit knowledge) can also be delivered through story telling, through an informal conversation with others, via a formal debriefing meeting, during a simulation (useful for skill acquisition).

Why is more active support for the knowledge processes important? It is important because knowledge in the new organization is itself active, living (some people even refer to knowledge ecology [10][11]) and continuously expanding. The knowledge worker does not need more sophisticated search engines to deliver yet more passive knowledge that he/she does not have the time to process, but more intelligent mechanisms that "digest" this knowledge and make it immediately usable.

2.3. The need to take into account the specificities of the user

Knowledge Management Systems do not usually take into account the specificity of the user, and in particular they usually provide the same interaction mode for all the users. When some form of personalization exists, this customization is very shallow and superficial: for instance the user is able to specify some preferences in the presentation of the information (such as the position of the information displayed in a portal), and in more advanced cases is able to specify some interest that the systems will take into account to filter the information to be displayed.

Knowledge Management Systems should go far beyond this superficial support of user specificity, and try to build a deeper understanding of the user. This understanding can include not only user's preferences, but also his/her role in the organization, his/her competencies, his/her cognitive style, his/her interests, his/her desires and his/her motivations.

Why is a deep understanding of the user information and personalization important? Firstly, this helps to increase the personal relevance of the knowledge that is delivered, and therefore to reduce cognitive load (the more a knowledge management system knows about a user, the more it will be able to deliver useful knowledge and intervene appropriately in knowledge-related processes). The second reason is that user-centered & personalized systems may be useful for defining, maintaining and expressing the identity of the user ([12], [13], [14]), and for facilitating the expression of the user's identity in the social environment (via the management of cyber-identities). The third reason is that these systems open the possibility to transform radically and tremendously the role, the perception and the value of Knowledge Management Systems. Knowledge Management Systems with a deeper understanding of the user (for instance his personality, his motivations, his goals) can be expected to develop a totally new relationship with this user and become virtual companions in symbiosis with the user [15] rather than being the external tools that they are today.

3. Our vision: highly social, active and personalized knowledge management systems

This section will present our vision for the next generation of knowledge management systems and in particular why and how they will provide
- A strong support for the social dimension.
- An active agent-based stimulation for dynamic knowledge exchanges
- A high level of personalization

3.1. Supporting the social dimension (management of tacit knowledge)

Different mechanisms supporting the social dimension and in particular facilitating the management of the tacit knowledge can be distinguished.

The first category of mechanisms includes all the communication mechanisms that help a community of users to communicate such as the different combinations of synchronous / asynchronous discussions between two / several individuals located at the same or two different places and using a different medium (voice or text) to communicate. Technological platforms propose different means to support these mechanisms with tools such as e-mail, forum, bulletin boards or the telephone. The availability of these communication means represent however only a necessary condition, and never a sufficient condition nor a guarantee that the communication will take place and evolve in a satisfactory way ([8][9]). As indicated previously, people need some good reasons to engage in a social exchange. They also need security and a minimal level of trust [16].

The second category of mechanisms addresses these latter concerns, and more generally includes all the means that contribute to support the social dynamics of communities. These mechanisms include components that facilitate the formation and the sustainability of social structures (groups and communities), trust and reputation or collaborative activities such as: (1) group formation systems (directories, matching services); (2) recommender/opinion systems, reputation systems [17][18], social activity visualization [19], which contribute to the transparency and therefore to the social motivation, the adoption of share values and the construction of trust; (3) coordination systems (negotiation systems, conflict resolution systems, group decision systems, voting systems) which help to support more structured social activities and to maintain the cohesion of the group.

3.2. Using agents and active components to stimulate the dynamics of knowledge exchange

The interaction of the user with Knowledge Management Systems should not be passive. On the contrary, Knowledge Management Systems should engage users in a continuous knowledge exchange. Different approaches and mechanisms can be proposed to support pro-actively the user in his knowledge-related activities.

First the knowledge can be represented and delivered in a much richer and active form. Knowledge does not need to be represented as static documents, but also can take the form of (1) structured and evolving documents that are collaboratively authored and annotated (using opinion systems techniques); (2) access to people (expert, specialists, pairs) with whom the user can engage in an interaction. Of course this includes not only services for locating these people, but also assessing how much they can be trusted and the reciprocal benefit of the interaction; (3) forum / discussion threads (fuzzily structured text knowledge); (4) stories that can be delivered via voice or video; (5) simulations, such as role playing simulation, in which the user acquire the knowledge by experimenting; (6) other knowledge management related tools (such as assessment or decision making tools).

Second the level of the interactivity with the user can be radically transformed with the use of artificial agents which pro-actively manage the process of knowledge delivery, and more generally any knowledge related processes. These agents support "intelligently" the knowledge worker in the whole knowledge management cycle and in particular: (1) anticipate user's needs; (2) propose pro-actively knowledge objects to him/her that he/she would not be aware of (3) guide him/her, assess problems, suggest solutions, and advise him/her during his/her work process (decision making, problem solving, knowledge creation); (4) assist him/her in his/her interactions with others (active support for the social

process); (5) stimulate [20] and motivate him/her (integrate the human dimension); (6) help him/her to reflect, to restructure and to acquire new knowledge (help him to learn).

3.3. Providing a high and deep level of personalization

Knowledge management systems should be user centric. More concretely, user-centered & personalized knowledge management systems can (1) support more efficiently the current activity of the knowledge worker by knowing his/her current focus, his/her goal and his/her role in the organization; (2) select and deliver knowledge in a way that maximizes its impact (for instance a conceptual user will feel comfortable with a book, whereas a more down to earth user will prefer a story or a case delivered in voice form, a very sociable person will prefer a conversation with a peer, and an engineer the access to a mock-up); (3) exploit the individual and social motivation of the user (people are driven by personal goals and believe that they have some strong influence on their commitment and therefore the quality of their work).

4. Some projects and systems illustrating this vision

This section will present three different projects and systems that illustrate how the vision that we have defined in the previous section has been or is being operationalized.

4.1. EdComNet: supporting the social process and people autonomy in a knowledge exchange community.

EdComNet is a research project supported by the European Commission that aims at defining a virtual learning community for adult citizens. This community will act as a portal stimulating the active learning of social skills by the citizen, thus enhancing the social integration of individuals within urban communities. It will empower the individual citizen to be a self-reliant part of society, fostering creativity and autonomous opinion forming as well as decision-making.

EdComNet implements the first facet of the vision: the provision of social mechanisms supporting social processes and therefore knowledge exchanges. Social spaces are designed (using communication technologies such as forums, chat spaces, e-mail, multi-user virtual reality technologies), and services are defined to support the emergence and the operation of social activities. Services include: group formation systems (implemented via automatic match-making, the definition of human facilitation procedures that help groups forming or spin-offing from existing groups); facilitation and mediation services; coordination mechanisms which help the group to organize their activities (implemented using electronic calendars, collaborative project management systems, definition of people roles, voting & pooling systems); knowledge and opinion sharing services (using recommendation techniques) which facilitate knowledge exchange as well as trust and reputation creation, and also contribute to the adoption of share values in the community; active collaborative activities (such as the organization of role playing simulations).

4.2. KInCA: Using personal cognitive agents to stimulate knowledge sharing in organizations

KInCA (Knowledge Intelligent Conversational Agent [21][22]) is a research project sponsored by the Xerox Corporation, which aims at supporting managers in learning, understanding, and applying knowledge sharing processes in organizations.

KInCA implements the second facet of the vision: using agents to stimulate and support the dynamics of knowledge exchange. The approach is based on the idea of associating to each user a personal artificial cognitive agent capable of helping him to progressively learn and adopt knowledge sharing behaviors. This personal agent cooperates with a set of expert agents implementing different strategies and modes of interaction. As a result the personal agent will, for instance, give some diagnostic to the user, or it will tell him a story, or it will suggest a document to read, or will comfort him. Through this interaction, the user progressively becomes aware, gets interested, tries and adopts the desired knowledge-sharing attitude. KInCA's model of the dynamics of knowledge adoption is based on Everett Roger's theory of innovation diffusion [23].

4.3. Ontologging: extracting social patterns and personalizing the interaction in a knowledge management system.

Ontologging (http://www.ontologging.com/) is a research project supported by the European Commission aiming to define a next generation knowledge management platform. Onto-Logging addresses the problem of corporate ontology formalization and intends to better integrate formal ontology definition methods within Knowledge Management Systems in order to make them more adaptable to the user needs and to better support the exchange of knowledge in organizations.

Ontologging implements the third facet of the vision: providing a deep level of personalization. One of the most important aspects of this project is its use of a sophisticate model of the user in order to achieve certain adaptive features and personalized interaction. This user model is defined as an ontology describing the different characteristics of a user that can be relevant in a knowledge management context (including not only identity and preference, but also competency, cognitive style and behavioral profile). Part of this user model is dynamically inferred by tracking the user interaction with the system.

5. Conclusions

The relatively limited success in the adoption of Knowledge Management Systems in companies has raised some questions on the validity of the approach used to design these systems. We believe that one of the main causes of this setback comes from a too document-centric approach that is incapable of supporting some of the most important knowledge related activities of modern organizations. What modern organization really need are not so much tools that are able to process even more efficiently their formalized knowledge & information, but rather some means to support all the knowledge-related activities and processes of their employees. In particular we believe that the next generation knowledge management systems should focus on providing organizations with the means to: (1) help themselves to better manage their tacit knowledge; (2) facilitate the dynamic of knowledge exchange; (3) provide users with a more personalized and higher level assistance for their work.

This paper has proposed a way to operationalize this new approach, which consists in the use of social components (such as opinion systems or group formation systems), artificial agents and personalization techniques. It is now important to go beyond the theoretical stage, and several projects implementing this approach pave the way to

It is now too early to determine if this new approach is indeed fulfilling the knowledge management needs of the modern organization, and what is the likeliness that this approach can be adopted quickly and easily by all the people of an organization (people may hesitate to adopt an approach that makes the work more transparent, makes some of their competence obsolete, or transforms their work habits too radically). Some other issues remain open such as if this approach should be considered more as competitive with or rather as complementary to the traditional approach (the two approaches may have some conflicting focuses, such as the formalization of knowledge versus its circulation in informal networks). Finally, a more fundamental question is related to the revolutionary or evolutionary nature of the approach: will this approach only help the employee in completing his/her work more efficiently, or will it transform the nature of his/her work more radically (contributing to the last iteration of mankind from homo sapiens to the knowledge worker [24]?).

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