IT Tools for Knowledge Management: A Study of the Current Situation

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In this document we describe a classification for systems of knowledge management based on two technical features we consider fundamental: the support the system gives to collaborative work and the focus it has on providing a structure for the knowledge it manages. We use this classification to make an analysis of what are, in our opinion, the most interesting knowledge management systems, both in terms of systems already commercially available and those under development in research projects. In this analysis we have included what we call Knowledge Management Integrated Systems*, which fulfil the two characteristics on which our classification is based, with the aim of establishing a technical benchmark for these systems.*

Keywords: Knowledge Management, Knowledge Management Integrated Systems, Groupware, Collaborative Work, Knowledge Structuring, User Communities, Information.

1 Introduction

In recent years attempts have been made to define what Knowledge Management is in various ways. Most of these definitions agree that the management of knowledge involves the capture, organisation, classification and dissemination of knowledge, and see this as a result of the way information is treated and the way a group of people interested in that information interact [McDermott 99].

Thus knowledge technology should be concerned with IT methods and techniques which allow for user interaction through the support and structure provided by user communities, while supplying a sufficiently efficient structure for the storage and treatment of information.

It is important to highlight that the ultimate purpose of a knowledge management system is not just the storage of information, but it should fulfil the social, economic, and academic needs of its users. Thus IT systems involved in the process of knowledge management should fulfil, to a greater or lesser extent, two technical characteristics:

a) Facilitate collaborative work among the users involved in the process of knowledge management.
b) Establish a robust structure for administering the information on which the knowledge to be managed is based.

We have used these two features as a basis for the classification we propose in section 2 of this document. This classification sets out the characteristics which best identify what, in our judgement, are the most interesting knowledge management systems both in the commercial field and in the area of technological research.

A description in chart form of the systems which we have considered as integrated knowledge management systems – by fulfilling most clearly the two aforementioned technical characteristics – will be presented in section 3, with the aim of serving as technical references for such systems.

2 Knowledge management systems

After analysing the characteristics that knowledge management tools should fulfil, we intend to classify on the one hand the tools which put more emphasis on facilitating collaborative work for the generation of communal knowledge,

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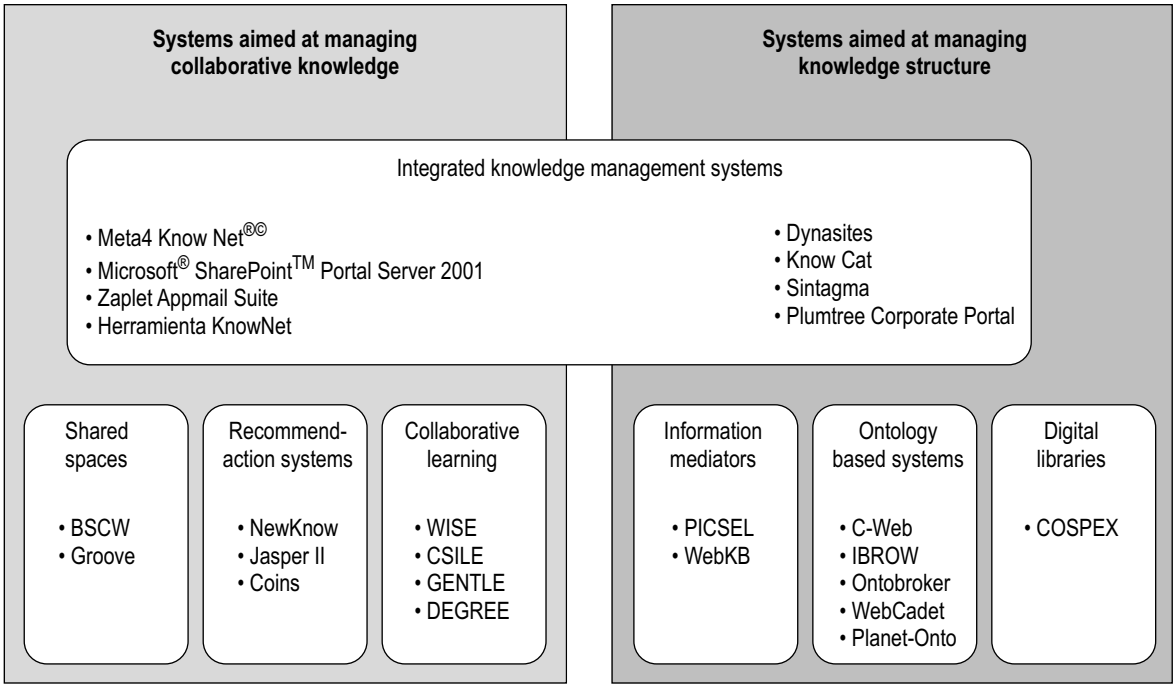

Figure 1: Classification of Knowledge Management systems.

and on the other, the tools which put greater emphasis on the generation of knowledge structures. There are also tools which provide techniques for collaborative work while at the same time they enable the internal organisation of a common knowledge memory: these we have called *knowledge management integrated systems*. See figure 1.

2.1 Knowledge Management Integrated Systems

Firstly we will analyse the tools which integrate collective knowledge in a common space in the form of a repository or organisational memory. The units of knowledge managed by these tools are generally documents in any format, anything from Web pages to personalised documents with a specific format.

The first aspect to analyse in this type of systems is the structure they use for the knowledge units they handle. This structure must basically fulfil two needs, the first being the need to reflect the inherent structure of the knowledge being managed. The most common mechanism used for this purpose is a topic hierarchy, or what we could also call a "knowledge tree". Another possible way is by means of hierarchical networks of nodes interconnected by relationships. The second need is for knowledge to be organised according to which people are going to use it and how they will share the knowledge among them. This is where structures based on discussion groups come in.

Examples of systems which organise knowledge in a topic hierarchy are Meta4 KnowNet®© developed by the company Meta4 <http://www.meta4.com>, Microsoft® SharePoint™ Portal Server 2001, <http:/www.microsoft.com/sharepoint/>, KnowCat (acronym for Knowledge Catalyser) [Alamán/Cobos 99], a system developed in the Universidad Autónoma de Madrid <http://www.ii.uam.es/~rcobos/investigacion/knowcat/esp/intro.htm>, the KnowNet tool, developed as part of the ESPRIT KnowNet project <http://www.know-netorg/>, and Sintagma, a tool developed by the company Carrot Informática y Comunicaciones <http://www.e-carrot.net/>.

Structures which organise knowledge according to the criteria of user groups are represented by systems such as Dynasites (*Dynamic, Extensible and Integrated Information Spaces*), developed in the University of Colorado <http://seed.cs.colorado.edu/dynasites.Documentation.fcgi>, which uses a structure based on discussion forums created within the system [dePaula et al. 01], or also in systems like Plumtree Corporate Portal, produced by Plumtree Software Inc <http://www.plumtree.com/products/>, which organises knowledge in user spaces called MyPages which can be shared so as to convert them into OurPages. Other systems such as the Zaplet Appmail Suite developed by Zaplet Inc <http://www.zapletcom/> organises knowledge according to a type of document called an *appmail*, which is created collaboratively by assembling elements known as knowledge blocks and is distributed among all interested users.

In some tools, the users can give their opinion on the knowledge stored, or even on its structure. Meta4 KnowNet®© Microsoft® SharePoint™ Portal Server 2001, Zaplet Appmail Suite and Dynasites are examples of such tools. KnowCat also allows users to contribute as well as give their opinion on the structure used to classify the knowledge contents.

These tools have different kinds of user: the reader or consumer of knowledge, the editor or producer of knowledge (who in some cases can contribute knowledge and in others

also give their opinion about it), the coordinator, whose role is to supervise contributions, and, finally, the expert. Some tools consider this last type of user to form part of the organisation's knowledge, and they allow experts to be located within certain topics (e.g. Meta4 KnowNet®©).

All the tools enable users to localise the knowledge they require. Most of them do this by means of searches on the Internet or of the knowledge stored within the tool. Some tools inform users of what knowledge units are the best for each topic or category, that is they provide a classification of contents by quality. This is the case, for example, of Microsoft® SharePoint™ Portal Server 2001 and KnowCat. Some tools, such as Meta4 KnowNet®© even make recommendations to the users regarding what documents might be of interest to them.

These tools have a series of groupware services allowing users to work in groups [Coleman 97]: discussion forums, messaging, online discussion or conferences, planning ... Additional services include the provision of reports or metrics (available in both Meta4 KnowNet®© and KnowCat), event notification (Microsoft® SharePoint™ Portal Server 2001, Zaplet Appmail Suite, KnowNet and KnowCat) and document version management (Meta4 KnowNet®© Microsoft® SharePoint™ Portal Server 2001, Zaplet Appmail Suite and Dynasites).

2.2 Systems aimed at collaborative knowledge management

In contrast to the tools described above, there are tools where the emphasis is placed on collaborative knowledge management, giving special importance to the users and their profile, and to the user community as a working unit. These tools can be split into three types: shared spaces, recommendation systems and those that are aimed at collaborative learning.

2.2.1 Shared spaces

Firstly, let us take a look at a series of tools or systems which provide an interface of shared space where a group of users can interact in order to share knowledge, create new knowledge collaboratively, etc.

These systems tend to offer a series of common functionalities:

- Communication tools: messaging, debate forums, and chat.
- Content sharing tools: for sharing files, contacts, links.
- Joint activity tools: joint web browsing, multi-user drawing and edition, group calendar.

As examples of systems of this type we have BSCW (*Basic Support for Cooperative Work*), a tool developed by GMD (*German National Research Centre for Information Technology*) <http://bscw.gmd.of/> [Appelt, 1998]; and Groove, developed by Groove Networks <http://www.groove.net>

2.2.2 Recommendation systems

Recommendation systems are based on collaborative filtering of information which ensures that users reach the information which they will be most interested in, given their tastes and preferences. The aim of these systems is to find information which other users with similar profiles have found useful and recommend it. Generally speaking the term "recommendation system" refers both to systems which recommend lists of products and those that help users to evaluate those products [Schafer et al. 00].

The first steps in collaborative filtering were taken by XeroX PARC with their Tapestry system [Goldberg et al. 92]. Later more product recommendation projects and systems came along, such as GroupLens, Ringo, EachMovie <http://www.research.compaq.com/SRC/eachmovie> and the one incorporated into Amazon.com <http://www.amazon.com/>.

As an example of a more knowledge oriented tool we have NewKnow, which has been developed by the company NewKnow Network <http://www.newknow.com/>. This tool classifies new knowledge in categories and is able to create relationships between documents by analysing users' consultations of these documents.

Other similar tools include Jasper II, developed by British Telecommunications <http://www.labs.bt.com/projects/>, a system which aims to encourage the interchange of tacit and explicit knowledge through communities of interest [Davies 01], and Coins, developed by the previously mentioned GMD <http://orgwis.gmd.of/projects/Coins/>, which recommends relevant web pages that have been rated highly by the people who read them recently.

2.2.3 Collaborative learning

In this group we are talking about systems or tools aimed at collaborative learning. Collaborative learning is a social activity involving a community of learners who share knowledge and acquire new knowledge, a process known as "social construction of knowledge" [Jonassen et al. 92].

We have taken an interest in some systems of this type because they enable students to learn by a process of integration, administration and distribution of users' knowledge, three features which are archetypical of knowledge management systems. These systems have in common the following features:

- A space for the learner community where they can swap ideas and knowledge, making use of a series of collaborative tools provided to help them in their group work.
- The knowledge is generally structured by topic. And the units of knowledge are not only documents but also exercises, studies, questions-answers, etc.

The first example of this type of system is WISE <http://wise.berkeley.edu>. It is a system for web based knowledge acquisition supported by the *National Science Foundation* (NSF). Its main aim is to provide learners with a didactic collaborative work tool by means of which students can learn from and respond to scientific controversies of the moment by designing and debating solutions. In addition to offering a space for the community of learners it gives supports to other types of user communities, for example a group of teachers interested in creating a common area of knowledge and sharing ideas and references about the topic and how it should be structured.

In the GENTLE system <http://wbt-2.iicm.edu/product> from the University of Graz, Austria, the knowledge takes the form of a static library (digital books and reviews) and a

dynamic library (indexing of web sites, databases of expert human knowledge, debate forums, etc.) and the whole can be seen as a collection of knowledge classified by topics, lectures and terms [Dietinger et al. 98].

Other systems manage student knowledge expressed in the form of ideas. An example is the DEGREE system (acronym for *Distance education Environment for GRoup ExperiencEs*), developed by the UNED (*National University for Distance Studies*, Spain), which allows users to swap ideas and contributions with a view to reaching agreements and thus jointly drafting a document [Barros/Verdejo 00]. Another example is the CSILE system (*Computer Supported Intentional Learning Environments*), developed by Marlene Scardamalia and Carl Bereiter of the Ontario Institute for Studies in Education, Toronto <http://www.ed.gov/pubs/EdReformStudies/EdTech/csile.html> [Scardamalia/Bereiter 99].

2.3 Systems centred on the generation of knowledge structures

We can split those systems which lay greater emphasis on the generation of knowledge structures into three groups: information mediator systems, digital libraries and ontology based systems. In the following sections we look at their basic characteristics.

2.3.1 Information mediator systems

The main aim of this type of system is to provide users with an interface through which they can make consultations about a particular domain, normally via the Web, involving scattered and possibly heterogeneous knowledge sources, which the interface will give the appearance of coming from a centralised homogeneous system.

In our analysis we have included two systems which are currently available as research projects: PICSEL <http://www.lri.fr/~picsel/> developed by the LRI (*Laboratoire de Recherche en Informatique* - Université Paris XI) and the CNET (*Centre National d'Études des Télécommunications*), and the WebKB system <http://meganesia.int.gu.edu.au/~phmartin/WebKB/> developed by the *School of Information Technology* of Griffith University, Australia.

These two tools have two technical features which we have identified as being archetypical of this group of knowledge management systems:

- The process of knowledge capture and integration is carried out *a priori* and does not involve any interaction with the system's end users.
- These systems incorporate languages for the description and indexing of knowledge sources and their content. In particular PICSEL uses a language which combines logical descriptions and rules (called Datalog) developed specially to model and relate information. However, the WebKb system uses standard RDF (*Resource Description Framework*) to define relationships between the units of knowledge obtained from the various sources.

This type of system is centred on the creation of a virtual structure which finds relationships in knowledge and makes it available in a transparent way, without giving any importance to possible interaction between users who are collaborating with or using the system.

2.3.2 Ontology based systems

The first uses of ontologies in computing systems were to be found in artificial intelligence systems. Later, ontologies have been used as the basis for several types of IT systems. Ontology based knowledge management systems are being exploited in various environments.

In the field of business we can find systems like WebCADET [Caldwell/Clarkson 00] which is a web based system for supporting decisions by applying an inference engine to ontologically structured databases. Another example is Planet-Onto [Domingue/Motta 00], a system developed as an intelligent news administrator for inter-institutional working groups.

Other more general purpose systems like C-Web <http://cweb.inria.fr/> and IBROW [Benjamins 00] offer – each in its own way – conceptual models for knowledge management distributed in work areas where domain relevant information has a structure which is known a priori: for example knowledge relevant to academic groups.

Finally, ontologies have also been used to support automatic information search systems and consultation engines on the Web: Ontobroker <http://ontobroker.semanticweb.org/> uses a powerful language to generate conceptual structures of knowledge on the Web and a structured consultation engine.

2.3.3 Digital libraries

By this we are referring to those systems which are a combination of communication technologies and digital information storage to reproduce, emulate and extend the service which conventional libraries provide such as the collection, cataloguing, administration and dissemination of bibliographic information. An example of this type of system is COSPEX (*COnceptual SPace EXplorer*) which captures information from scattered sources of information and allows the user to build up their own digital library <http://www.r.dl.itc.u-tokyo.ac.jp/~sugi/cospex/>.

3 More detailed analysis of Knowledge Management Integrated Systems

Finally in table 1, we present a more detailed analysis of the features of the Knowledge Management Integrated Systems we have described in previous sections.

4 Conclusions

The aim of this document is to explain and classify a set of tools for knowledge management. Firstly we have stated the two features which should be present to a greater or lesser extent in any knowledge management system. They should have utilities which enable collaborative work among users involved in the knowledge management process, and which facilitate the creation and administration of a robust structure for that knowledge.

Taking these two features as our starting point we have considered three groups of tools. Firstly, there is the group which emphasizes both features, containing the systems which we

have called Knowledge Management Integrated Systems. Secondly we have the group of tools which are focused on collaborative work techniques, which hinge on the concept of a community of users. And finally we have considered the group of tools which are primarily centred on the internal organisation of a common knowledge memory.

This paper has been partially sponsored by the projects TIC98-0247-C02-02 and TIC2001-0685-C02-01 of the Spainsh National R&D Plan.

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Translation by Steve Turpin

Table 1: Characteristics of the Knowledge Management. Integrated Systems

		Meta4 KnowNet®©	Microsoft® SharePoint™ Portal Server 2001	Zaplet Appmail Suite	KnowNet Tool	Dynasites	KnowCat	Sintagma	Plumtree Corporate Portal
KNOWLEDGE INTEGRATION	**Repository of knowledge**	Knowledge in the form of documents in any format.	Knowledge in the form of documents in any format.	Knowledge in the form of documents called *appmails*, created collaboratively among users.	Knowledge in the form of documents in any format.	Knowledge in the form of web pages and references to articles published in reviews or congress proceedings.	Knowledge in the form of web pages, free format.	Knowledge in the form of nodes, having a name, attributes, content and parent.	Knowledge in the form of documents in any format
KNOWLEDGE ADMINISTRATION	**How is the knowledge organised?**	Knowledge tree. Organisation created a priori according to the needs of the company or organisation.	By means of a system of directories (topics). Created a priori by the administrator of the system.	There is no basic structure.	Knowledge structured in taxonomies.	Hierarchically, in discussion forums. Non-classified links and references.	Hierarchical topic structure (knowledge tree), collaboratively created by users	Hierarchical structure by nodes and relationships. User can create relationships.	Each user has their own file or directory system. A file system can also be maintained by groups.
	Can users collaborate by giving opinions or recommendations about the knowledge?	Users can evaluate the documents they read.	Users can give their opinion about documents; document approval process.	A document generated is put before the group for consideration; if approved it is published.	No	Users can evaluate their own contributions and those of others.	Users can evaluate knowledge in the form of structure and in the form of contents or documents	No	No
KNOWLEDGE DISTRIBUTION	**Can knowledge be requested?**	Searches on the Internet and in the knowledge stored by the tool. Allows advanced searches.	Internet portal. Searches on the Internet and in the knowledge stored by the tool.	No	Any type of resource stored by the tool can be accessed.	Stored forum discussions can be accessed.	Topics can be accessed on the knowledge tree from where the desired document can be selected.	Taking a node as the starting point, the sought for knowledge can be filtered and found.	Searches on the Internet and in the knowledge stored by the tool.
	Does the system make recommendations?	The users are provided with the documents they should read.	The tool indicates what the best documents are in a given category.	No	No	No	The tool indicates what the best documents are for each topic of the knowledge tree.	No	No
ADMINISTRATION OF USERS	**Is there personal space for users? (Types of users)**	Yes (Editors, creators, evaluators and consumers)	Yes. (Coordinator, author, and reader)	Yes, in fact the units of information are created in users' personal spaces.	Yes, each user has his own "knowledge folder"	No. (All users are consumers and producers of knowledge)	Yes. ("Browser", coordinators, experts and collaborators)	Yes. (All users are consumers and producers of knowledge)	Yes. (All users are consumers and producers of knowledge)
	User communities	There are communities of experts	User communities are formed when a document needs to be approved for publication.	User communities are formed when a document is created collaboratively.	There are practical communities of users. They have a common space where the collaborative tools are.	Each community has a discussion forum.	Virtual communities of experts are formed around the topics of the knowledge tree.	No	Communities of experts are formed round OurPages, a space shared among users.
	Does the figure of espert exist?	The expert is part of the organisation's knowledge. The tool allows users to locate experts in certain topics.	The experts are the users who have to approve the publication of documents.	No	No	The users who initiated an information sspace.	Experts can give opinions about the elements of knowedge in their virtual community. Experts can be found on certain topics.	No	No
SERVICES	**Event notification service**	No	Notification of changes in documentation or new documentation.	Yes	Yes	No	Notification of all kinds of events occurring in the system.	No	No
	Discussion fora	Yes	Yes	Yes	Yes	Yes	No	No	Yes
	Are there document versions?	Yes	Yes	Yes	No	Yes	No	No	No
	Other services	Yellow pages. Measurements (metrics) and reports.			Online discussion. Online conferences. Messaging. Virtual course planning.		Discussion via e-mail. Activity reports. Allows users to see and modify their profile.		Those related to e-mail administration.