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Roadmap for KRSM RTD.

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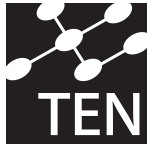
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Building The European Network for Lifelong Competence Development

Building the European Network
For Lifelong Competence Development

TENCompetence IST-2005-027087

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1 Introduction

This document reports the future perspective of WP5 as currently devised. It can be certainly considered the richest part of the WP5 research work. It stems from the initial State-of-the-Art input developed in order to set the common base ground for the WP5 partners and the consortium (see the Annexes for the most relevant subject considered), and it has been fed mainly by the research work on models and methods run in WP5 task 4 of the project first cycle (see in D5.1) and by the outcome of a cooperative work performed in a focus meeting among WP5 partners, the TENC Vision Group and representatives from WP3 (Technical Design & Implementation of the Integrated System) as here described in §3. All in all provides the drivers for the WP5 R&D efforts in the second cycle (and afterwards). Please note that overall WP5 outcomes are reported in D5.1 deliverable and that the implementation of the R&D Roadmap here provided will be reported in deliverable D5.2 that will collect intermediate results in the internal deliverable ID5.3 to ID5.10, see (TENC staff, 2007)¹.

Remarks:

Please note that in order to maintain document's consistency with other WP5 documentation (such as D5.1), and to make it self contained, some excerpts from other suitable documents have been integrated.

Please also note that all References are here reported in footnotes and detailed in the main document D5.1.

¹ TENC staff (2007). TENCompetence – Building the European Network for Lifelong Competence Development. Detailed Implementation Plan month 13-30.

2. WP5 in the TENCompetence context

2.1 General objectives

As stated in §2 (Project Objectives) of the Description of Work of the TENC project (TENC staff, 2005)², the “central need addressed by TENCompetence is to provide ubiquitous and lifelong adapted access to facilities that support the creation, storage, use and exchange of formal and informal knowledge and learning resources”.

Therefore, it is clear from the very beginning of the project presentation that the KRs management plays a key role in the overall framework infrastructure. In fact, the third major requirement addressed by the TENC infrastructure is to “provide policies and software agents that support the proactive sharing of knowledge and learning resources”. This is the core goal of WP5 on Knowledge Resources Sharing and Management.

Moreover, since the KRs dealt with by all the other aspect WPs can be sought via the KRSM system, it is apparent how WP5 is functional to address the other main issues tackled by the project (i.e. new pedagogical models, finding adequate learning opportunities, assessment, support tools, decentralized management, integrate isolated tools).

Again, the “field of Knowledge Resource Sharing & Management” including “the fields of knowledge management, digital repositories, learning management systems that work on learning objects, etc.” represents one out of the four pillars of the integrated TENC infrastructure (along with the fields of Learning Activities & modelling of Units of Learning, of Formal and Informal Programmes for Competence Development, and of Networks and Communities of Lifelong Learners), that aims to serve the “lifelong competence development in Europe”.

Stemming from this background analysis, the fourth project objective outlines the scope that WP5 will take charge of during project lifespan: “4. To research and develop innovative methods and technologies for the creation, storage, use and exchange of **knowledge resources** related to lifelong competence development.”

2.2 The first cycle approach

As far as the actual relation of WP5 with the other WPs in the project is concerned, the work performed in the first project cycle has been

² TENC staff (2005). TENCompetence – Building the European Network for Lifelong Competence Development. Annex I - “Description of Work”.

devoted to provide the basic proof-of-concept technical infrastructure for the KRs handling so that the KRSM system developed could work both as a standalone tool and as a component ready to be integrated in the overall TENC framework. The actual integration in the general infrastructure will start in the second cycle. Therefore, in the first phase, the user requirements identified at WP5 level fed the WP2 general definitions, while the cooperative work with WP3 has helped to outline how the KRSM system will be integrated in the general infrastructure. A taxonomy of knowledge resources has been built in order to list all kind of items that are processed at TENC infrastructure level and that may be handled via the KRSM system. This taxonomy has been fed by estimating the input coming from other aspect WPs. In particular, given the close relationship at research level, even though operating on different scope and perspective, it is foreseen that the collaboration between WP5 and WP8 will be strengthen in the project second phase³. After the first cycle such a list will be validated by aspect WPs and then used to populate WP5 updated scenarios and use cases.

2.3 WP5 and the TENCompetence Domain Model

Last but not the least, it is useful to see where the KRs are placed in the 'Domain Model' (TENC staff, 2006)⁴ that defines the conceptual framework of the project in order to fully understand the key role played by WP5. In the following picture, one can see, highlighted in light blue, the connections / relation of the Knowledge Resource class with the other classes. It is apparent that apart from the auto-inferential link KRs are accessed and invoked by Activities and / or Actions performed by Actors. Moreover, KRs are handled by Products

³ WP5 perspective should be addressed to the individual users of knowledge resources while WP8 point-of-view should be more community- (i.e. network)-oriented. In fact, the focus of WP8 task 3 is clearly on communities management "This task describes, develops and tests tools and models that help understand and manage the dynamic behaviour of networked communities." (TENC staff, 2007).

Therefore, the two WPs consider two different aspects of the same issue:

- 1) (WP5) how individual users take advantage of the tools developed for sharing KRs (this means that the models will help in understanding what are the most proper tools to be used / developed - likely by WP8 - and how to use them - this would help also in terms of usability design, e.g. the model foresee a particular way of interaction that has to be taken into account in the GUI design),
- 2) (WP8) how the community and the networked communities are related to each other and how the individuals towards to the community(-ies). Therefore the knowledge resources sharing has to be taken into account since it affects the relationship dynamics in the community(-ies) and is functional to them (e.g. as a prerequisite).

⁴ TENC staff (2006). TENCompetence – Building the European Network for Lifelong Competence Development. Domain Model v.1.0.

(used by Actors), that is the KRSM and / or the ones developed in the aspect WPs and the general TENC infrastructure.

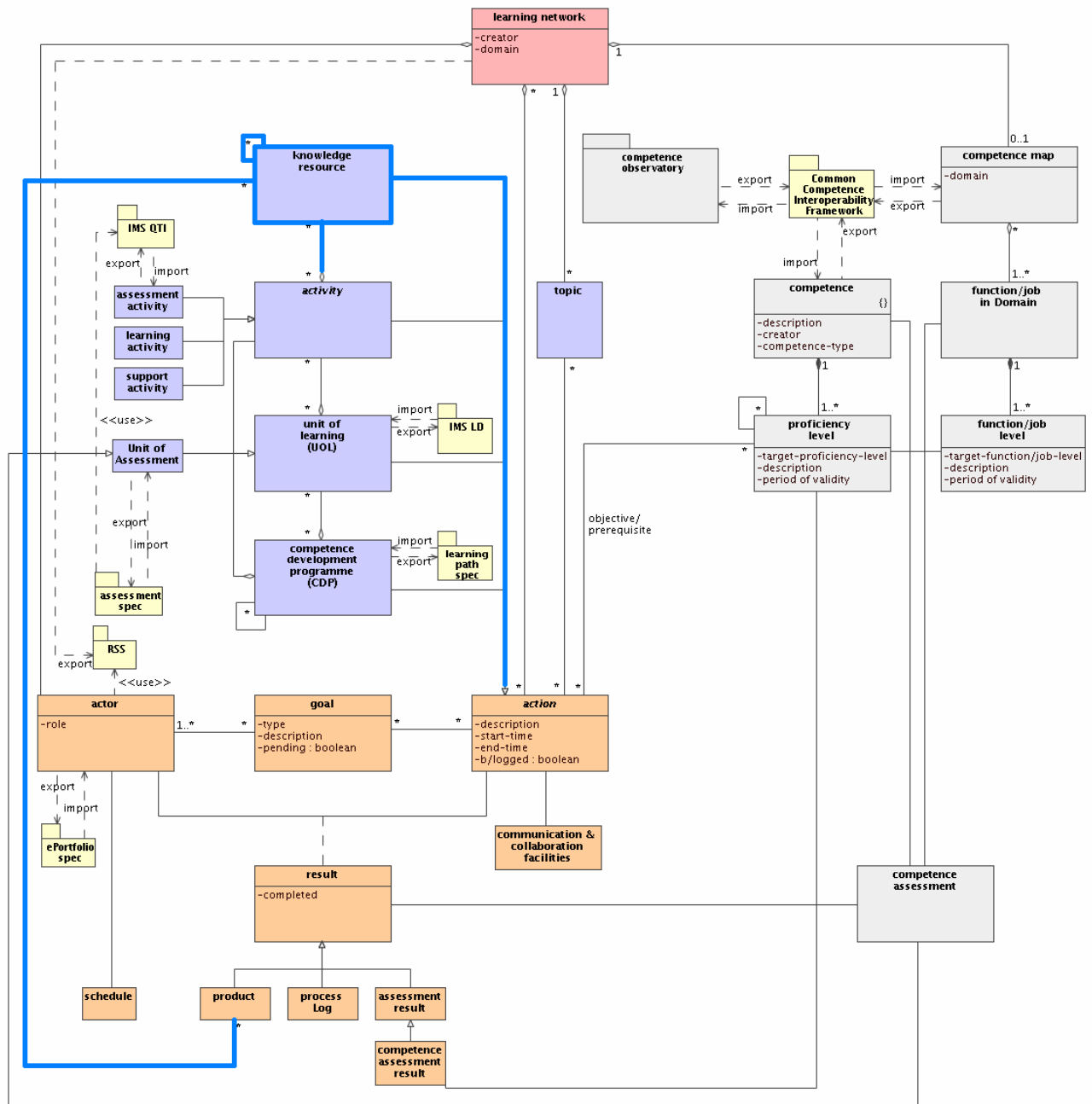


Figure 1 – TENCompetence Domain Model v.1.0 (TENC staff, 2006)

2.4 State-of-the-art and WP5

A first thorough State-of-the-art analysis has been performed at the beginning of the project in order to set the bases for a common and shared background information and knowledge among the WP5 partners mainly. The results of such work were collected into the first WP5 White Paper. However, current research and technologies have been constantly investigated during the project lifespan in order to always guarantee the best approach and choices provided that general project perspective and guidelines are safeguarded.

In the White Paper mentioned above all the relevant aspects related to Knowledge Management (KM) have been addressed. Therefore, after reporting the KM scientific foundations extensive analyses of categories of KRs and of off-the-shelf SW have been performed.

All the relevant information has been here reported in the Annexes A to E.

In particular, the list of categories of KRs reported into the first WP5 White Paper, was provided as preliminary base-ground of the taxonomy currently being developed.

2.5 R&D Roadmap: DIP-1 vs. DIP-2

The main difference between DIP-1 (TENC staff, 2005)⁵ and DIP-2 (TENC staff, 2007)⁶ emerges at first sight while considering the order tasks are detailed within. In fact, in a sort of top down representation, one can see outcomes from task 1 feeding the tasks following (i.e. task 2, task3...). According to this pattern, it is apparent a different perspective in carrying out and in prioritising WP5 activities in DIP-1 and DIP-2. Hence, in the first project phase (DIP-1) the first task, pretty technical, had to provide the basic infrastructure, in terms of digital accessible repositories and services, as proof-of-concept of the knowledge resources sharing and management; then, running in parallel, the liaison-related activities, the experimentation and, lastly, the research followed. On the contrary, DIP-2 puts on the top (and in the main focus) the research work, and then the technical development and the experimentation.

The different scope and point-of-view was apparent and, along with the research work on methods and models described in Part I and performed at DIP-1 task 5.4 level, drove the discussion of the WP5 focus meeting that was organised among WP5 partners, TENC Vision

⁵ TENC staff (2005). TENCompetence – Building the European Network for Lifelong Competence Development. Annex I - "Description of Work".

⁶ TENC staff (2007). TENCompetence – Building the European Network for Lifelong Competence Development. Detailed Implementation Plan month 13-30.

Group and WP3 representatives at Giunti Labs premises around mid-March 2007.

3 WP5 focus meeting outcomes

The meeting held in Sestri Levante on 12th and 13th March 2007 was very important and fruitful since set out the research guidelines for WP5 in the second project cycle and, in perspective for the remaining project lifespan.

Two main (reciprocally-related) issues have been considered:

- 1- Where is the **Competence Management** aspect in WP5?
- 2- How can **Tacit Knowledge** be transferred into KRs?

Both questions are relevant since the first one deals with the main issue and objective of the project, while the second one addresses directly the typology of KRs used / handled at WP5 (and KRSM system) level. The latter, in particular, points out the problem of mapping in a proper and concrete way KRs that are difficult to be practically formalised, but that, if skipped or not sufficiently considered, a potential loss of knowledge would occur.

3.1 Main findings

The most relevant outcome of the meeting was to change the focus of WP5 scope from the KRs **Search** to KRs **Discovery**. This introduces a fundamentally different approach which is completely in line with the changed perspective of DIP-2 with respect to DIP-1, as mentioned in the Introduction.

The real added value of the renewed point-of-view relies on discovering (by harvesting) the **Connections / Relations** associated to and among KRs as well as on analysing such connections.

Moreover, the clarification of WP3 new developments brought new light to the possible interfacing between the KRSM system and the TENC one as well as support to the new discovery-oriented approach. In fact, because of the strict client-server architecture of the TENC infrastructure, all pure P2P features will be removed in order to follow the general pattern for client communication architecture.

Another relevant finding is related to the introduction of the **Collaboration Cost Reduction** concept. This is obviously related to KRs sharing, use and reuse and, indirectly, to the motivation that will trigger collaboration and to the competence needed for repurposing KRs or valuable part of them. In fact, the cost of finding valuable information in a KR used in a certain context in order to reuse it in another one depends on the cost of (a) the de-contextualisation effort – for extracting more transferable Knowledge from a 'less-transferable' and high and context-specific KR; and of (b) the re-contextualisation

effort – for repurposing the extracted Knowledge in a different KR and into a more generic context. This research issue will be likely addressed at a later stage in the project (i.e. cycle 3).

3.2 *Related open issues*

There are some open issues related to these findings that will have a concrete impact on actual WP5 future activities. For instance, the fact that the actual discovery process relies on harvesting and analysing connections among KRs requires the identification and / or definition of a specific intelligence that properly handles their indexing. And **Indexing** the relations among KRs is a task that deserves special attention itself.

A further impact on investigation activities will be in terms of identification and definition of suitable new scenarios and use cases, on the one hand, and of new **Metadata** in order to provide the linking information, on the other hand (of course, already existing information – metadata included – have to be analysed, e.g. by data mining on logs – for the same reasons). In both cases, the **Taxonomy** of KRs, that has been introduced in D5.1, has to be revised in order to take into account the linking information.

Once the KRs have been discovered likely new ways of KRs **browsing** and **visualisation** have to be investigated in order to meet user's (new) approach (i.e. discovering them rather than simply searching for). For instance, a user-friendly way for visualising the relations among KRs could be given by the use of concept maps.

However, aside this structural analysis of KRs that makes visible and understandable the connections, there is the need of analysing KRs usage in terms of e.g. users' reputation (i.e. the higher, the more reliable her/his 'judgement' on use of KRs is), WEB 2.0 tagging. This is a key factor for addressing and fostering the collaboration during KRs authoring. In fact, by means of **log mining** (e.g. on content, people involved, schedule: start and stop timing), and of coupling with the output coming from the communication among users (e.g. via chat, email, Instant Messaging, Audioconference, Videoconference, webinars) it is possible not only to make tacit knowledge explicit, but also to derive useful information to drive KRs recommendation and rating. Of course, **privacy** issues related to acquisition, storage, access and use of the data stored and / or detected have to be carefully investigated. Enforcement privacy mechanisms for centralized and distributed indexing, search and retrieval must be investigated.

Moreover, in relation to fostering the collaboration, other investigation efforts should be performed in order to suitably identify how to set up a proper set of authors. Discovering the right people can be helped by

analysing competence-driven rating, or just by advertising the subject to work on. Again, the **GUI design** could play a key role for presenting 'discovery' results in an effective way.

Again usability concerns should address the work of displaying the tips arising from the discovery outcomes, in case a recommending system will be implemented to support the user. In fact, the possible invasiveness of pushing suggestions, for instance via pop-up windows, and the prioritisation of such information have to be seriously taken into account in order not to lose the advantage given by the additional semantic rich information gained along with the discovery outcomes.

On the architectural side, moving the TENC infrastructure towards a **client-server** architecture means that KRSM P2P features have to be skipped since publishing and sharing KRs will become one common function, provided with more sophisticated access and filtering mechanisms and supported just by saving KRs on TENC server(s). It is clear and already accepted that APIs for accessing the repositories are provided by WP3.

In addition, there are some other problems related to the definition of the APIs for the devised integration of the Google search engine and of the Google Docs & Spreadsheet (also in terms of services **licensing**), on the one hand, and to the lack of **cross platform** solutions for some collaborative tools that can be considered, on the other hand. A further issue is represented by the fact that some WEB 2.0-oriented tools do not provide public **APIs**. Finally, keyword-based search still produces an overload for the user side. Combinations of keyword search and metadata based queries should be investigated.

4 Next Steps & Conclusions

4.1 *The updated R&D roadmap*

The R&D agenda of WP5 can be easily derived from the previous sections, in terms of research subjects and of accompanying issues, and can be broken down into the second and the third project cycles according to the following main drivers:

1. The change in approaching the seek of KRs, that is, from the (traditional) search, based on standard and extensive use of interfaces with digital repositories, towards to the combination with metadata possibly extracted from the discovery of KRs and identification / detection of the connections that may link KRs one another. The intrinsic semantic value of the connections provides users with richer information than just the bare items sought. This is certainly the main focus of R&D work in the next project phases.
2. the combined introduction of collaboration and KRs creation in terms of collaboration cost reduction for the last phase of the project that will address the use and reuse of KRs as well as their customisation. In particular, it will be interesting to investigate how to establish the group of authors that collaboratively work on a subject and on a (set of) KR(s) as well as how to optimise the de-contextualisation and re-contextualisation efforts to be spent in repurposing KRs, or part of them.

The actual outcomes that are expected by the implementation of such roadmap will be clear after the new round of scenarios and use cases identification and definition that will start after the conclusion of the first project cycle. From that analysis not only 'what' has to be 'discovered' but also 'how' to do it will be understood. KRSM v2.0 system design and development will be affected accordingly, too. Therefore, at month 30 the new KRSM system will offer users at least some of the new semantically enriched functionalities and services that are intrinsic to the objectives mentioned above.

4.1.1 **Actions list**

From a practical point of view the changed perspective has a certain impact on WP5 activities breakdown. In fact, and first of all, the scenarios and use cases related to the KRSM system will be revised and updated accordingly. They will be used for designing and developing the new version of the KRSM system on the one hand, and for modelling the relation between the KRSM system and the **Personal**

Competence Manager (PCM), that is the final and overall TENC infrastructure, on the other hand.

Next, we have to rework the KRSM system architecture, in order to fit it to the current TENCompetence infrastructure, moving from pure P2P communications to client-server based communication model. This will have significant impact on both the KRSM client, as well as on some of our services already developed. We will need to re-design our client tool and adapt and extend existing services to allow for their integration into the new architecture.

But we also need to design and implement new services and functionalities as well. In particular, the most WEB 2.0-related issues, such as social bookmarking, folksonomies, cloud tagging (where not only the owner of a KR is allowed to tag it but also other users), collaborative editors, e.g. Google Docs, wikis, forums, personal and automatic annotation, will be addressed. Other items to be investigated are related to the ways of setting up a group of collaborators on a specific subject as well as the use of logs and of communication tools output for tracking users' interests and KRs use. However, as already pointed out, and in relation with the PCM development, efforts will be devoted to the integration of the collaboration services with the authoring tools, on the base of the enhancement of the Knowledge Resources Taxonomy, and its integration in both the KRSM client as well as in the TENCompetence server(s), and its joint use and re-use with other TENCompetence tools and services, developed by other WPs.

4.1.2 Short term view

The kind of investigation mentioned above will guide the research work from the second cycle of the project on. The following more specific activities will be needed at first place:

- Completely new GUI component have to be developed as an Eclipse plug-in
- New Publishing and Sharing services have to be developed, adopting the centralized TENCompetence server(s) approach, using centralized DB
- Searching functionality needs to be changed and improved.

However, and in the meanwhile, some other activities have to be performed in order to complement the current version of the KRSM system and setting the ground of the future work.

In particular, (1) the integration of the Google search engine, since it is the most effective and popular, will be further investigated and implemented provided that it will be possible in terms of licensing, (2) a wider integration of the Taste recommending system, already used

in the KRSM system, and that will be fed by the rating services in order to be more effective, (3) the integration of the DSpace digital repository, in order to accomplish one of the objectives of the project first cycle, (4) finalizing implementation of the services for downloading (i.e. get) , publishing (i.e. post) and metadata handling (e.g. update, delete) on the Ariadne and Lobster repositories, and (5) the integration of the adopted solution for the user's Authentication and Authorisation as will be defined by WP3.

Summary

The initial WP5 approach, described in DIP-1 (TENC staff, 2005), was more technology oriented, while the specificity of the personal competence development was not fully addressed. Therefore, and according to the overall development, WP5 changed its focus and point-of-view as far as the main subject of R&D research is concerned. The new focus shifted from infrastructural basic requirements to more specific knowledge management and WEB 2.0 issues. So that the KRs retrieving is no longer linked to the bare 'search' concept only, but has been enriched with a strong 'semantic' flavour as attention is paid in harvesting and analysing the connections among KRs, their use and related user's behaviour etc.

This new 'discovery'-oriented approach is completely in line with fostering the collaboration between users and the 'intelligent' use (and re-use, exchange and sharing) of the KRs, that could have been apparently at risk after WP3 decision of adopting the client-server pattern that somehow drops off the role covered by P2P in the KRSM architecture.

The 'intelligence' mentioned above is in relation with the minimisation of the efforts required for repurposing a KR or a part of it from a specific context into a new a one. This demanding objective will guide WP5 R&D research in the last phase of the project lifespan.

Of course, several issues will arise and have to be addressed. In particular, KRs handling and exchange bring IPRs and licensing problems that will be better met at project general level. The same applies for the privacy of the users once their logs are 'investigated' in order to drive rating and recommending facilities in the TENC clients.

It is also likely that in order to maintain full grasp with project evolution other WP5 focus meetings, as the one organised in March 2007, will be organised in the following project cycles on regular basis or at need.

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A.1 Definitions

When dealing with knowledge management (KM) the first issue is to define knowledge itself. We need such a definition as this will directly impact the whole discussion eventually preventing a real understanding on what exposed. Therefore, as usual in all multidisciplinary environments, it is necessary to agree on used terms in order to fully avoid misunderstanding.

Unfortunately, there's no universal definition of KM, just as there's no agreement as to what constitutes knowledge in the first place. Over the millennia, philosophies of each age have added their own definition of knowledge to the list, so did Science. According to Plato (as emerging from his dialogues) and other Greek philosophers we have that:

- *Knowledge is what is True (Socrates). That which is true represents Reality as it is (definition of Truth) so, Knowledge represents Reality as it is.*
- *Conceptual Knowledge is truly Knowledge for us (psychological fact), so Conceptual Knowledge represents Reality as it is.*
- *Conceptual Knowledge represents Reality as immobile, eternal and necessary. (Parmenides)*
- *The Phenomenal world (becoming) is not immobile, eternal and necessary. (Heraclitus)*
- *The Phenomenal world is not Reality. Therefore Conceptual Knowledge doesn't represent the phenomenal world.*

From what just stated is apparent that the concept of knowledge can be split in what is absolutely true (maybe also unknowable) and what is perceivable. In the latter, knowledge is specific to the cognitive system that created it, not residing outside the cognitive system.

As a matter of fact several definitions of knowledge management have been given in time by different authors as evident from the following collection:

Author	Definition
Charles Savage	Knowledge comes alive in an organization when people learn to trust one another and seek out and build upon their capabilities and aspirations - individually, across functions and with other companies.
Debra M. Amidon	Knowledge management is an oxymoron and could run the course of a fad. Knowledge innovation is fundamentally sustaining a collaborative advantage

Author	Definition
	for the excellence of an enterprise, the sustainability of a nation's economy and the advancement of society.
Alvin Toffler	People do not manage knowledge; knowledge manages people.
Gene Meieran	Knowledge management is about the use of computer and communication tools to help people gather and apply their collective data, information, knowledge and wisdom in order to make better, quicker, wiser and more effective decisions.
Matthias Bellmann	Knowledge Management is the transformation of knowledge into business—and learning the transformation of information into knowledge.
Karl Erik Sveiby	It is the art of creating value by leveraging the intangible assets. To be able to do that, you have to be able to visualize your organization as consisting of nothing but knowledge and knowledge flows. ⁷
Charles Armstrong	It's about elevating organizational conductivity to improve our capability to engage with the outside world and our customers. This requires creating the place, time and mood to promote reflective work and the strategic effectiveness of our interactions.
Robert K. Logan	It's about using information strategically to achieve one's business objectives. Knowledge Management is the organizational activity of creating the social environment and technical infrastructure so that knowledge can be accessed, shared and created.
Larry Prusak	It is the attempt to recognize what is essentially a human asset buried in the minds of individuals, and leverage it into an organizational asset that can be accessed and used by a broader set of individuals on whose decisions the firm depends.
Hubert Saint-Onge	It is creating value based on the intangible assets of the firm through relationships where the creation, exchange and harvesting of knowledge builds the individual and organizational capabilities required to provide superior value for customers.
Peter Vieser	The hybrid medium of Internet technology facilitates information and knowledge sharing among colleagues which enhances the intellectual capital of the organization.

⁷ Sveiby, Karl-Erik, "What is knowledge management"

Author	Definition
Howard Eisenberg	The modern term knowledge worker is a misnomer. Instead we need Thinkers, people who can perceive current limitations, detect emerging trends, anticipate possibilities and heuristically re-tool themselves for the opportunities of tomorrow. Such knowledge workers would then become appreciating assets - the reserve and source of intellectual capital which can be deployed to create competitive advantage.
Chris Argyris	The art of management is managing knowledge. That means we do not manage people per se, but rather the knowledge that they carry. Leadership means creating the conditions that enable people to produce valid knowledge and to do so in ways that encourage personal responsibility.
Josef Hofer-Aleis	KM is the systematic and explicit management of policies, programmes, practices and activities in the enterprise which are involved in sharing, creating and applying of knowledge. The management of knowledge aims to enhance existing knowledge and its networking and reuse. The management for knowledge aims to enhance new knowledge and the ability for innovation. (with acknowledgement to P. Seeman and K. Wiig)
Josef Hofer-Aleis	It is one of the most important factors for enterprise value, competition and production.
Linda Stone	Knowledge management initiatives help to transform an individual's tacit knowledge and experience into explicit knowledge that is readily accessible by others, which thereby increases our structural capital.
Stan Lepeak	A knowledge management system is a virtual repository for relevant information which is critical to tasks performed daily by organizational knowledge workers.
Thomas Koulopoulos	Knowledge management is the ability to link structured and unstructured information with the changing rule by which people apply it.
InformationWeek (March 16, 1998)	Knowledge management is the concept under which information is turned into actionable knowledge and made available effortlessly in a usable form to the people who can apply it.
University of	Knowledge management is the systematic process

Author	Definition
Texas KM Server	of finding, selecting, organizing, distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest. Knowledge management helps an organization to gain insight and understanding from its own experience. Specific knowledge management activities help focus the organization on acquiring, storing and utilizing knowledge for such things as problem solving, dynamic learning, strategic planning and decision making. It also protects intellectual assets from decay, adds to firm intelligence and provides increased flexibility.
Fernando J. Moran	Knowledge Management is the ability to help oneself or others, strategically achieve goals, ambitions, objectives and life-time dreams. Knowledge is NOT power, it is how you use it that matters!

The often used definition of knowledge as information made actionable⁸ refers to the observable output of knowledge, not knowledge itself. Encyclopaedias, handbooks, manuals, other reference material, speeches, lectures, conversations contain only information, not knowledge.

Understanding written and oral material requires a cognitive system (i.e. a human) to transform the information contained in that material into knowledge.

Groups are cognitive systems that have a shared knowledge resulting in a shared or mutual understanding from one or more interactions between individuals within the group. Hence, organizations are cognitive systems possessing a shared understanding that is the result of socialization and culturalization processes⁹.

Therefore we believe that it is possible to state that KM is the process through which individuals and organizations generate value from their intellectual and knowledge-based assets. Most often, generating value from such assets involves sharing them among individuals / employees, departments and even with other companies in an effort to

⁸ Whereas the first part of the "information revolution" focused on information, the second needs to focus on knowledge, on understanding. The often used definition of knowledge as information made actionable refers to the observable output of knowledge, not knowledge itself. The role of knowledge management should be to increase the cognitive system's understandings so more information can be made actionable - so cognitive systems can take more effective action based upon its knowledge, not based upon the amount of information it can process.

⁹ "Knowledge Management" <http://members.aol.com/rgwenig/homepage.htm>

devise best practices. It's important to note that the definition says nothing about technology; while KM is often facilitated by IT, technology by itself is not KM.

What is even more interesting from our point of view is that knowledge can be turned in a real asset. Valuable and tangible as it is possible to transfer it according to a well defined process. Our statement is supported by the following considerations. Fleming¹⁰ says that information, knowledge and wisdom are more than collections. He states that a collection of data is not information and similarly a collection of information is not knowledge ... proceeding in the same way he turn to say that also wisdom is not a collection of knowledge nor truth a collection of wisdom. This implies that the whole represents more than the sum of its parts and has a synergy of its own.

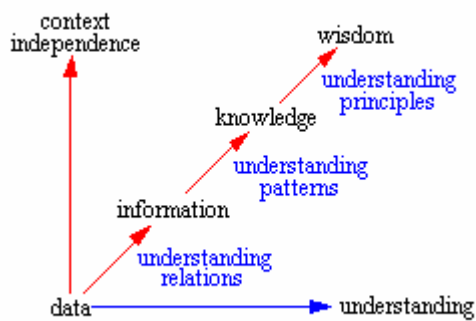


Fig. 1 – The process from data to wisdom

It's a well known fact that when we bounce in some raw data we automatically tend to arrange it into some context, maybe guessing, and this suddenly fabricates meaning which was not there in the data itself.

Pieces of data may represent information, yet whether or not it becomes information depends on the knowledge of the interpreter.

It seems that information entails an understanding of the relation between data, is relatively static in time and linear in nature being mainly a relation between data with great dependence on context. Such statement is expressible also in graphical terms as evident from figure 1, where are highlighted the factors that characterise the quantum leap from one state to the other. On the axes are reported the two main characterising factors: understanding and context independence.

¹⁰ Neil Fleming, "Coping with a revolution: Will the Internet Change Learning?", Lincoln University, Canterbury, New Zealand

What is particularly interest to examine is the relation between the aforementioned process and the interpretation of complexity by Csikszentmihalyi. According to his approach what is more highly differentiated and integrated is more complex. So in his view while high levels of differentiation without integration promote the complicated, that which is highly integrated, without differentiation, produces mundane. Also this approach can be represented with a diagram.

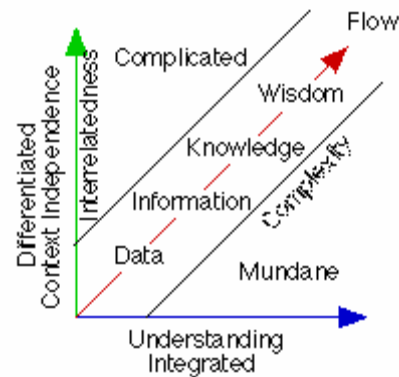


Fig. 2 – Complexity evolution & wisdom process

What is apparent at first sight is that the superposition of this diagram on the previous one is that there is a direct correlation between “**integrated**” and “**understanding**” as well as between “**context independence**” and “**differentiated**”.

In the overall it seems that the path from data to wisdom correlates exactly with Csikszentmihalyi’s model of evolving complexity. This is reported in the schema presented in figure 2 where the two diagrams are superimposed to each other.

From what just stated is apparent that not all information is valuable. Therefore, it's up to individuals / companies to determine what information qualifies as knowledge-based assets. In general, however, such assets fall into one of two categories: **explicit** or **tacit**

Included among the former are assets such as patents, trademarks, business plans, marketing research and customer lists. As a general rule of thumb, **explicit knowledge** consists of anything that can be documented, archived and codified, often with the help of IT.

Much harder to grasp is the concept of **tacit knowledge**, or the know-how contained in people's heads. The challenge inherent with tacit knowledge is figuring out how to recognize, generate, share and manage it. While IT in the form of e-mail, groupware, instant messaging and related technologies can help facilitate the

dissemination of tacit knowledge, identifying tacit knowledge in the first place is a major difficulty for most organizations.

Further information related to the definition of Knowledge Management is provided in the Appendices.

A.2 The starting point

For our purposes we can define knowledge management as a business activity with two primary aspects:

1. Treating the knowledge component of business activities as an explicit concern of business reflected in strategy, policy, and practice at all levels of the organization.
2. Making a direct connection between positive business results and organization's intellectual assets – both explicit [recorded] and tacit [personal know-how].

In practice, knowledge management often encompasses identifying and mapping intellectual assets within the organization, generating new knowledge for competitive advantage within the organization, making vast amounts of corporate information accessible, sharing of best practices, and technology that enables all of the above — including groupware and intranets.

Knowledge management has direct connections with several well-known management strategies, practices, and business issues, including:

- Change management
- Best practices
- Risk management
- Benchmarking

According to several sources knowledge management can be seen as a natural extension of "business process reengineering,". The need to manage knowledge seems obvious, and discussions of intellectual capital have proliferated, but few businesses have acted on that understanding. Where companies have take action (actually the number is growing) implementations of KM may range from technology-driven methods of accessing, controlling, and delivering information to massive efforts to change corporate culture. Opinions about the paths, methods, and even objectives of knowledge management abound. Some efforts focus on enhancing creativity (creating new knowledge value) while other programs emphasize leveraging existing knowledge.

In traditional perceptions of the role of knowledge in business organizations, tacit knowledge is often viewed as the real key to getting things done and creating new value. Not explicit knowledge. Thus we often encounter an emphasis on the "learning organization" and other approaches that stress internalization of information (through experience and action) and generation of new knowledge through managed interaction.

A.3 Knowledge management: a cross-disciplinary domain

Knowledge management draws from a wide range of disciplines and technologies. In this section we try to point out the most relevant one and certainly the list is not inclusive.

Cognitive science. Insights from how we learn and know will certainly improve tools and techniques for gathering and transferring knowledge.

Expert systems, artificial intelligence and knowledge base management systems (KBMS). AI and related technologies have acquired an undeserved reputation of having failed to meet their own (and also marketplace's) high expectations. In fact, these technologies continue to be applied widely, and the lessons practitioners have learned are directly applicable to knowledge management.

Computer-supported collaborative work (groupware). In Europe, knowledge management is almost synonymous with groupware ... and therefore with Lotus Notes. Sharing and collaboration are clearly vital to organizational knowledge management (with or without supporting technology). This is in any case just a point of view.

Library and information science. We take it for granted that card catalogs in libraries will help us find the right book when we need it. The body of research and practice in classification and knowledge organization that makes libraries work will be even more vital as we are inundated by information in business. Tools for thesaurus construction and controlled vocabularies are already helping us manage knowledge.

Technical writing. Under-appreciated as a professional activity, technical writing (often referred to by its practitioners as technical

communication) forms a body of theory and practice that is directly relevant to effective representation and transfer of knowledge.

Document management. Originally concerned primarily with managing the accessibility of images, document management has moved on to making content accessible and re-usable at the component level. Early recognition of the need to associate "metainformation" with each document object prefigures document management technology's growing role in knowledge management activities.

Decision support systems. According to Daniel J. Power, " DSS have brought together insights from the fields of cognitive sciences, management sciences, computer sciences, operations research, and systems engineering in order to produce both computerised artifacts for helping knowledge workers in their performance of cognitive tasks, and to integrate such artifacts within the decision-making processes of modern organisations." In practice the emphasis has been on quantitative analysis rather than qualitative analysis, and on tools for managers rather than everyone in the organization.

Semantic networks. Semantic networks are formed from ideas and typed relationships among them (sort of "hypertext without the content," but with far more systematic structure according to meaning). Often applied in such arcane tasks as textual analysis, semantic nets are now in use in mainstream professional applications, including medicine, to represent domain knowledge in an explicit way that can be shared.

Relational and object databases. Although relational databases are currently used primarily as tools for managing "structured" data (and object-oriented databases are considered more appropriate for "unstructured" content) we have only begun to apply the models on which they are founded to representing and managing knowledge resources.

Simulation. According to Karl-Erik Sveiby (a well known KM Expert) "simulation" is a component technology of knowledge management, referring to "computer simulations, manual simulations as well as role plays and micro arenas for testing out skills."¹¹

¹¹ Sveiby, Karl-Erik, "What is knowledge management"

Organizational science. The science of managing organizations increasingly deals with the need to manage knowledge (often explicitly). It's not a surprise that the American Management Association's APQC has sponsored major knowledge management events.

As already stated this is only a partial list. Other technologies include:

- object-oriented information modelling;
- electronic publishing technology,
- hypertext, and the World Wide Web;
- help-desk technology;
- full-text search and retrieval;
- performance support systems.

The term "knowledge management" is now in widespread use. Karl-Erik Sveiby¹² identified two "tracks" of knowledge management:

- **Management of Information.** To researchers in this track, according to Sveiby, "... knowledge = Objects that can be identified and handled in information systems."
- **Management of People.** For researchers and practitioners in this field, knowledge consists of "... processes, a complex set of dynamic skills, know-how, etc., that is constantly changing."

Sveiby's characterization is certainly relevant even if less complete than the one given by Knowledge Praxis, nominally:

A.3.1 Mechanistic approaches to knowledge management

Mechanistic approaches to knowledge management are characterized by the application of technology and resources to do more of the same better. The main assumptions of the mechanistic approach include:

- Better accessibility to information is a key, including enhanced methods of access and reuse of documents (hypertext linking, databases, full-text search, etc.)
- Networking technology in general (especially intranets), and groupware in particular, will be key solutions.
- In general, technology and sheer volume of information will make it work.

¹² Sveiby, Karl-Erik, "What is knowledge management"

A.3.2 Cultural/behaviouristic approaches to knowledge management

Cultural/behaviouristic approaches, with substantial roots in process re-engineering and change management, tend to view the "knowledge problem" as a management issue. Technology (though ultimately essential for managing explicit knowledge resources) is not the solution. These approaches tend to focus more on innovation and creativity (the "learning organization") than on leveraging existing explicit resources or making working knowledge explicit. Assumptions of cultural/behaviouristic approaches often include:

- Organizational behaviours and culture need to be changed ... dramatically. In our information-intensive environments, organizations become dysfunctional relative to business objectives.
- Organizational behaviours and culture can be changed, but traditional technology and methods of attempting to solve the "knowledge problem" have reached their limits of effectiveness. A "holistic" view is required. Theories of behaviour of large-scale systems are often invoked.
- It's the processes that matter, not the technology.
- Nothing happens or changes unless a manager makes it happen.

A.3.3 Systematic approaches to knowledge management

Systematic approaches to knowledge management retain the traditional faith in rational analysis of the knowledge problem: the problem can be solved, but new thinking of many kinds is required. Some basic assumptions:

- It's sustainable results that matter, not the processes or technology ... or your definition of "knowledge."
- A resource cannot be managed unless it is modeled, and many aspects of the organization's knowledge can be modeled as an explicit resource.
- Solutions can be found in a variety of disciplines and technologies, and traditional methods of analysis can be used to re-examine the nature of knowledge work and to solve the knowledge problem.
- Cultural issues are important, but they too must be evaluated systematically. Employees may or may not have to be "changed," but policies and work practices must certainly be changed, and technology can be applied successfully to business knowledge problems themselves.

- Knowledge management has an important management component, but it is not an activity or discipline that belongs exclusively to managers.

A.4 Basic principles & Main issues

In general, managing knowledge has been perceived as an unmanageable kind of problem that was intractable with traditional management methods and technology.

There is a tendency to treat the activities of knowledge work as necessary, but ill-defined. It is often perceived that explicit manifestations of knowledge work are forms of publishing and by-products of "real" work.

As a result, the metrics associated with knowledge resources (and our ability to manage those resources in meaningful ways) have not become part of business infrastructure.

We do know a lot about how people learn and how organizations develop and use knowledge. The body of literature about managing intellectual capital is growing. We have new insights and solutions from a variety of domains and disciplines that can be applied to making knowledge work manageable and measurable. Computer technology (even if it's also a cause of the problem) can provide new tools to make it all work too.

A.4.1 What benefits can organisations and institutions expect from KM?

Some benefits of KM correlate directly to bottom-line savings, while others are more difficult to quantify. In today's information-driven economy, organisations and institutions uncover the most opportunities — and ultimately derive the most value — from intellectual rather than physical assets. To get the most value from a company's intellectual assets, KM practitioners maintain that knowledge must be shared and serve as the foundation for collaboration. Yet better collaboration is not an end in itself; without an overarching business context, KM is meaningless at best and harmful at worst. Consequently, an effective KM program should help a complex organization do one or more of the following:

- Foster innovation by encouraging the free flow of ideas
- Improve customer and users service by streamlining response time
- Boost revenues by getting products and services to market faster

- Recognizing the value of organization members' knowledge and rewarding them for it
- Streamline operations and increase efficiency by eliminating redundant or unnecessary processes
- Increase the efficiency and effectiveness of learning and training processes within the organization

These are the most prevalent examples. A creative approach to KM can result in improved efficiency, higher productivity and increased revenues in practically any business function.

A.4.2 *What are the challenges of KM?*

The major problems that occur in KM usually result because organizations ignore the people and cultural issues. In an environment where an individual's knowledge is valued and rewarded, establishing a culture that recognizes tacit knowledge and encourages members to share it is critical. For instance, within a company the need to sell the KM concept to employees shouldn't be underestimated; after all, in many cases employees are being asked to surrender their knowledge and experience (the very traits that make them valuable as individuals).

One way companies motivate employees to participate in KM is by creating an incentive program. However, then there's the danger that employees will participate solely to earn incentives, without regard to the quality or relevance of the information they contribute. The best KM efforts are as transparent to employees' workflow as possible. Ideally, participation in KM should be its own reward. If KM doesn't make life easier for employees, it will fail.

KM is not a technology-based concept. Don't be duped by software vendors touting their all-inclusive KM solutions. Organisations and institutions that implement a centralized database system, electronic message board, Web portal or any other collaborative tool in the hope that they've established a KM program are wasting both their time and money.

A KM program should not be divorced from a business goal. While sharing best practices is a commendable idea, there must be an underlying business reason to do so. Without a solid business case, KM is a futile exercise.

As with many physical assets, the value of knowledge can erode over time. Since knowledge can get stale fast, the content in a KM program should be constantly updated, amended and deleted. What's more, the relevance of knowledge at any given time changes, as do the skills of employees. Therefore, there is no endpoint to a KM program. Like

product development, marketing and R&D, KM is a constantly evolving business practice.

Organisations and institutions diligently need to be on the lookout for information overload. Quantity rarely equals quality, and KM is no exception. Indeed, the point of a KM program is to identify and disseminate knowledge gems from a sea of information.

A.5 Basic technologies

KM tools run the gamut from standard, off-the-shelf e-mail packages to sophisticated collaboration tools designed specifically to support community building and identity. Generally, tools fall into one or more of the following categories:

- knowledge repositories,
- expertise access tools,
- e-learning applications,
- discussion and chat technologies,
- synchronous interaction tools,
- search and data mining tools.

Annex B Categories of knowledge resources

Two main categories of knowledge resources can be identified: on the one hand the 'material' resources of knowledge, on the other hand the 'immaterial' ones.

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B.1 Material' Resources of Knowledge

In this category the most traditional resources can be listed:

- Digital resources:
 - Resources Descriptors (e.g. .xml, .rdf),
 - Planning & Design (e.g. .mpp)
 - Text & Hypertext (e.g. .txt, .doc, .rtf, .pdf, .sxw, .odt, .tex, .htm, .chm, .cfm),
 - Spreadsheets (e.g. .xls, .ods, .sxc, .dif, .csv, .sdc),
 - Images & Graphics (e.g. .tiff, .jpg, .png, .gif, .ai, .eps, .psd, .bmp, .raw, .xcf, .ico, .ps, .tga, .wmf, .wrl, .3ds, .w3d),
 - Presentations (e.g. .ppt, .pps, .odp, .sxi, .sda),
 - Audio & Movies & Animations (e.g. .wav, .aif, .ram, .mpeg, .avi, .mov, .qt, .rm, .dcr, .dir, .osx, .swf, .fla),
 - DTP (e.g. .qxd),
 - OCR (e.g.),
 - Data Base (e.g. .mdb, .dbf),
 - Scripting (e.g. .asp, .jsp, .cgi)
 - Executable Programs & Libraries & Source Codes (e.g. .exe, .com, .dll, .c, .h, .java)
 - e-learning courses (e.g. .xpf).
- Other Resources:
 - References (e.g. libraries, publications).
 - Sources & Repositories (e.g. P2P networks & P2P tools – such as BitTorrent, Kazaa, Gnutella, Edutella, Lionshare, AllPeers¹³

Zippping formats (e.g. .zip, .rar, .cab, .sqx, .Z, .gz, .7z, .tar) have not been considered on purpose since the compression tools do not alter the properties of the processed resources.

¹³ Next-to-come new Firefox extension, as reported by ZDNet Asia (<http://www.zdnetasia.com/news/software/0,39044164,39302503,00.htm>) and announced by AllPeers official website (http://www.allpeers.com/more_f.htm)

B.2 'Immaterial' Resources of Knowledge

Within this category all 'qualitative' resources can be grouped:

- Human resources (e.g. personal skills i.e. acquired competencies, personal abilities i.e. natural capabilities, personal 'operative' / on-the-field experience),
 - Human Area Network (HAN) resources (i.e. "Human Area Networks connect mobile terminals and devices within the human movement"¹⁴; e.g. RedTacton¹⁵),
- Environmental resources (e.g. organization know-how, training and lifelong learning 'governmental' policies at European / National / local level),

B.2.1 Further insight

In this section some considerations on the human resources are provided in order to better focus on the 'added value' related to their unexpressed potentialities in terms of effective '(re)sources' of knowledge.

People as knowledge resources

Most traditional Knowledge Management Systems reflect the classic, "document-centered" approach for managing knowledge. Such classic approaches have some advantages, such as providing users with a powerful means to access and manipulate a huge amount of "formalized & formalizable" knowledge of the domain. However, 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, i.e. *tacit knowledge*;
2. the knowledge delivered is static, and frequently represented in a form difficult to apply, is often obsolete, incomplete and is also disconnected from its context of use;
3. the mode of delivery does not take into account the specificity of each user such as current activity, existing competencies, and working style.

These limitations are particularly frustrating in the context of modern professional fields, which need to be flexible and adaptable and for which a large amount of knowledge (experiences, social knowledge, or

¹⁴ From NTT's RedTacton website (<http://www.redtacton.com/en/info/index.html#a04>)

¹⁵ (*ibid.*) "RedTacton is a new Human Area Networking technology that uses the surface of the human body as a safe, high speed network transmission path." (<http://www.redtacton.com/en/info/index.html#a01>)

know-how) is not formalized in repositories but is present in people's heads.

Tacit knowledge management

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. The design of KMS needs to consider at least two other components

1. **The users**, with their targets, intentions, attitudes (towards competency development, towards using a CMS, etc.), motivation, etc., and
2. **The Social Network**, which provides the context in which competency development takes place.

The social network encompasses many different types of relationships users have (and develop) with individuals in their professional context (typically an organization, or a community) as well as in their broader social context.

A new model

KMS has to rely on a new vision that requires a fundamental shift from current content-oriented e-learning solutions towards a more user-centered, interactive and collaborative model of learning. In the new model, the learner is no longer considered as a simple passive recipient of data and information, but is seen as a participant that is actively engaged through a rich set of interactions (e.g. learning by doing, educational games, simulation environments, problem-based learning, learning by discussing, knowledge discovery, etc). This set of processes plays an important role not only for the delivery of the knowledge, but also in the knowledge selection process, the stimulation of the learner, the construction and the internalization of this knowledge, the validation of this knowledge, its situating in a social context, and its application in real world situations.

Annex C State-of-art on knowledge resources management and sharing

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C.1 Introduction

In the present section we will examine in more detail what is presently available in terms of technology, tools, products

A table of classified products is also presented. What surprises to most is that in less than 5 years the majority of reported links have become obsolete or totally unavailable, despite they refer to products and companies still on the market. This is a clear evidence of the fast evolution of the market. It is also quite evident that the technology underlying these products has also evolved fast enough to cause the quick obsolescence of the provided solution and in certain case also the failure of the producing company.

C.2 Survey

Category	Reference
Knowledge Management	E@SY InfoMap by Aw Kong Koy Insights Knowledge Server Knowledgebuilder by Servicesoft Technologies Knowledger by Knowledge Associates International Knowledge XchangeTM Knowledge Management System Scintilla by CyberMarché Sentient System for Engineering SolutionBuilder and SolutionPublisher by Primus Wincite Intelligence Software
Groupware	Axista.com - Collaborative Software Products GroupSystems by Ventana Corporation K.net by Milagro Systems
HyperText/Media Access/Development	Emissary Fulcrum Knowledge Network Internet Explorer KnowledgeX Netscape Navigator Web Conferencing Software Webinator from Thunderstone http://www.adobe.com/ Claris HomePage Microsoft FrontPage
Problem Resolution	Ask.Me Pro from KnowledgeBroker, Inc. Assistum Visual Designer by Higher Level Systems Case Advisor, Case-Based Reasoning Group, Simon Fraser University, Burnaby, BC Ernie from Ernst & Young Help!CPR by The Haley Enterprise Network Based Information Brokering, a Project at Knowledge Systems Lab, Stanford University SolutionBuilder and SolutionPublisher,

	Primus Communications, Seattle, WA. Top of Mind, Molloy Group
Information Management	InfoCentral by Corel VisiMap by CoCo Systems
Document Management/Information Retrieval	Folio Views, Folio Corporation Intraspect Know It All MeltingPoint NetAnswer Open Text Corp Search '97, Verity, Inc. SearchServer , Fulcrum Technologies, Inc.
Problem Tracking/Management	Action Request System from Remedy CA-Paradigm by Computer Associates Clarify Clientele Software SupportMagic by Magic Solutions

In the remainder of this section are presented some specific products in more detail. We have reported the general product description and some other data aiming to provide a rational basis for evaluation.

C.2.1 Protégé¹⁶

Protégé is a free, open-source platform that provides a growing user community with a suite of tools to construct domain models and knowledge-based applications with ontologies. At its core, Protégé implements a rich set of knowledge-modeling structures and actions that support the creation, visualization, and manipulation of ontologies in various representation formats. Protégé can be customized to provide domain-friendly support for creating knowledge models and entering data. Further, Protégé can be extended by way of a plug-in architecture and a Java-based Application Programming Interface (API) for building knowledge-based tools and applications.

An ontology describes the concepts and relationships that are important in a particular domain, providing a vocabulary for that domain as well as a computerized specification of the meaning of terms used in the vocabulary. Ontologies range from taxonomies and

¹⁶ All the information here reported is taken from the Protégé official website (<http://protege.stanford.edu/>). "Protégé is a national resource for biomedical ontologies and knowledge bases supported by the National Library of Medicine. Protégé is a core component of The National Center for Biomedical Ontology. Copyright © 2005 Stanford Medical Informatics" (*ibid.*)

classifications, database schemas, to fully axiomatized theories. In recent years, ontologies have been adopted in many business and scientific communities as a way to share, reuse and process domain knowledge. Ontologies are now central to many applications such as scientific knowledge portals, information management and integration systems, electronic commerce, and semantic web services.

The Protégé platform supports two main ways of modelling ontologies:

- The **Protégé-Frames** editor enables users to build and populate ontologies that are *frame-based*, in accordance with the Open Knowledge Base Connectivity protocol (OKBC). In this model, an ontology consists of a set of classes organized in a subsumption hierarchy to represent a domain's salient concepts, a set of slots associated to classes to describe their properties and relationships, and a set of instances of those classes - individual exemplars of the concepts that hold specific values for their properties.
- The **Protégé-OWL** editor enables users to build ontologies for the *Semantic Web*, in particular in the W3C's Web Ontology Language (OWL). "An OWL ontology may include descriptions of classes, properties and their instances. Given such an ontology, the OWL formal semantics specifies how to derive its logical consequences, i.e. facts not literally present in the ontology, but entailed by the semantics. These entailments may be based on a single document or multiple distributed documents that have been combined using defined OWL mechanisms" (see the OWL Web Ontology Language Guide).

Further information on this product can be found in the Appendices.

C.2.2 *PathMaker*¹⁷

PathMaker 6.0 is the most powerful suite of collaborative tools for problem-solving, continuous improvement, Six Sigma¹⁸, planning and project execution. It is a new breed of software, which automates and supports team processes, decision making, and rapid action. It provides software support for the logical and creative thinking,

¹⁷ All the information here reported is taken from the PathMaker official website (<http://www.skymark.com/pathmaker/pathhome.asp>).

¹⁸ "[...] It's a very specific measure, and it's a new way of managing. PathMaker helps you translate it from a new idea, to an actual working system, in your organization, without a huge investment. Six Sigma gets its name from a fairly arcane statistical measure -- how wide a process is vs. its specification limits. The point is that making parts that are out of spec is expensive for everyone, so we want to reduce variation until the actual variation in the process is much less than the variation that is allowed by the specification." [...] from <http://www.skymark.com/pathmaker/uses/sixsigma.asp>

consensual decision-making, planning, data analysis, organization and virtual collaboration - all the essential activities of the manager, the knowledge worker, and the leader. The tool suite consists of:

- Virtual Collaboration
 - support for projects and teams
 - use any of the tools together
 - meet, discuss, and analyze together
 - solve problems together
- Project Management
 - project pathways
 - modifiable templates
 - progress tracking
 - reporting, storyboards
- Meeting Support
 - agendas
 - minutes
 - decision/action item logs
- Local Thinking
 - flowchart
 - cause & effect diagram
 - FMEA
 - Forms for process analysis
- Decision-Making
 - consensus builder
 - force field analysis
 - multi-voting
 - weighted criteria rating
- Data Analysis
 - Pareto chart
 - 7 control charts
 - pie, radar and bar charts
 - run chart
 - scatter plot
 - histogram and normal plot
 - process capability indices
 - bubble chart
- Creative Thinking
 - brainstorm
 - affinity diagram
- Just-in-Time learning
 - 32 computer slide shows on
 - essential management tools

Technical Specifications:

PathMaker® 6.0 is 32-bit software for use with Windows® XP, ME, 2000, NT®, 98 or 95. We recommend that users' systems have 20MB of available RAM, a 100MHz processor minimum, and 40MB of hard disk storage. PathMaker® 6.0 includes Help Cards and a full context-sensitive help file. The software is easy to learn for people who are familiar with other Windows software. Each project you are involved in has its own file. Within the project file, you create a pathway, which grows to include all the steps you take as you work through the project. Details of installation and systems administration are available in a Systems Administrator's Guide on <http://www.skymark.com>.

C.2.3 *MindManager*

MindManager by MindJet is computer software for using the Mind Mapping method of Tony Buzan. MindManager lets one outline information by organizing it in a tree structure, with branches growing out from a root. The resulting diagram can be enhanced graphically by adding pictures, fonts, colours, and so on, as recommended by the principles of Mind Mapping. Recommended uses include preparing speeches and presentations, planning, tracking and communicating complex projects, creating websites and site maps, effective note taking. The intent is to bring together the logical left brain and the visual/creative right brain to improve memory and productivity. Updates are possible from VisiMap and Activity Map. An overview describes the MindManager Open Interface which can be accessed through the internal scripting language MMScript, and also Visual Basic, Visual C++ and ATL, or any other language that supports Automation programming such as Java, Delphi, Perl, etc.. eMindMaps is a lighter version specifically for creating mind maps. Users have contributed several dozen examples, and there is a MindManager Users Group at www.egroups.com/list/mindmanager. Current version is 6.0. There is a list of books, including The Mind Map Book - How to Use Radiant Thinking to Maximize Your Brain's Untapped Potential by Tony Buzan, Barry Buzan (Contributor), and also Mindmapping - Your Personal Guide to Exploring Creativity and Problem-Solving by Joyce Wycoff. Mind mapping is also taught to university students as concept mapping. [http://www.mindjet.com/eu/, , 12/99, Andrius Kulikauskas. Rytis Umbrasas]

C.2.4 *TheBrain*

The Brain by TheBrain Technologies Corp is a system for creating and visualizing relations between items, called thoughts. Thoughts can be

linked to files, web pages, and notes. A user of The Brain connects one thought to another in one of three ways: as a parent, child, or jump. Parent-child relationships can be used to create a hierarchy or grouping of ideas, while

Jump relationships represent exclusive relationships between items. When one selects a thought, it moves to the center of the screen, with its parent thoughts shown above, its child thoughts below, and its jump thoughts to the left. Siblings (thoughts that share a parent) are shown to the right. The visual effect of selecting items is like wandering through ideas. TheBrain Technologies Corp has implemented many progressive ideas, such as enabling The Brain to organize files, allowing the import of file systems from Windows, and encouraging users to publish their Brains on the Web. A software development kit is available, as well as a solution center. Upcoming developments include a collaborative Brain, and a version for Java environments. [<http://www.thebrain.com>, Andrius Kulikauskas, Harlan Hugh, 5/99.]

C.2.5 *WisdomWare*

WisdomWare Sales Coaching is an interactive software application that gives salespeople the information they need to make more effective sales calls. Plug it into any existing sales automation software, and it will provide answers to specific questions on your products and services, customer needs and the competition. It also offers sales advice, describes best sales practices and reminds your salespeople of the value propositions or other special messages you want them to be delivering consistently. Sales Coaching includes an easy-to-use tool for capturing and sharing best sales practices so that marketing staff can more effectively develop product positioning and messages. WisdomWare has created a general-purpose knowledge model designed specifically for interactive coaching. The software is structured as a three-level pyramid, with each level providing users with answers to increasingly difficult types of questions.

- The bottom level offers Information: It includes data, descriptions and facts that answer the question, "What is it?"
- The middle level provides Insight: It includes ramifications, value judgments, opinions, conclusions and links to other related information, answering the question "What does it mean?"
- The top level offers Wisdom: It includes recommendations and advice that answer the question, "What should I do?"

WisdomWare's patented approach to knowledge management, called Relational Knowledge Object Management (RKOM), creates a multi-dimensional view of your best sales and marketing knowledge.

Through its powerful coaching interface, WisdomWare lets salespeople instantly access the answers they need in a way that is natural for them. If more detailed information is necessary, it links salespeople to the best “large objects” available (such as external Web sites), no matter where they are located. The software’s unique knowledge-navigation approach rapidly delivers just the right knowledge in small, rich bites that facilitate both learning and retention. Because knowledge is in the mind of the beholder and, in most cases, is fuzzy rather than precise, a good coaching system must also help people equate knowledge with answers to the specific questions they have. And the more pressing the question or need, the more valuable that knowledge must be. Furthermore, because the mind processes knowledge in small pieces, WisdomWare links information together in a relational fashion. To fully leverage enterprise knowledge assets, WisdomWare employs a “closedloop” approach that includes a complete knowledge-sharing workflow process of creation, deployment and refinement.

C.2.6 *MultiCentrix*

Multicentrix by Aw Kong Koy is a multicentric information mapping system, previously known as InfoMap. Multicentrix allows objects to be related in both hierarchies and networks. Also, each link in the network can itself be an object. Multicentrix has tools for editing the objects, hierarchies, networks, interfaces, links. It allows for the import of hierarchies and associations.

The Multicentric Information Model provides a multi-dimensional framework for storing and managing complex information. Everything in the information network is visible. Users can browse and navigate the information base, expand from a single topic to lists of related topics and the lists can be expanded progressively. Conversely, the list can be grouped, filtered and consolidated. These are the foundations of information management, beyond full text search, that enable users to gain insights and deep understanding from the diverse information available.

Multicentric Technology developed Schema-Forms, an electronic form program based on the W3C XML Schema Recommendation to address this issue. Schema-Forms enable structured information to be captured and managed in MultiCentrix.

MultiCentrix provides a powerful, versatile, easy-to-use Windows-based environment for capturing, viewing, organizing, and managing networks of concepts, documents, and images.

In addition, MultiCentrix provides the following publishing capabilities:

1. The MultiCentrix database can be published as interlinked HTML pages, in PDF format, or in the Microsoft Compiled HTML format.
2. The MultiCentrix Web Publisher allows large MultiCentrix information networks to be served dynamically on the web.

Aw Kong Koy describes Multicentrix/Infomap in his paper Computer Aided Thinking. kkaw@multicentric.com
[\[http://www.multicentric.com\]](http://www.multicentric.com), Andrius Kulikauskas, 12/99, Zigmās Bigelis]

C.2.7 Wincite

Wincite LAN and eWincite main feature can be summarised as follows¹⁹:

- **Intuitive Navigation Tools and Features for Business Users**
Targeted at users who can use the system without any formal training beyond the skills of using a Web browser. Access to most features is based on clicking on buttons or list of options. Efficiency of navigation. The "Home Page" interface feature provides users access to specific segments of the database that relate to their areas of interests and responsibilities. An application can have any number of Home Pages, each tailored to the unique needs of a user group or individual. The "click and view" buttons in a screen trigger the display of internal files and Web pages in a browser window that is embedded in the screen. Users can view Web pages, Microsoft Office files, charts, images, documents, maps, and PDF files without leaving a Wincite screen. The Wincite screens have a number of navigation controls that support ease of access to related information sources and the option to drilldown to detailed supporting documents and files.
- **Integration of a Database with Web Intranet Services**
- **Populating and Managing Updates** With text, hyperlinks, and objects you can "drag and drop" or "copy and paste" items into Wincite fields or on to buttons. Live links to Web sites provide a means of automatically showing current information. Each field in a Wincite screen has an audit card identifying who updated the field, when, information sources, and priorities.
- **Reporting**
- **Search Features** Wincite is frequently integrated with a company's internal search tools such as Microsoft's Index Server or Site Server. The results of the search are displayed in Wincite as a list of hits ordered by the degree they match the user's criteria. The hit list has a brief summary of each selected document or file and the full content of a document or file can be viewed. Integration of a

¹⁹ <http://www.wincite.com/>

number of Web search engines to a screen lets the user click a button and display the different list of hits based a common criteria. Searches can be saved and linked to "click and view" buttons. The results of database queries to internal databases can be displayed in Wincite screens. You can incorporate subject names or the content of fields as parameters in the database queries.

- **Development Platform Supported by Business Analysts.**
- **Collaboration** Tables embedded in the screens can form the basis of an interactive dialog between individuals in different locations such as FAQ from the field sales personnel and responses from corporate staff analysts Buttons on screens can initiate email messages to specialists by specific areas of interest Using the Wincite Painter, customized forms can be developed and used to capture and update information from intranet users throughout a dispersed organization. Each field in Wincite has the option to display a pop-up dialog box for users to view and add "Notes".
- **Security Features**

Annex D Relevant existing initiatives concerning knowledge resources management and sharing

In the following sections some information is provided about low- and high-level initiatives and technologies that could be considered as the background we should consider for the realization of the knowledge resources management and sharing subsystem in the TENCompetence framework.

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D.1 Connected communities through peer-to-peer networks

For millions of individual consumers and thousands of global enterprises, using computing networks as a platform for communicating, collaborating, and sharing is as routine as using telephones and the post office. Individuals use instant messaging and e-mail to stay in touch and conduct business, work remotely via corporate intranets and web portals, and use web-based services for work and play. Networks and the myriad of devices used to access them — PCs, laptops, PDAs, even cell phones — are now integral to the fabric of business and society.

Two fundamental truths of networks are their dynamic nature and the rapid expansion of information and resources available through them, both on publicly accessible Web sites and private corporate intranets. The peer-to-peer (P2P) model offers many benefits for dealing with this unchecked growth in the number of connected users and devices, content, bandwidth, applications, and computing power. True peer-to-peer computing makes it easier and more intuitive for users to find and share resources, while providing more direct channels of communication to devices at the edge of the network. The existence of multiple peers make P2P applications inherently highly available, as they are not dependent on a single central server. Should any one peer fail, remaining peers can continue to answer requests and provide uninterrupted services to users. Today, innovative P2P applications and services are enabling interactive communication with almost any device on the expanded Internet; helping to deliver the right information and services anywhere on the network; and providing better access to network resources while maintaining uncompromised security.

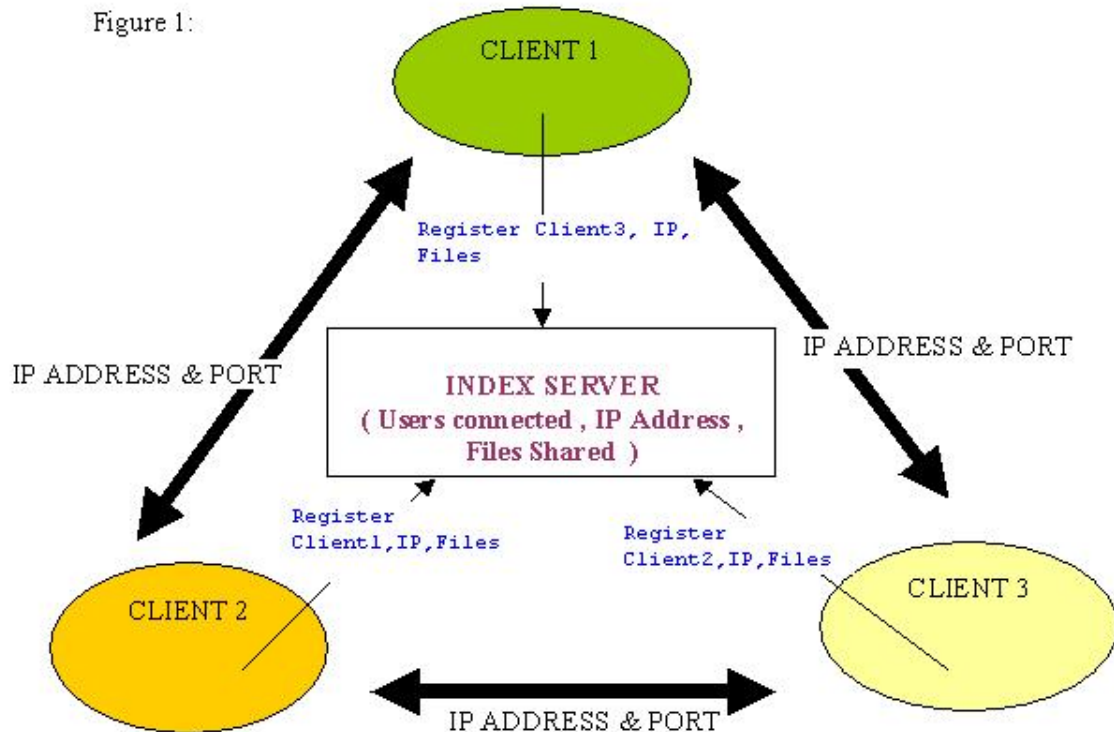
D.1.1 Generic P2P architecture

The figure below gives a general idea of how P2P works (more information at <http://www.csharphelp.com/archives/archive261.html>). Although there are many other kinds where index server or central servers are not required, or can be eliminated so client talk directly to other clients.

The P2P concept generally consists of a central Index server. This server does not contain any files, physically. It only maintains the information about the users who are logged on to the network, the IP address of the client and the list of files shared at any given moment

by a user. The client and the server communicate with each other over a socket connection using simple commands.

Figure 1:



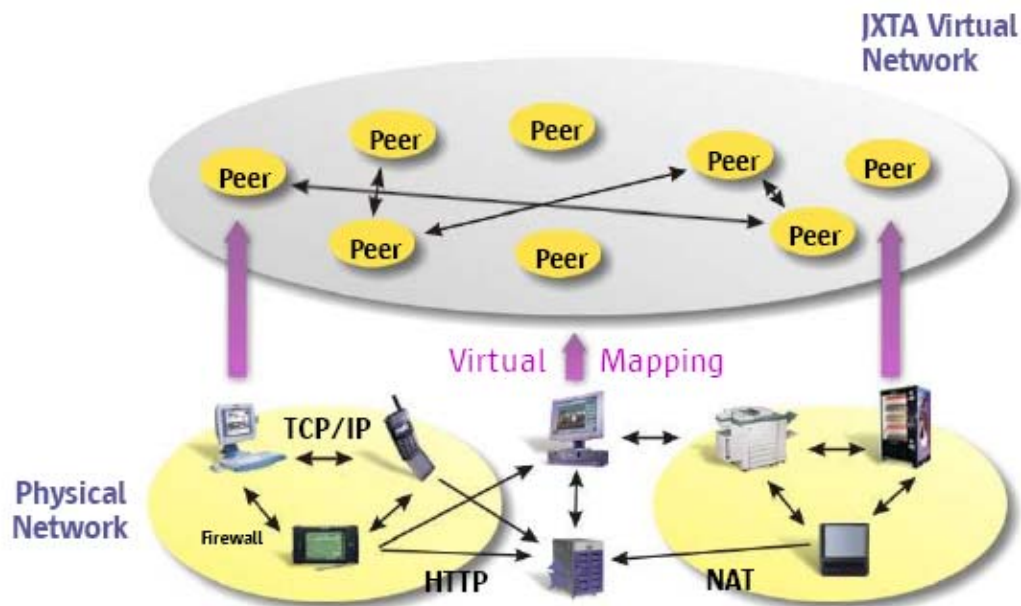
When a client "A" wants to search for files shared by other clients on the P2P network:

- The Client "A" logs into the index server with a user id and the folder information that the client is willing to share.
- The Client "A" registers all the files with the server so that other clients can search for these files.
- The Client "A" makes a request to the index server to search files matching a given input pattern.
- The index server searches files names in its repository and returns to the Client "A":
 - The user sharing the file eg Client "B"
 - IP address of the user
 - Files names that it found.
- Once the Client "A" selects the download option, Client "A" makes a socket connection to the Client "B" using the IP address returned by search.

- If a successful connection is established, "A" informs the other client to begin sending the file.
- Once the download is complete, "A" registers this file with the index server as your copy of the shared file.

D.1.2 JXTA

The JXTA technology (<http://www.jxta.org/docs/JXTA-Exec-Brief.pdf>) is a set of simple, open peer-to-peer protocols that enable any device on the network to communicate, collaborate, and share resources. JXTA peers create a virtual, ad hoc network on top of existing networks, hiding their underlying complexity, as represented in the figure below. In the JXTA virtual network, any peer can interact with other peers, regardless of location, type of device, or operating environment — even when some peers and resources are located behind firewalls or are on different network transports. Thus, access to the resources of the network is not limited by platform incompatibilities or the constraints of a hierarchical client-server architecture.



JXTA technology espouses the core technology objectives of ubiquity, platform independence, interoperability, and security. JXTA technology runs on any device, including cell phones, PDAs, two-way pagers, electronic sensors, desktop computers, and servers. Based on proven technologies and standards such as HTTP, TCP/IP and XML, JXTA

technology is not dependent on any particular programming language, networking platform, or system platform and can work with any combination of these.

D.1.3 Gnutella Architecture

Gnutella is a file sharing network used primarily to exchange music, films and software. It is a true peer-to-peer network; it operates without a central server. Files are exchanged directly between users. Users place the files they want to share on their hard disks and make them available to everyone else for downloading in peer-to-peer fashion. Gnutella client programs connect to the network and share files. Search queries are passed from one node to another in round-robin fashion. Gnutella clients are available for a number of platforms. Though Gnutella is conceptually quite similar to the old Napster, two big differences can be identified:

- There is no central database that knows all of the files available on the Gnutella network. Instead, all of the machines on the network tell each other about available files using a distributed query approach.
- There are many different client applications available to access the Gnutella network.

To envision how Gnutella works, imagine a large circle of users (called nodes), who each have Gnutella client software. The client software on the initial use must bootstrap and find at least one of those other nodes. Different methods have been used for this, including a pre-existing list of possibly working node addresses shipped with the software, using Gwebcache sites on the web to find nodes, as well as using IRC to find nodes. Chances are at least one node (call it B) will work. Once it has connected, node B will send node A its own list of working nodes. Node A will try to connect to the nodes it was shipped with, as well as nodes it receives from other nodes, until it reaches a certain quota, usually user-specifiable. It will only connect to that many nodes, but it keeps the nodes it has not yet tried. (It discards ones that it tries but did not work.)

Now, when user A wants to do a search, it sends the request to each node it is actively connected to. It is possible that some of them will no longer work, in which case user A tries to connect to the nodes it has saved as backups. The number of actively connected nodes for user A is usually quite small (around 5), so each node then forwards the request to all the nodes it is connected to, and they in turn forward the request, and so on. In theory, the request will eventually find its way to every user on the Gnutella network. As the size of the Gnutella

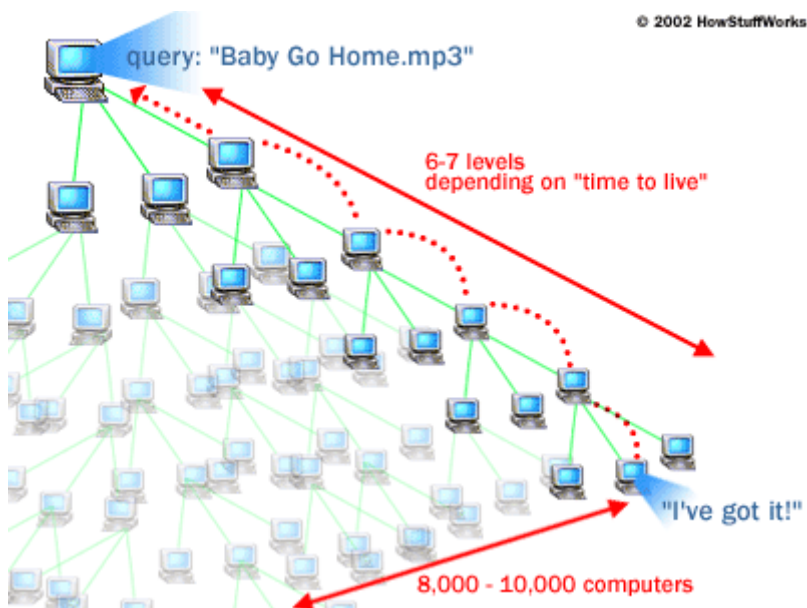
network has grown and its developers have fought excess traffic consumption, global searchability of the network has diminished.

If a search request turns up a result, the node that had the result contacts the searcher either directly or indirectly. If the node that sent the search request is not firewalled, the node with the result directly returns the result. If the node that sent the search request is firewalled (many are), then the result is (indirectly) routed back along the route the search was received on. After the result is returned, they negotiate the file transfer and the transfer proceeds. If more than one copy of the same file is found, the searcher can perform a "swarm" download - download pieces of the file from different nodes a la BitTorrent. This results in increased download rates.

Finally, when user A disconnects, the client software saves the list of nodes that it was actively connected to, and that it was keeping as a backup, for use next time it connects.

In practice, searching on the Gnutella network is often unreliable. Each node is a regular computer user; as such, they are constantly connecting and disconnecting, so the network is never completely stable. Since individual users' bandwidth are likely to be limited, some search requests may be dropped before they reach the whole network. As a result most queries will never reach more than 50% of the network.

The real benefit of having Gnutella so decentralized is to make it very difficult to shut the network down. Unlike Napster, where the entire network relied on the central server, Gnutella cannot be shut down by shutting down any one node. As long as there are at least two users, Gnutella will continue to exist.



D.2 EduSource Communication Layer (ECL)

EduSource is a broad network as it aims at the wide spectrum of services it wants to support. One of the major goals of eduSource is to create an open network for users, organizations and service providers. EduSource identified three major pieces to support openness of the network: i) ready to use tools, repositories, and services, ii) clearly defined protocol, and iii) connecting middleware for existing systems. Another important requirement for eduSource to become an open network is that it has to build its protocol on existing standards and recommendations.

EduSource defines its eduSource Communication Layer (ECL) as an implementation of the IMS DRI specification. However, IMS DRI recommendation is not specific enough for direct implementation and the current penetration of recommended technologies is not as widespread as assumed in the IMS DRI specification. Main features are:

- eduSource is a heterogeneous network consisting of existing and future institution repositories, peer-to-peer network, individual small repositories, and application interfaces.
- ECL will be evolving over time of the project which makes all the parallel activities vulnerable to changes in the protocol.
- ECL supports many new services non-existing in the current systems. Some of these services require asynchronous communication, such as search through a peer-to-peer network or alert.
- ECL is a complex protocol. To achieve its fast and easy adoption it has to be supported with pre-configured middleware.
- A solution for connection between eduSource and other initiatives has to be easy to maintain and easy update if there is a change in the protocol used by the other initiative.

ECL closely follows IMS DRI specification and uses SOAP as a communication layer. IMS DRI core functions are defined and implemented as eduSource services. Repositories or tools connected to the eduSource network can implement some of these services and register them in an eduSource maintained registry (such as UDDI). Registration is a preferred way for discoverability of permanent services. However, in many cases user tools connected to the network will not register any service. For more details on ECL design and implementation see <http://www.sfu.ca/~mhatala/pubs/edmedia04-ecl-oki-submit.pdf>.

D.3 Human Area Networking (HAN) - a future technology

Nippon Telegraph and Telephone Corporation (NTT) is pursuing research and development of an innovative Human Area Networking technology called RedTacton (<http://www.ntt.co.jp/news/news05e/0502/050218.html>) that safely turns the surface of the human body into a data transmission path at speeds up to 10 Mbps between any two points on the body. Using a novel electro-optic sensor, NTT has already developed a small PCMCIA card-sized prototype RedTacton transceiver. RedTacton enables the first practical Human Area Network between body-centred electronic devices and PCs or other network devices embedded in the environment via a new generation of user interface based on totally natural human actions such as touching, holding, sitting, walking, or stepping on a particular spot. RedTacton can be used for intuitive operation of computer-based systems in daily life, temporary one-to-one private networks based on personal handshaking, device personalization, security, and a host of other applications based on new behavior patterns enabled by RedTacton. NTT is committed to moving RedTacton out of the laboratory and into commercial production as quickly as possible by organizing joint field trials with partners outside the company, under NTT's comprehensive producer program.

D.3.1. *Potential Applications*

One-to-One services: with the ability to send attribute data from personal information devices worn on the body to computers embedded in the environment, one-to-one services could be implemented that are tailored to the individual needs of the user.

- **Intuitive operation of personal information devices:** communication is triggered by totally natural human actions and behavior, so there is no need to insert smart cards, connect cables, tune frequencies, or any of the other inconveniences usually associated with today's electronic devices.
- **Device personalization:** setup, registration, and configuration information for an individual user can all be uploaded to a device the instant the device is touched, eliminating the need for the device to be registered or configured in advance.
- **New behavior patterns:** tables, walls, floors and chairs can all act as conductors and dielectrics, turning furniture and other architectural elements into a new class of transmission medium. For

example, a user could have instant access to the Internet merely by placing a laptop onto a conductive tabletop.

- **Security applications:** RedTacton could be installed on doors, cabinets and other locations calling for secure access, such that each secure access could be initiated and authenticated with a simple touch. At the same time, all the transaction details and relevant user attributes (personal identity, security clearance, etc.) could be logged by the security system.

D.4 KInCA: Using cognitive agents to help the adoption of knowledge sharing processes in organizations

KInCA (Knowledge Intelligent Conversational Agent) is a research project sponsored by the Xerox Corporation, which aims at supporting managers in learning, understanding, and applying knowledge sharing processes in organizations (Angehrn et al., 2001; Roda et al., 2003).

KInCA uses 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 her/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 her/him a story, or it will suggest a document to read, or will comfort her/him. Through this interaction, the user progressively becomes aware, gets interested, tries and adopts the desired knowledge-sharing attitude.

D.5 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 works on providing a deep level of personalization to the user. One of the most important aspects of this project is its use of a sophisticated 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. This information is used by personal agents (designed using the Jade platform) to select and deliver to the user the more relevant knowledge objects.

D.6 ICDT

The ICDT Platform is a web-based virtual environment aimed at supporting distributed groups and communities. The platform is the result of research and development efforts conducted at INSEAD's Centre for Advanced Learning Technologies since 1994 in the domain of groupware design and collaborative, distributed learning.

The ICDT Platform is a virtual groupware-based, cooperative workspace. Starting from the assumption that organizations can be seen as networks of cooperating agents (individuals, teams, task forces, organizational and inter-organizational units such as departments or Learning Networks, etc.), the framework views groupware platforms as efficient Information, Communication, Distribution and Transaction channels. It purposes to: (1) increase the **visibility** of the users (individuals, groups, as well as software agents), the 'interaction spaces' they can use and create dynamically, as well as the 'knowledge assets' (content, services, activities) included in, accessed through and exchanged within the platform, (2) improve **communication** and cooperation potential, (3) support efficient **exchange and distribution** of internal content, knowledge and digital services, and (4) provide a platform for formal, workflow-related **transactions**.

Accordingly, the ICDT Platform consists of different **interaction spaces** (*Virtual Information Space, Virtual Communication Space,*

Virtual Transaction Space, Virtual Distribution Space), each of which serves a different function or activity. The purpose of the division is to help new members familiarize more rapidly with the virtual community context (people, spaces, knowledge assets, ongoing activities) and reduce search costs and increase value creation opportunities for each community members by supporting the efficient identification of relevant spaces, people, knowledge assets, interaction and collaboration opportunities. Furthermore, **software agents** are introduced to stimulate and support members in the gradual process of becoming more active members of the community.

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E.1 introduction

Although knowledge management is not a new subject, the concept of standards in knowledge management is still lacking. As a direct prove of this we could notice that in Jul 2002 SPRING Singapore (Standards, Productivity and Innovation Board) organised a seminar where knowledge management experts from Australia, Europe, Singapore and the United Kingdom presented their views on standardising knowledge management and gave insights into how companies could benefit using the standards.

Mr Dave Snowden, Director for IBM Cynefin Centre for Organisational Complexity states that "The difference between a successful and unsuccessful organisation is not the processes or the quality standards. The things that make a difference are the ability to make timely decisions and the ability to create the space for innovation. This is actually what knowledge management is about". In his view knowledge management - an area which often conjures up disparate views - is a tool to enable people to make better decisions or to create the space in which they can innovate. It is because of these that knowledge has a profound effect. On the European perspective there is the European KM Forum - an open pan-European network of professionals managed by the EC and working together to promote European excellence in KM.

To date, guides for KM good practices have been developed. For example there is the *"PAS2001 - Knowledge Management : A Guide to Good Practice"* from British Standards Institution (BSI) and CEN KM Standards Committee.

Standards Australia International (SAI) has published a handbook titled *"Knowledge Management : A Framework for Succeeding in the Knowledge Era"*.

Still it is considered to be premature to develop a knowledge management standard in the immediate future because knowledge management is still evolving. Nevertheless there is sufficient interest in KM and KM standardisation to initiate an interest group and to monitor international developments.

Therefore, this section offers an overall view on current standards and specifications that might be relevant for the realization of the knowledge resources management and sharing subsystems. More detailed information can be found following the links that are also provided.

Of course, the current list is not exhaustive and will need to be extended/updated/revised.

E.2 XML (Extensible Markup Language)

Extensible Markup Language (XML) is a simple, very flexible text format derived from SGML (ISO 8879). Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere. It will be used also for learning objects themselves. XML allows separation between the semantic content and its presentation. By conforming to XML standardization, learning objects will then become public or commercial items that can be used as library components to generate a final learning product. The project will also focus on XHTML, which is basically HTML reformulated as an XML application. XHTML describes Web content in a way that is understandable by any XML-compatible browser, XHTML developers don't have to write separate versions of their pages for each device. Further information about XML can be found at: <http://www.w3.org/XML/>

E.3 The Extensible Stylesheet Language Family (XSL)

XSL is a family of recommendations for defining XML document transformation and presentation. It consists of three parts:

- XSL Transformations (XSLT): This specification defines the syntax and semantics of XSLT, which is a language for transforming XML documents into other XML documents. XSLT is designed for use as part of XSL, which is a stylesheet language for XML. In addition to XSLT, XSL includes an XML vocabulary for specifying formatting. XSL specifies the styling of an XML document by using XSLT to describe how the document is transformed into another XML document that uses the formatting vocabulary. XSLT is also designed to be used independently of XSL. However, XSLT is not intended as a completely general-purpose XML transformation language. Rather it is designed primarily for the kinds of transformations that are needed when XSLT is used as part of XSL
- XML Path Language (XPath): an expression language used by XSLT to access or refer to parts of an XML document. (XPath is also used by the XML Linking specification)
- XSL Formatting Objects (XSL-FO): an XML vocabulary for specifying formatting semantics

An XSLT stylesheet specifies the presentation of a class of XML documents by describing how an instance of the class is transformed into an XML document that uses a formatting vocabulary, such as (X)HTML or XSL-FO.

Further information about XSL can be found at:
<http://www.w3.org/Style/XSL/>

E.4 ADL–SCORM (Sharable Content Object Reference Model)

The Advanced Distributed Learning (ADL) initiative has developed the Sharable Content Object Reference Model (SCORM) to incorporate many of emerging standards and specifications (e.g. LOM, IMS CP) into one content model. SCORM will provide a technical infrastructure that will allow content objects to be easily shared across multiple learning delivery environments. A longer term expectation of ADL is to encourage the development of technologies that enable so-called dynamic learning where content is custom-assembled and delivered to learners according to their own personal pace and need.

SCORM Version 1.2 introduces the concepts of content packaging. This version of the SCORM also updates the meta-data used to describe learning content. The update has been made to reflect the latest meta-data specifications developed by the IMS Global Learning Consortium and the IEEE LTSC.

SCORM Version 1.2 is considered stable, meaning that enough experimentation and testing has taken place to establish confidence that applications based upon the model can be implemented and tested for conformance. However, key aspects of SCORM are likely to evolve and change based on future, industry-wide developments. This means that some aspects of the model may need to be "deprecated" in favour of newer approaches that will be developed as required. Deprecated functionality will be replaced with newer, improved functionality with sufficient forewarning to permit clear and manageable migration to subsequent versions. There are no features or items marked for deprecation in Version 1.2 of SCORM.

Further information about ADL-SCORM can be found at:
<http://www.adlnet.org/>

E.5 DC-Ed (Dublin Core Metadata Initiative Education Working Group)

The Dublin Core Metadata Initiative is an open forum engaged in the development of interoperable online metadata standards that support a broad range of purposes and business models. DCMI's activities include consensus-driven working groups, global workshops, conferences, standards liaison, and educational efforts to promote widespread acceptance of metadata standards and practices.

The objectives of the Working Group are to continue discussion and development of proposals for the use of Dublin Core metadata in the description of educational resources. The scope includes educational resources applicable for many national education communities and cross-sectoral communities (e.g. pre-school, K-12, further and higher education, vocational and technical training and lifelong learning). The Working Group will continue its work in the development of qualifiers to the Dublin Core Metadata Element Set (DCMES) and/or domain specific elements, element qualifiers and value qualifiers to describe educational materials for the purpose of enhancing resource discovery. Further information about DC-Ed can be found at: <http://dublincore.org/>

E.6 IEEE LOM (IEEE Learning Object Metadata)

The purpose of the standard is to facilitate search, evaluation, acquisition and use of learning objects by, for instance, learners, instructors or automated software processes. The purpose is also to facilitate the sharing and exchange of learning objects, by enabling the development of catalogs and inventories while taking into account the diversity of cultural and lingual contexts in which the learning objects and their metadata will be exploited.

The intent of the standard is to specify a base schema, which can be used to build on as practice develops, for instance in order to facilitate automatic, adaptive scheduling of learning objects by software agents. The standard does not define how a learning technology system will represent or use a metadata instance for a learning object.

IEEE 1484.12.1-2002 (Learning Object Metadata – Data Model) was approved as a new standard by the IEEE-SA Standards Board on 13 June 2002.

Further information about IEEE-LOM can be found at: <http://ltsc.ieee.org>

E.7 IMS CP (IMS Content Packaging)

The IMS Content Packaging Specification provides the functionality to describe and package learning materials, such as an individual course or a collection of courses, into interoperable, distributable packages. Content Packaging addresses the description, structure, and location of online learning materials and the definition of some particular content types.

The Content Packaging Specification is aimed primarily at content producers, learning management system vendors, computing platform vendors, and learning service providers. Learning materials described and packaged using the IMS Content Packaging XML format should be interoperable with any tool that supports the specification. Content creators can develop and distribute material knowing that it can be delivered on any compliant system, thereby protecting their investment in rich content development.

Further information about IMS-CP can be found at:
<http://www.imsglobal.org>

E.8 IMS Digital Repositories

The IMS Digital Repositories specification provides recommendations for the interoperation of the most common repository functions. These recommendations should be implementable across services to enable them to present a common interface.

On the broadest level, this specification defines digital repositories as being any collection of resources that are accessible via a network without prior knowledge of the structure of the collection. Repositories may hold actual assets or the meta-data that describe assets. The assets and their meta-data do not need to be held in the same repository. This specification is intended to utilize schemas already defined elsewhere (e.g., IMS Meta-Data and Content Packaging), rather than attempt to introduce any new schema.

Further information about IMS Digital Repositories can be found at:
<http://www.imsglobal.org>

E.9 IMS Enterprise

The objective of the IMS Enterprise Information Model is to define a standardized set of structures that can be used to exchange data between different systems. These structures provide the basis for standardized data bindings that allow software developers and implementers to create Instructional Management processes that interoperate across systems developed independently by various software developers. The major classes of Enterprise applications supported by this model are Training Administration, Student Administration, Library Management and Human Resource systems.

Further information about IMS Enterprise can be found at:
<http://www.imsglobal.org>

E.10 IMS LIP (IMS Learner Information Package)

The specification supports the exchange of learner information among learning management systems, human resource systems, student information systems, enterprise e-learning systems, knowledge management systems, resume repositories and other systems used in the learning process. In this specification such systems are called learner information systems regardless of any other functionality they possess or roles they fulfil. The IMS Learner Information Package specification does not address requests for learner information or the exchange transaction mechanism.

Further information about IMS-LIP can be found at:
<http://www.imsglobal.org>

E.11 IMS Learning Design

The IMS Learning Design specification supports the use of a wide range of pedagogies in online learning. Using the approach only one set of learning design and runtime tools need to be implemented in order to support a wide range of pedagogies. The language was originally developed at the Open University of the Netherlands (OUNL). Further information about Learning Design can be found at:
<http://www.imsglobal.org>

E.12 IMS-QTI (IMS Question and Test Interoperability)

The IMS Question & Test Interoperability (QTI) specification proposes an XML data structure for describing questions and tests. The specification has been produced to allow the interoperability of content within assessment systems.

QTI is widely supported within the industry. This specification will be useful for publishers, certification authorities, teachers, trainers, publishers and creators of assessments, and the software vendors whose tools they use.

Further information about Learning Design can be found at:
<http://www.imsglobal.org>

E.13 IMS RDCEO (IMS Reusable Definition of Competency or Educational Objective)

The Reusable Definition of Competency or Educational Objective (RDCEO) specification provides a means to create common understandings of competencies that appear as part of a learning or career plan, as learning pre-requisites, or as learning outcomes. The information model in this specification can be used to exchange these definitions between learning systems, human resource systems, learning content, competency or skills repositories, and other relevant systems. RDCEO provides unique references to descriptions of competencies or objectives for inclusion in other information models. Further information about IMS RDCEO can be found at: <http://www.imsglobal.org>

E.14 IMS Simple Sequencing

The IMS Simple Sequencing specification defines a method for representing the intended behaviour of an authored learning experience such that any learning technology system (LTS) can sequence discrete learning activities in a consistent way. A learning designer or content developer declares the relative order in which elements of content are to be presented to the learner and the conditions under which a piece of content is selected and delivered, or skipped during presentation.

The specification defines the required behaviours and functionality that conforming systems must implement. It incorporates rules that describe the branching or flow of learning activities through content according to the outcomes of a learner's interactions with content. The representation of sequencing may be interchanged between systems designed to deliver instructional activities to learners.

Further information about IMS Simple Sequencing can be found at: <http://www.imsglobal.org>

E.15 OKI – OSID

The OKI - Open Knowledge Initiative (<http://www.indiana.edu/~webdev/2003/submissions/management/1064612177.MEA-SPEELMON-PR.ppt#257,3,What is OKI?> and http://sourceforge.net/docman/display_doc.php?docid=17032&group_id=69345) defines an open and extensible architecture for general purpose infrastructure with a specific focus on learning technology targeted to the higher education community. O.K.I. provides detailed

specifications for interfaces among components of a learning management or other environment, and open source examples of how these interfaces work. The O.K.I. architecture is intended for both commercial product vendors and higher education product developers. It provides a stable, scalable base that supports the flexibility needed by higher education, as learning technology is increasingly integrated into the education process.

O.K.I. defines an architecture that precisely specifies how the components communicate with each other and with other systems. The architecture offers a standardized basis for development with proven, scalable technologies, thereby reducing development effort and encouraging the development of specialized components that integrate into larger systems. By clearly defining points of interoperability, the architecture allows integrating independently developed and updated components into complex learning environments. Learning technology and content, shared more easily among schools and departments, provides a catalyst for cooperative and commercial development.

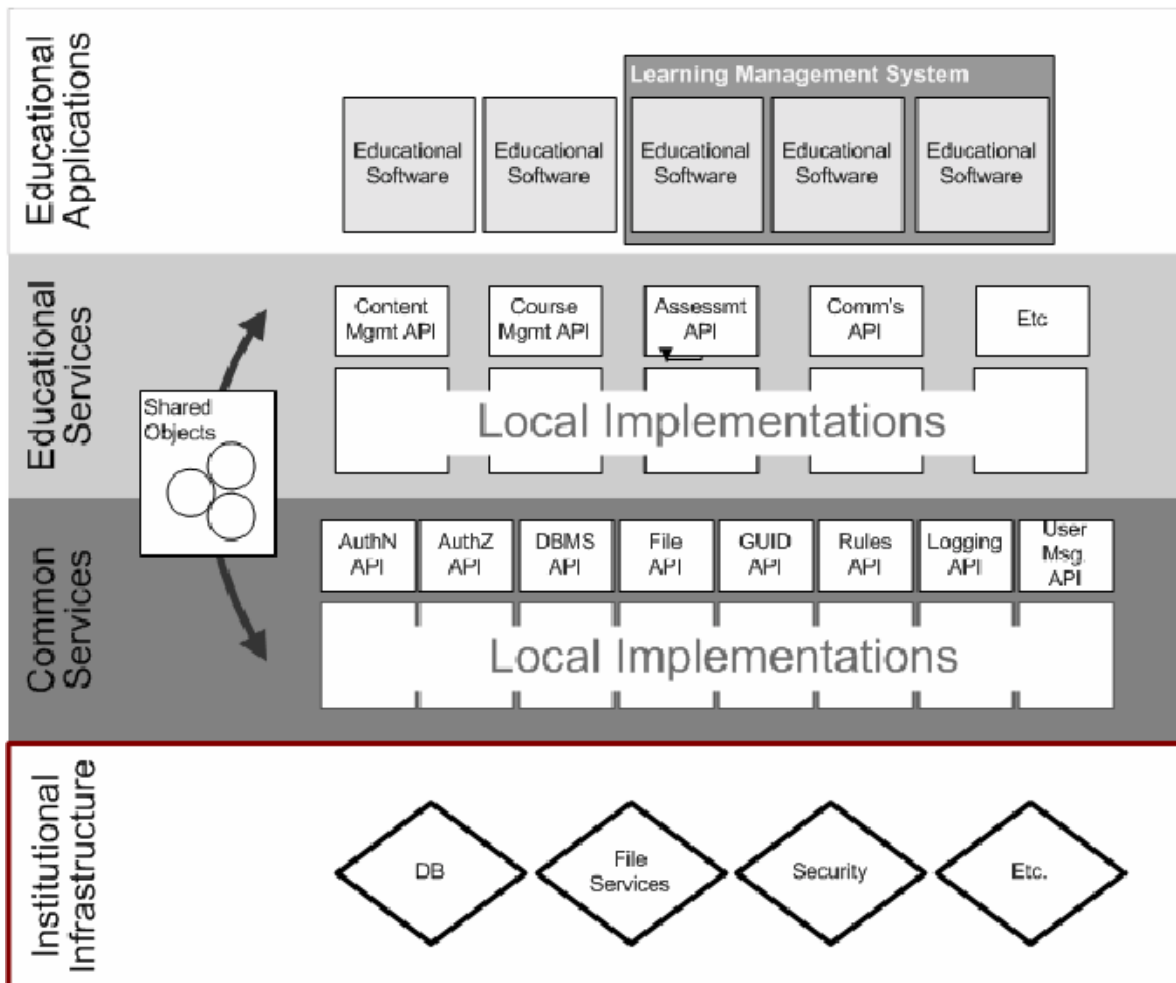
At the core of O.K.I. is a set of service interface definitions (SIDs) that realize the O.K.I. architecture. O.K.I. is providing Java versions of these APIs for use in Java-based systems (but binding with other language are in progress) and also as models for other object-oriented and service-based implementations. O.K.I.'s partners and developer community are providing open source examples and reference implementations that use the APIs.

There are several benefits that flow from an API approach. The most important benefit is that the work of building an application can take place independently of the services it will require from the API. Another benefit is that more than one implementation of a service is possible without requiring the application program to change. So long as an implementation of a service maintains the API, implementations can vary without requiring any changes in an application using the API. By defining APIs that are not bound to any one implementation of a particular service, O.K.I. provides a layer buffering application from infrastructure that is localized or might go through changes that would otherwise require major re-writes of application-level. The services themselves are modular, bound together loosely through shared objects and interfaces. O.K.I. architecture offers APIs that occupy a variety of layers, from the basic infrastructure through application domains.

The goal is to facilitate development and sharing of applications, which O.K.I. commonly calls "Tools", through a rich set of services. These allow developers to concentrate on the real pedagogical aspects of

design rather than basics such as how to authenticate a user or where to store documents and metadata. Sharing is facilitated through the abstraction provided by APIs, allowing an application built at one institution, using a particular collection of infrastructure services, to be easily transported to another.

E.15.1 OKI – OSID Architecture



As we can see in the previous figure, OSID provides many interfaces for:

- Assessment
- Authentication
- Authorization
- CourseManagement
- DBC
- Dictionary
- DigitalRepository

- Filing
- Hierarchy
- Logging
- Scheduling
- Shared
- SQL
- UserMessaging
- Workflow

Relevant OSIDS are described in the following sections.

Digital Repository Interface (DRI)

- The Digital Repository Open Service Interface Definition covers storing and retrieving digital content, referred to as Assets, as well as information about the Assets.
- Assets, examples of which include: documents, course material, assessment item, images, video, audio, etc, reside in Digital Repositories which have names and descriptions and which support a specific set of Asset Types.
- Digital Repositories are themselves organized by the Digital Repository Manager that keeps track of repositories and supports certain operations such as searching for Assets across repositories.
- Associated with each Asset Type are RecordStructures that define the format of information comprising the Asset or information describing the Asset. An Asset can have content as well as InfoRecords, which are data in the format defined by the Asset's RecordStructures. Assets may contain other Assets.

As we can see from DRI description above is necessary to define (profiling) some aspects of DRI interface as:

- Asset Type
- Asset Part (using Type)
- Search query language, Search criteria and Search Type.
- It's also necessary to define how to download the Asset

Authentication

The Authentication OSID gathers required credentials from an agent, vouches for their authenticity and introduces the agent to the system. The Authentication OSID permits an application to abstract the authentication process without having to manage the details of the underlying authentication service.

Authorization

The Authorization OSID allows an application to establish and query a user's privileges to view, create, or modify application data, or use application functionality.

Applications that can change Enterprise data need to manage a user's access to that data. An application must provide a fine degree of authorization granularity to reflect the complexity of a user's interaction with an application.

Shared

The Shared OSID contains fundamental objects used in the other OSIDs to provide their functionality. The contents of the Shared OSID are used throughout O.K.I.-compliant implementations and applications.