INFORMATION SOCIETIES TECHNOLOGY (IST) PROGRAMME

Deliverable D4.2
Final Version of Strategic Roadmap

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Introduction

The *VISION Project* provides a strategic roadmap for future developments towards next-generation organizational knowledge management. It so prepares the ground for future Knowledge Management RTD activities in the upcoming sixth framework program of EC research funding by investigating future research challenges and by creating a vision; and by outlining a roadmap that shows how to implement the VISION model with a minimum of risk or social fallout. Unlike some methods where the end-point is forecast, the VISION roadmap process starts with the end-point – the vision – clearly in mind, and then traces the alternative technology paths to achieve it. We shortly repeat the VISION ultimate vision of next generation KM:

> "Next-Generation Knowledge Management is:
>
> - focusing on the design of KM technologies **for people and organizations** and not on making people and organizations adapt to KM technologies;
> - aiming to make KM technology **invisible**, **embedded** in our natural surrounding and present **whenever** we need it; and
> - at making **interaction** with the technology simple and effortless."

For the realization of this roadmapping work package **a scenario-driven approach** has been used, i.e. several scenarios for possible future applications concerning Knowledge Management have been developed. The corresponding roadmaps, provided by the VISION Core partners, the leaders of the VISION Special Interest Groups, the VISION Network, and a number of additional senior experts, show possible ways to realize these scenarios.

The First version of this roadmap document (deliverable D4.1) started with the selection and analysis of four scenarios covering user requirements and key technologies with regard to next generation knowledge management. Based on the analysed scenarios, we have developed four technology roadmaps providing an expert-based consensus view of the future science and technology landscape concerning ng-KM.

For the second and final version of this roadmap document we have elaborated and validated the scenario management approach, the roadmap approach as well as the developed scenarios and roadmaps themselves with senior experts from industry, research and education. This has been done by several face-to-face interviews and on the Knowledgeboard Forum "NEXT GENERATION TECHNOLOGY FOR KM". Furthermore we have presented and discussed the selected scenarios and corresponding roadmaps on the VISION Workshop at the 9th International Conference of Concurrent Enterprising, 18 June 2003 in Espoo, Finland. The discussed topics of the workshop can be gleaned from deliverable D7.4.

The roadmap document is structured as follows:

- Chapter 2 describes:
  - the analysis, consolidation and categorization of user requirements with regard to next generation Knowledge Management,
  - the analysis of KM key enabling technologies and required technologies to solve problems,
  - and deficits derived from the analysis of VISION Deliverable D3.3 - *Final Version of State-of-the-Art Report on KM Core Show Cases and Experiences* by the use of predefined analysis dimensions, and, finally
  - the matching of the achieved user requirements against the key enabling technologies.

- Chapter 3 depicts the development of a scenario management approach and the selection of four key scenarios covering different aspects of the user requirements and key technologies concerning ng-KM. The main objective of the key scenario selection was to guarantee a minimal overlap by the use of a Scenario – Technology and a Scenario – User Requirements Matching. In a next step we analysed the achieved scenarios concerning necessary key enabling technologies, future technology requirements as well as economic aspects like added value, implementation and research costs and critical success factors.

- Chapter 4 concentrates on the comparison of different existing roadmap types and approaches, the selection of a suitable roadmap methodology and finally the development and detailed description of four specific technology roadmaps for each of the analysed scenarios from chapter 3.

2 Analysis

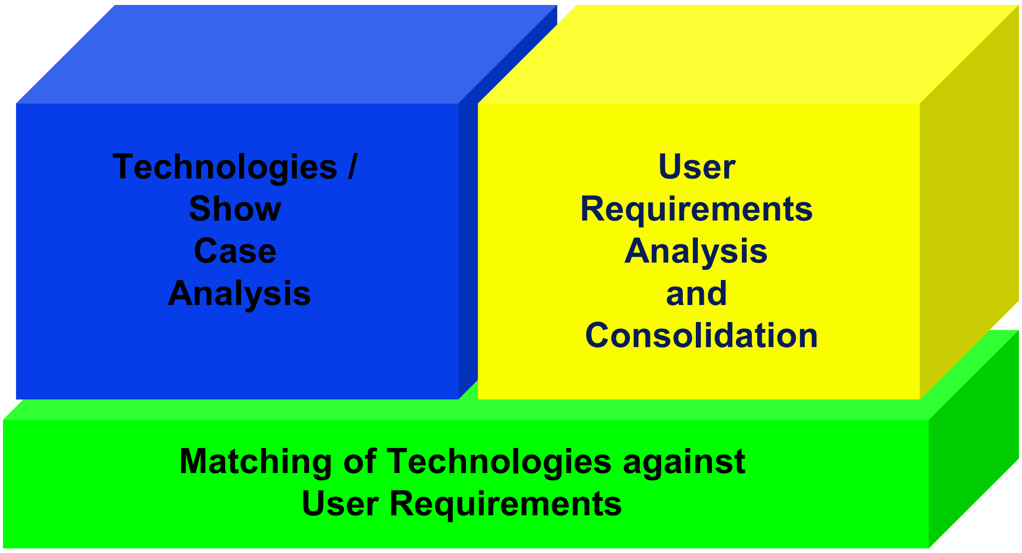
2.1 Analysis Methodology

This chapter is divided into three main parts, **the user requirements analysis**, **the analysis of the key enabling technologies** with regard to the successful introduction of Next Generation Knowledge Management, and finally the **requirements-technology matching**.

The user requirements analysis consists of the pro-active collection, analysis and validation of user requirements, the analysis of relevant Knowledge Management studies and the consolidation and categorisation of all achieved requirements.

The analysis of the key enabling technologies comprises the composition of analysis dimensions and the analysis according to these introduced dimensions. The analysis concludes with a matching of the user requirements analysis results against the identified key enabling technologies.

In a final step we matched the extracted and consolidated user requirements against key enabling technologies in the context of ng-KM.



The major building blocks of our analysis approach (as shown in the picture above) will be discussed in the following subsections.

2.2 User Requirements Categorisation and Consolidation

In Work Package 3 we extended and refined the overall analysis of the state of the art on show cases and technologies in the context of Next Generation Knowledge Management (ng-KM) based on the results of a European wide survey started in WP 2. Deliverable D 3.4 *Final Version of User Requirement Report* is the result of Task 2.7 “collect and describe user’s requirements within the development of a knowledge management solution” and Task 3.4 “refine and extend user requirements” through questionnaires specifically designed for this purpose. Three major steps have been used to obtain insights in user requirements:

1. Support from senior experts and literature search targeted at identifying available user requirement studies for KM

2. Pro-active collection and analysis of user requirements in the light of ng-KM scenarios

3. Validation of the results during the public VISION Workshop at the end of January (2003)

For the active collection of user requirements, which constitute the basis of the analysis, a questionnaire has been designed and distributed, focusing at the specific needs of two main groups:

- providers/developers/researchers
- (end) users of KM applications

The questionnaires aimed at collecting and describing the purposes, the functionalities, the problems and improvements required when developing, implementing and using Knowledge Management Systems inside organisations. Furthermore the questionnaires have been used for the collection, identification and analysis of experiences, cases and needs of the user communities.

Besides the requirements coming from the expert questionnaires, we achieved some “critical mass” of input by considering a significant amount of user requirements coming from a literature study. To this end, our approach for consolidating relevant KM studies had the following steps:

- **Selection of relevant KM Study Results**
  In this step we analysed KM studies concerning (i) current knowledge problems, (ii) objectives and benefits of a KM introduction strategy, (iii) most pressing and challenging theoretical research issues for understanding and advancement of knowledge management, and (iv) primary reasons why companies adopt a KM initiative. Furthermore, we considered (v) expected benefits and (vi) critical success factors with regard to an introduction of KM, as well as (vii) relevant KM product characteristics today and in the future

- **Transformation of results**
  After the selection of relevant KM Study results we transformed both the results of the VISION User Requirement Report and the results of these selected KM Studies into the same format in order to make them comparable. This means practically that we had to translate several scales used in the several KM studies into one overal 100% scale for our comparison.[1] Moreover, we focused on analysis results with a relevance of at least 50%.

[1] For instance, some studies presented their results in the form of statements like “x% of the interviewees considered topic y relevant” which is the kind of scale that we used in the unified report. However, others used, e.g., qualitative scales assigning to each topic an value between 1 and 3 or 1 and 5

After this, both the results of our questionnaires and the unified statements of the selected KM studies were processed as follows:

- **Categorization of requirements by the use of predefined categories**
  In order to categorize the received user requirements of all KM studies, we defined three main categories:

  - requirements to solve current knowledge problems in general (these requirements essentially amount to general goals and motivations in terms of business benefits users want to achieve with a KM solution)

  - requirements to technology in order to solve knowledge problems (these requirements mainly comprise functional requirements for KM systems and modules)

  - requirements to the functionality/ usability of a KM system today and in the future (this class of requirements contains many non-functional or not specifically KM-related aspects of KM systems)

- **Requirements Consolidation**
  In a final step we compared the transformed and categorized requirements and threw out redundant ones. This transformation mainly aimed at a more consistent and coherent overall picture, coming to a common wording and understanding within the VISION consortium, grouping similar things, removing not really central topics, etc.

Figure1 depicts our approach for categorizing and consolidating the results of the VISION User requirements report and selected KM studies.

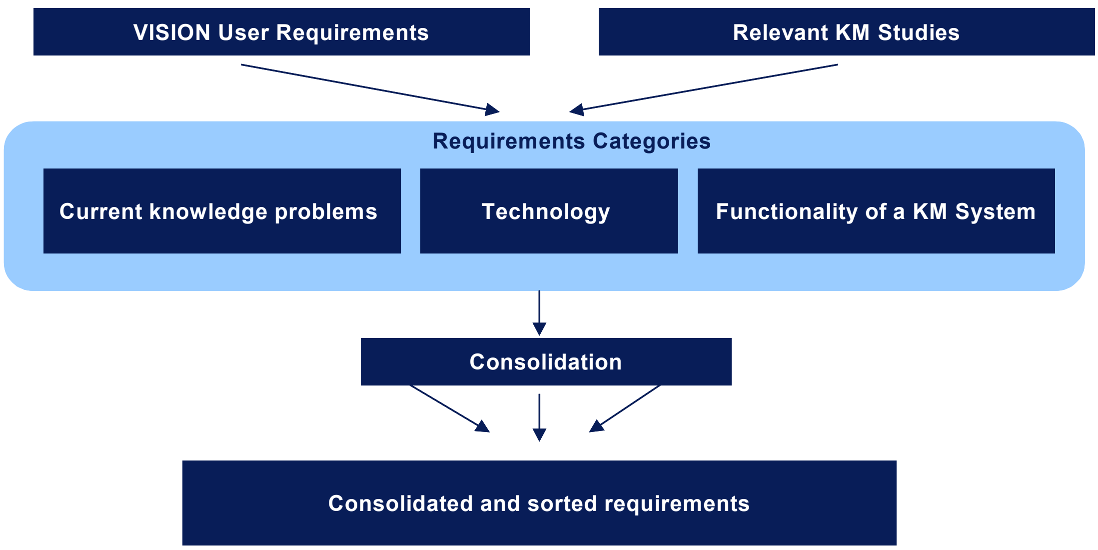


Figure 1: User Requirements Categorisation and Consolidation Process

In the following subsection we first give an overview of the KM studies examined, then list their specific contributions in detail, and then come up with our consolidated and sorted list of requirements distilled from all these inputs.

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expressing a semantics such as "not relevant at all" or "low relevance". These different kinds of result presentation were transformed into a standard scale.

2.2.1 Analysed KM Studies

Name of Study	VISION - KM User Requirements Report	Knowledge Management Research Report 2000 (KPMG)	Metagroup Study	Delphi Study of Fraunhofer IPK and Humboldt University Berlin	IDC - knowledge management (KM) study
Short Description	The VISION - KM User Requirements Report includes the collection and analytical description of user requirements for Next Generation Knowledge Management solutions. The collection of user requirements has been distinguished into two parallel methods that are used to obtain insight in user requirements: • the literature search targeted at identifying available user requirement studies for KM • the Pro-active collection and analysis of user requirements in the light of NGKM scenarios	The Knowledge Management Research Report 2000 which is published by KPMG Consulting investigates organisations' claims that they are implementing KM effectively	The META Group analysed the Knowledge Management market in Germany and Switzerland from the end of June to the middle of August 2001. The evaluated data are based on the results of a direct questioning of 803 user enterprises. The questioning of the enterprises took place by telephone on the basis of a detailed questionnaire. All contacted enterprises had at that time at least 200 employees.	The purpose of the Delphi Study was "to sharpen the view for the most pressing research issues and practical problems, the most promising theoretical and practical approaches and the recent advancements in the field". In this study KM scientists and practitioners were asked open questions. After that the questions were categorized and written down as items. In a second questionnaire the participants had the possibility to rate these items. The results of these two questionings were then presented and interpreted.	Based on survey data collected in February and March of 2002. IDC collected information from companies involved in KM initiatives that give insight into their interest in using various technologies and services to support this initiative. The data cannot be extrapolated to the overall worldwide market, but it provides insight into current and future trends within the KM buying segment.
Date	2003	2000	2001	2002	2002
number of respondents	54	423	803	45	740
sectors	• Industry • Telecommunications • IT • KM	• Financial services • Industrial products • Chemicals • Pharmaceuticals • Information, communication and entertainment • Government • Services • Transport • Consumer markets	• Discrete Manufacturing • Process-oriented Manufacturing • Telecommunication • Transport • Trading • Financial services • Assurances • Education • Health Care • Business Services • Public Sector	• computer science • business administration • social sciences	• Business and Legal Services, Software • Discrete Manufacturing, Government • Financial Services • Process Manufacturing • Education • Wholesale/Retail • Telecommunications • Healthcare Services • Utilities
country of origin	Europe and United States	UK, mainland Europe and the United States	Germany, Switzerland	worldwide	worldwide

2.2.2 Relevant Results of KM Studies

The following tables and charts comprise transformed results of the four selected relevant KM studies which we later used for a consolidation with the received results of the VISION User Requirements Report.

2.2.2.1 Knowledge Management Research Report 2000 [KPMG00]

Current knowledge problems [KPMG00]	**in %**
No time to share knowledge	72,00
Information overload	69,00
Not using technology to share knowledge effectively	65,00
reinventing the wheel	63,00
Difficulty capturing tacit knowledge	63,00

The same information in a diagrammatic presentation:

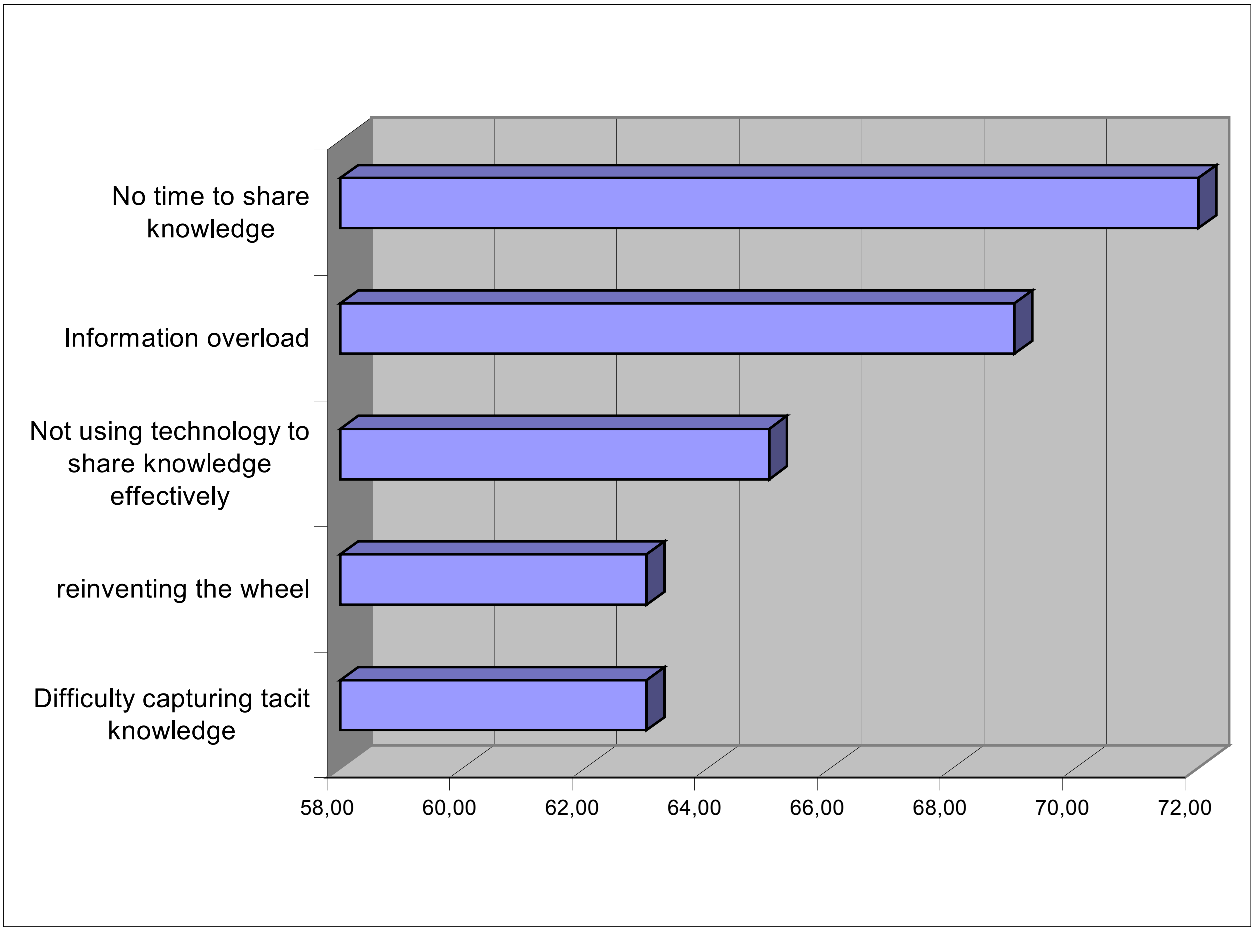

Figure 2: Current knowledge problems [KPMG00]

Expected benefits of KM implementation [KPMG00]	in %
Better decision making	71,00
Faster response to key business issues	68,00
Better customer handling	64,00
Improved employee skills	63,00
Improved productivity	60,00
new ways of working	58,00
Reduced costs	57,00
new business opportunities	54,00
Sharing best practice	53,00
Increased profits	52,00

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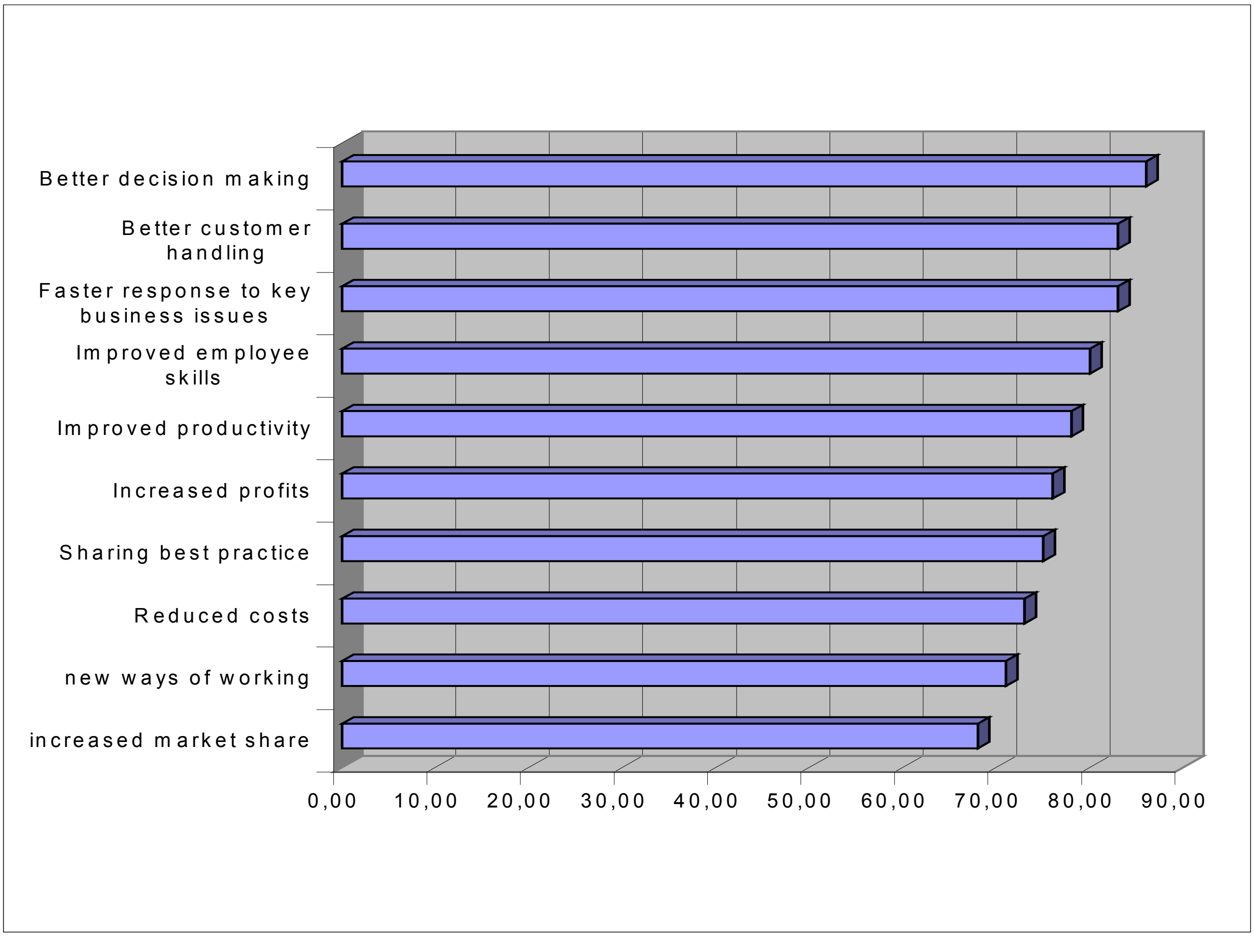

Figure 3: Expected benefits of KM implementation [KPMG00]

2.2.2.2 *Metagroup Study [MG01]*

Objectives / benefits of KM strategy [MG01]	**in %**
Advancement of internal Know-how-transfer	96,00
Faster access to knowledge resources	96,00
Guarantee availability of knowledge at any time	95,00
Improvement of internal procedures	94,00
Reusability of already developed solutions	92,00
Teamwork	91,00
Achieve Synergy Effects	87,00
Advancement of internal communication	86,00
Increase productivity	84,00
Reduction of process cycle time /concurrent operation	81,00
Reduction of Process Costs	80,00
Fortification of core competencies of organisation	78,00
Acceleration of innovation processes	74,00
Improvement of Customer Relationship Management	65,00
Defence and generation of strategic competitive advantage	63,00
Advancement of education	63,00
Fortified identification of employee with organisation	63,00
Development of new knowledge areas	61,00
Fortification of personnel development	60,00
Avoidance of brain drain	53,00

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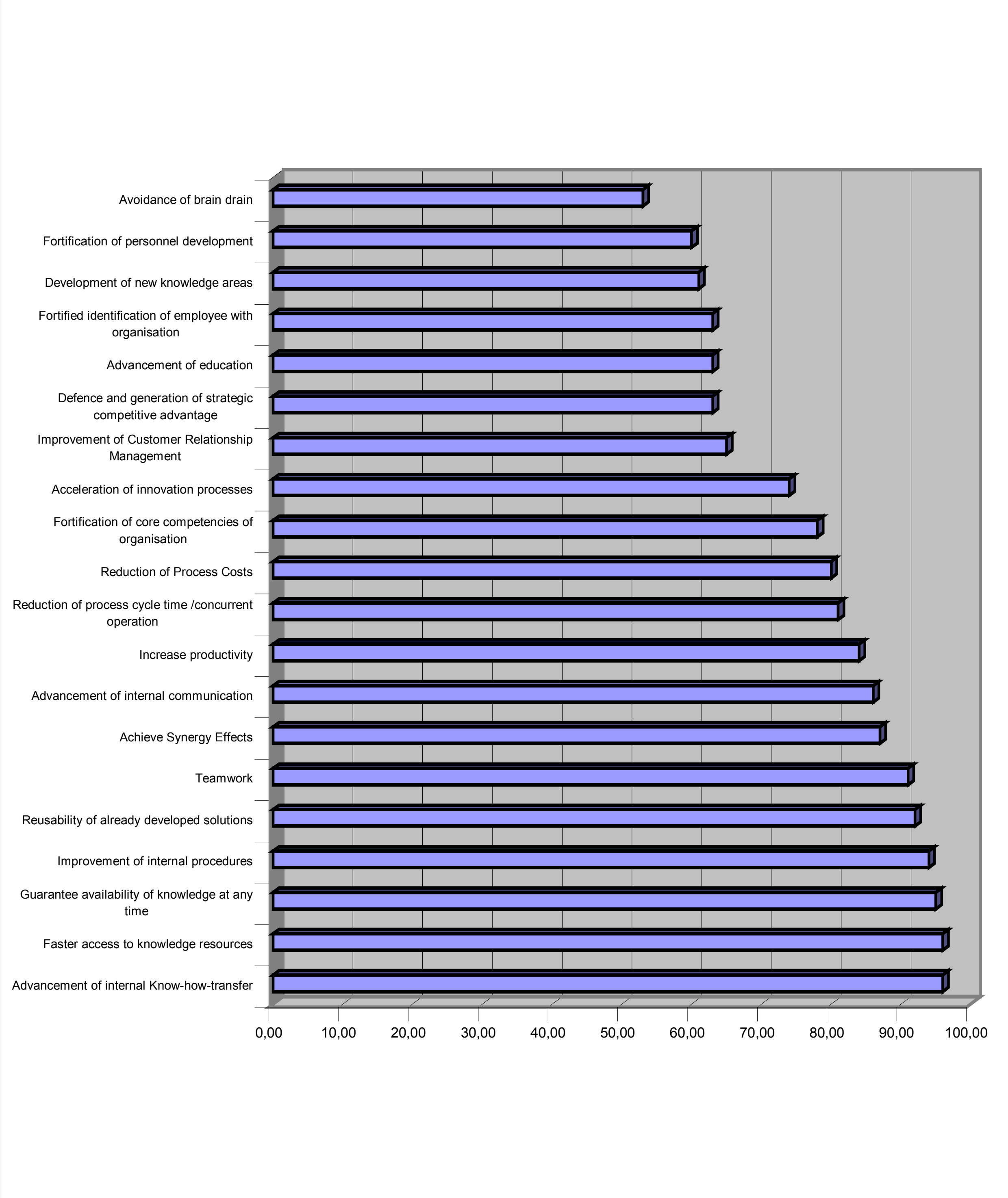

Figure 4: Objectives/ benefits of KM strategy [MG01]

Relevant KM Product characteristics today [MG01]	**in %**
Usability	96,00
Definable access rights	95,00
Standard Interfaces	95,00
System integration capability	94,00
Supported database systems	93,00
Supported operating systems	92,00
User concept	90,00
Inclusion of arbitrary database systems	90,00
System scalability	86,00
Individual adaptability of system	86,00

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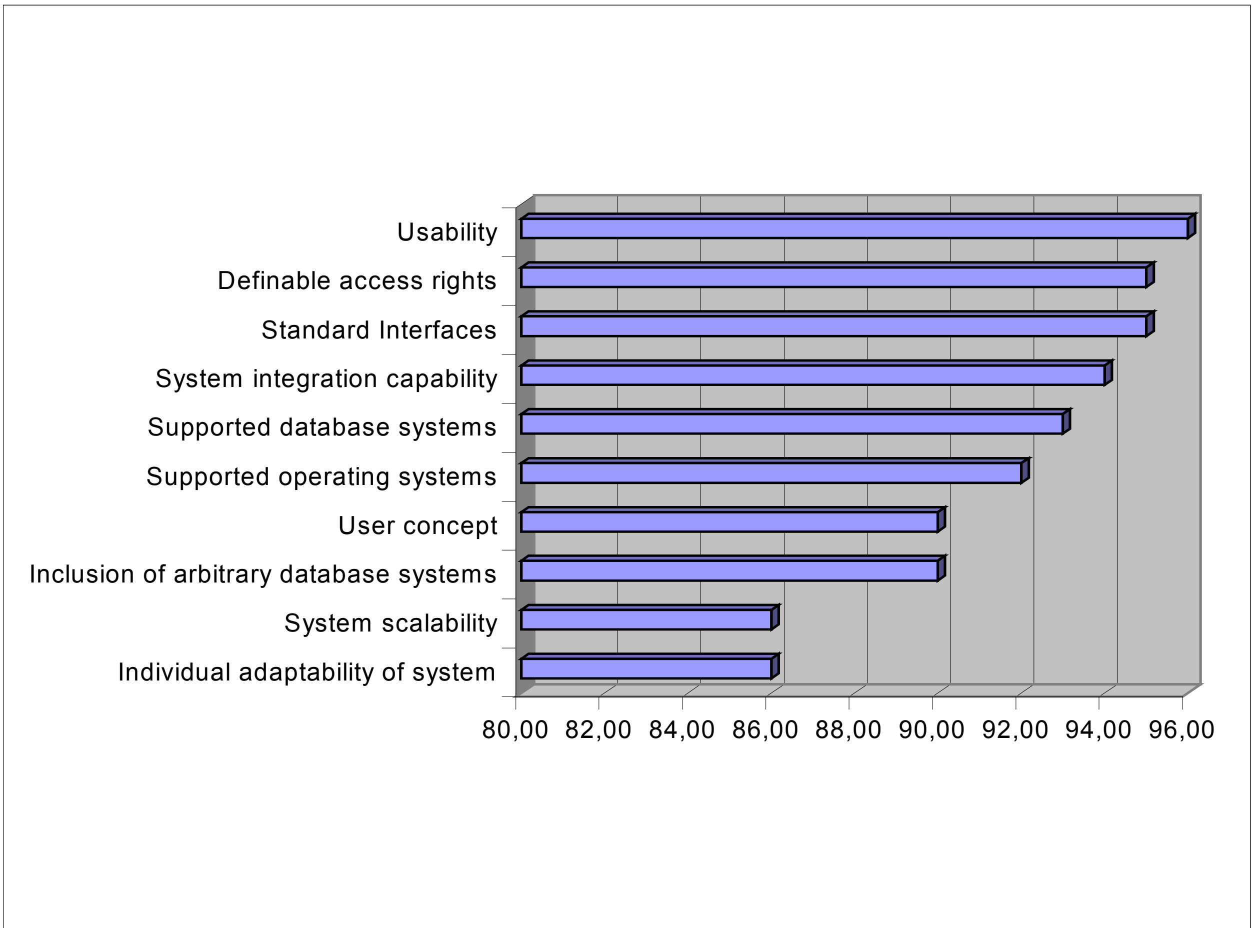

Figure 5: Relevant KM Product characteristics today [MG01]

Relevant KM Product characteristics in the future [MG01]	**in %**
Usability	97,00
Standard interfaces	97,00
System integration capability	96,00
Inclusion of arbitrary database systems	96,00
Definable access rights	95,00
Supported Database Systems	95,00
Supported Operating Systems	93,00
User concept	91,00
System scalability	89,00
Individual adaptability of system	89,00

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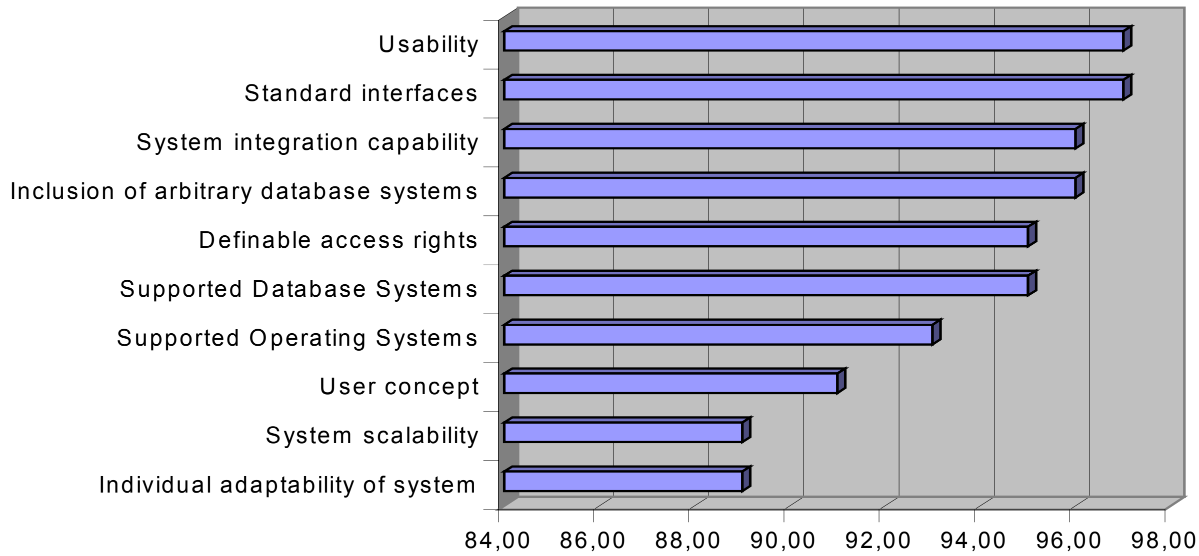


Figure 6: Relevant KM Product characteristics in the future [MG01]

Critical Success Factors for the Implementation of a KM System [MG01]	in %
Reduction of search time	88,00
Reduction of processing time	86,00
Shorter processing time / process cycling time	84,00
Shorter period of vocational adjustment	83,00
Increase of employee satisfaction	80,00
Increase of customer satisfaction	78,00
Fortification of strategic competitive advantage	67,00
Acceleration of innovation processes	66,00
Acceleration of time-to-market	50,00

The same information in a diagrammatic presentation:

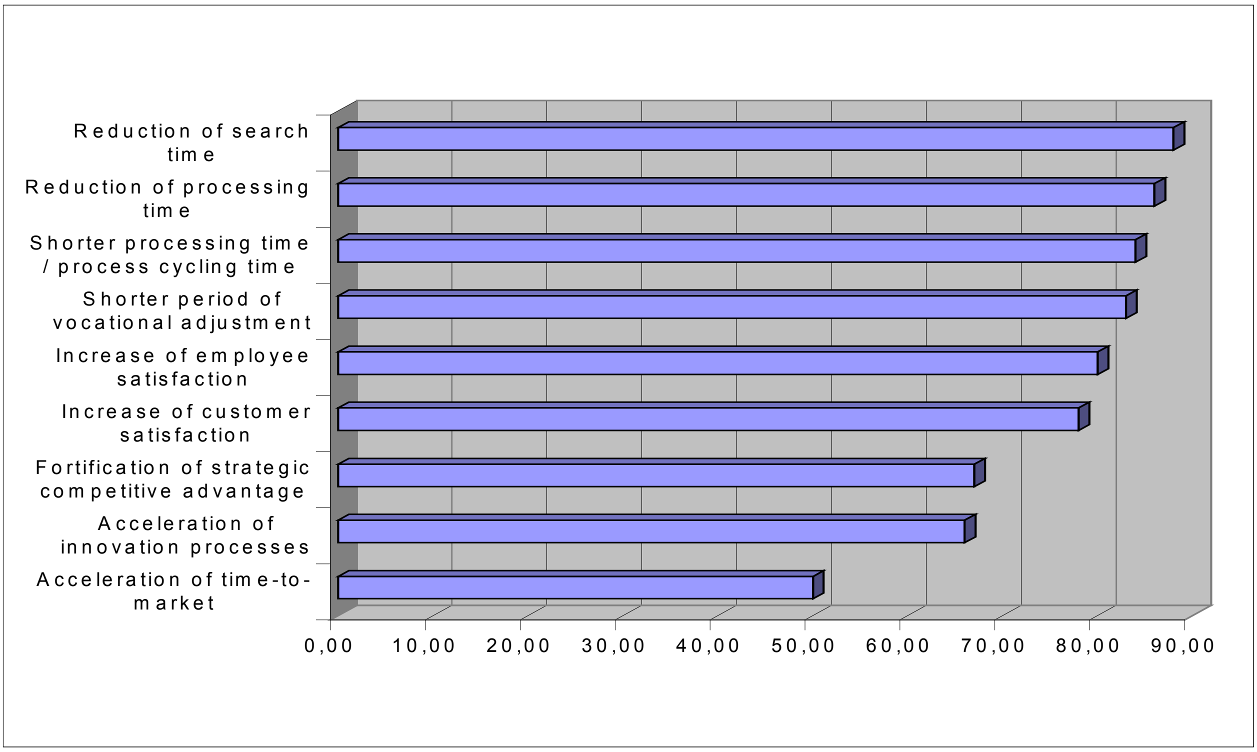


Figure 7: Critical Success Factors for the Implementation of a KM System [MG01]

2.2.2.3 Delphi Study of Fraunhofer IPK and Humboldt University Berlin [Delphi02]

Most Pressing Research Issues [Delphi02]	**in %**
Integration of KM into business processes	85,33
Knowledge sharing, e.g. identifying the knowledge bearers within an organisation, convincing and motivating people to share their knowledge	84,00
Organisational learning, e.g. forming and developing organisational competence, its connection with business success	82,00
KM framework: integrating human resource management, organisational management and information management	76,00
Knowledge assessment, e.g. valuing contributions to a knowledge pool, identifying invalid knowledge as well as measuring valuable knowledge and intellectual capital in unambiguous terms/ Knowledge assessment, e.g. valuing contributions to a knowledge pool, identifying invalid knowledge as well as measuring valuable knowledge and intellectual capital in unambiguous terms	75,33
Motivation, e.g. motivating people to participate in KM	74,00
Knowledge creation, knowledge selection and use of knowledge	72,00
Terminology, e.g. definitions, taxonomies, classification and ontologies	67,33
Knowledge enabling; enabling knowledge management e.g. by using KM infrastructure	66,67
Implicit Knowledge and integrating text documents and data bases into knowledge bases	63,33
Knowledge-orientated data bases, e.g. structuring and integrating text documents and data bases into knowledge bases	50,00

The same information in a diagrammatic presentation:

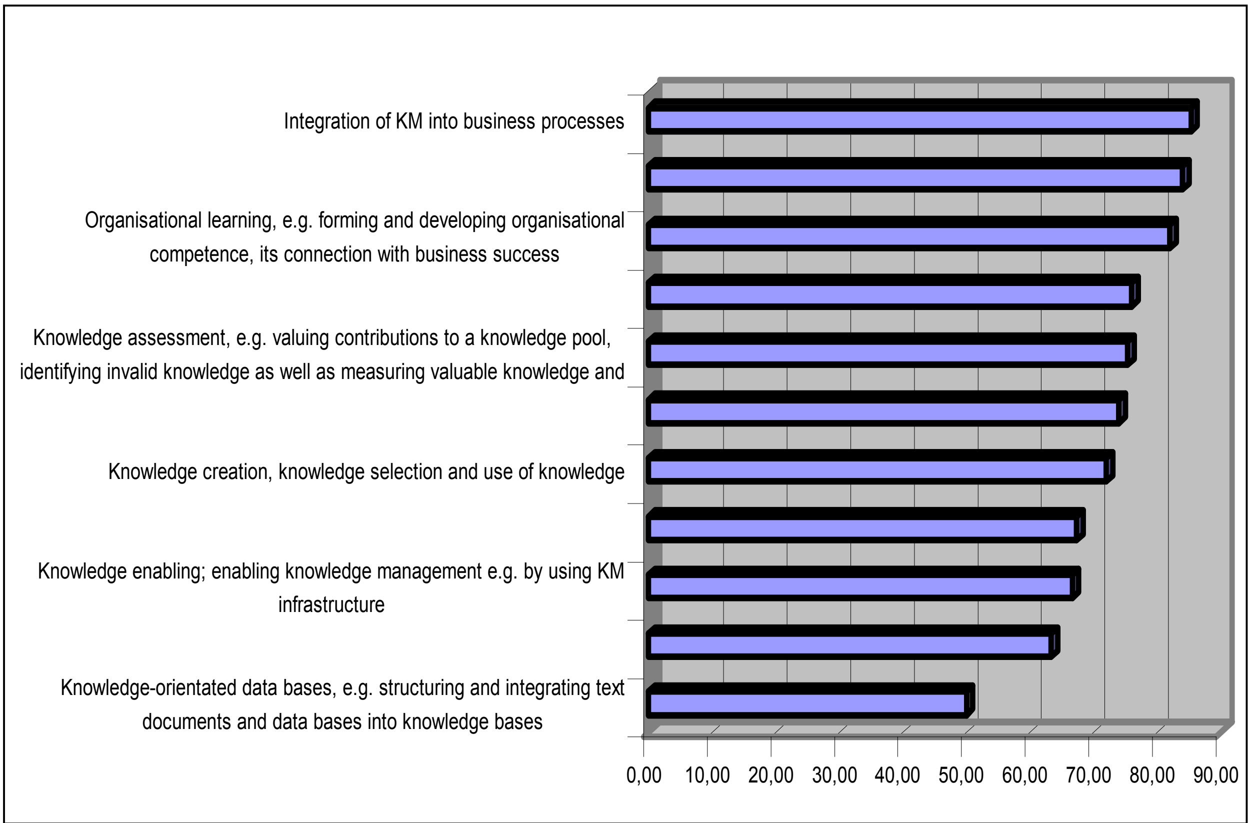


Figure 8: Most Pressing Research Issues [Delphi02]

2.2.2.4 IDC - Knowledge Management (KM) Study [IDC02]

Primary Reasons Companies Do Adopt a KM Initiative [IDC02]
enhance internal collaboration
capture and share best practices

2.2.3 Consolidated and Sorted Requirements

The following three tables show the results of the user requirements consolidation and categorisation using the predefined categories (a) *Requirements to solve current knowledge problems in general*, (b) *Requirements to technology in order to solve knowledge problems* and (c) *Requirements to the functionality / usability of a KM system today and in the future*

(a) Requirements to solve current knowledge problems in general
Acceleration of innovation processes
Acceleration of time-to-market
Advancement of education / Improve employee skills / Increase of employee satisfaction
Advancement of internal Know-how-Transfer
Avoidance information overload
Avoidance of brain drain
Better decision making
Capturing and sharing of best practices
Capturing of tacit knowledge
Defence and generation of strategic competitive advantage
Development of new knowledge areas
Faster access to knowledge resources
Fortification of core competencies of organisation
Fortification of personnel development
Fortification of strategic competitive advantage
Fortified identification of employee with organisation
Guarantee availability of knowledge at any time
Improvement of CRM / Increase of customer satisfaction
Improvement of SRM (supplier relationship management)
Increase of productivity and profit / Reduction of costs, e.g. process costs
Increase of teamwork, e.g. internal communication and collaboration
Knowledge assessment
Knowledge sharing, e.g. identifying the knowledge bearers within an organisation
Reduction of process cycle time /processing time and concurrent operation
Reusability of already developed solutions

(b) Requirements to technology in order to solve knowledge problems
Capturing of implicit knowledge
Integration of KM into business processes
Integration of text documents and databases into knowledge bases
KM technology framework: integrating human resource management, organisational management and information management software/ tools
Knowledge creation, knowledge selection and use of knowledge
Knowledge enabling; enabling knowledge management e.g. by using KM infrastructure
Knowledge-orientated data bases, e.g. structuring and integrating text documents and data bases into knowledge bases
Technology to share knowledge effectively
Terminology, e.g. definitions, taxonomies, classification and ontologies

(c) Requirements to the functionality / usability of a KM system today and in the future
Definable access rights
Supporting arbitrary database systems
Individual adaptability of system
Standard Interfaces
Supporting arbitrary operating systems
System integration capability
System scalability
Usability / Ergonomic user interfaces
User driven concept

2.3 Enabling Technologies & Show Case Analysis

This section provides the identification and analysis of enabling technologies for next-generation knowledge management as well as the analysis of the required technologies to solve occurred problems/ identified deficits that we achieved from Deliverable D 3.3 (Final Version of State-of-the-Art Report on KM Core Show Cases and Experiences). The section is structured as follows: First we will introduce the analysis dimensions as a basis for this document. Second, we will analyse the core enabling technologies according to the introduced dimensions.

2.3.1 Analysis Dimensions for Enabling Technologies

We distinguish between the following analysis dimensions for enabling technologies.

Dimension	Description
Methods / Algorithms	Are there well accepted methods? Are these methods parts of commercial products?
Standards	Are there well accepted standards? Are there competing standardization organisations? Are the standards pushed by industry or by academia?
Scalability	Are the technologies scalable?
Applicability	Are there commercial products available and if yes how robust are they?
Costs	How expensive is it to introduce this technology? What are the costs for maintenance? Total cost of ownership and ROI?
Market and Reference Applications	Is there a market? Are there successful reference applications / application fields?

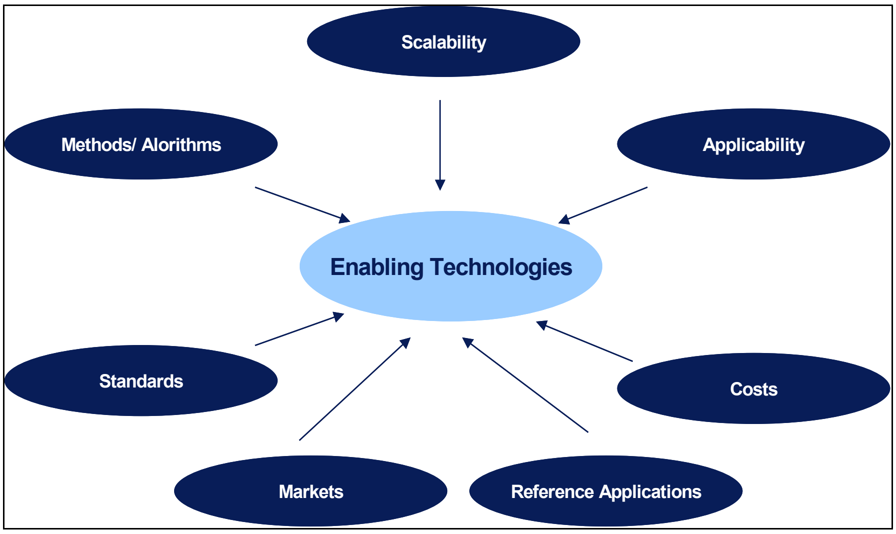


Figure 9: Analysis Dimensions

2.3.2 Analysis of Technologies

Semantic Web

Dimension	Comments
Methods / Algorithms	▪ Ontologies and metadata are well accepted methods. ▪ Inferencing methods and reasoning algorithms are quite heterogeneous. One may distinguish between description logics-like approaches and others that need satisfyability-based inference, rule-based reasoning on the basis of horn logic / datalog / production rules, etc. ▪ Querying the Semantic Web is not solved at all. There are some proposals, but still much work has to be done. ▪ The Multiple Ontology Problem is not solved. Inclusion facilities are not advanced. Mapping is still an open issue. ▪ Methods for reusing ontologies are quite unclear. There is no consensus on whether and how upper-level ontologies should be designed and used. ▪ There are several methodologies for ontology building & evolution, but not yet standards wide-spread in industry. ▪ Methods for integrated managing the overall ontology life cycle do not exist (e.g. versioning, evolution, etc.). ▪ Another open/ unsolved field are methodologies for ontologies deeply integrated with other fields of technology like business process analysis.
Standards	▪ Standards are not well accepted. There are proposals like RDF(S), OIL, OWL, … ▪ Standards are not related to classical conceptual modelling approaches like ER-Modelling and UML. E.g. the semantics of well-known primitives like domain/range constraints of relations is considered differently. ▪ Interoperability between different SW apps is only possible on a data level. ▪ There are competing standardization organisations: W3C, ISO, OMG. E.g. OMG is developing MOF, the meta object facility which shares many similarities with RDF. In the field of MPEG-21 there are several ongoing activities that again are quite similar to the SW standards. ▪ Standards are designed by researchers. In contrast to the XML / Web Service field, SW standards are mainly designed by researchers or by people in research departments of companies. ▪ Terminology within the SW community is not stable (e.g. semantic web technologies are not generally accepted in industrial usage environments).
Scalability	▪ Until now scalability has not yet been demonstrated in many domains and convincing practical applications. ▪ Complexity of reasoning methods is high (e.g. exp-time of tableaux-based reasoning). ▪ Most of the overall processing task is done in main memory. May result in problems when dealing with large amounts of data. ▪ It is unclear what happens if there are thousands of different ontologies.

Applicability	▪ Several companies have begun to develop commercial products in the field. Products are still in an early stage. There is ongoing work in the field of integrating SW tools into standard software like Microsoft Office, SAP, Lotus Notes, etc. etc. ▪ Open Source activities are progressing well. ▪ Current solutions are far too complex. ▪ Applications within research projects are not really showing the full power of Semantic Web technology, mainly focusing on simple things like taxonomies. ▪ Semantic Web is the grand challenge for IT (… for the next 10-20 years). ▪ Only a very few applications show the value-added of complex representation & inference mechanisms.
Costs	▪ Costs for setting up a Semantic Web app are high. The more complex the underlying representation, the more difficult will be the management and the higher will be the overall costs. ▪ End users typically can not deal with the overall complexity (What is a “transitive” relation? How do I express a First-Order Logic Rule?) ▪ Maintenance costs are unpredictable.
Market and Reference Applications	▪ No clear market right now. ▪ People seem to be interested in the Semantic web vision. ▪ No concrete realistic problems defined. ▪ May be toy applications, no convincing real-world application known to us.

Knowledge Discovery

Dimension	Comments
Methods / Algorithms	▪ There are well accepted methods and algorithms like SVMs, association rules, decision trees, clustering, etc. These techniques have been investigated for many years. Typically, supervised techniques are more advanced than unsupervised techniques. ▪ While methods and tools for simply structured relational data are far developed, work on complex-structured, semistructured or even text-based or multimedia data still has to be done. ▪ There is some lack of methodological support, expert users are required. Though academia provides methodologies, tool support, end-user oriented tools and demonstration projects showing application scenarios and business benefits, could be more advanced.
Standards	▪ Standards are not well accepted. There are some markup languages but it seems that the overall standardization process is still ongoing. ▪ Interoperability between different KD applications is not given. ▪ Standards proposals are designed by companies.
Scalability	▪ Methods/Algorithms for relational data do scale. ▪ If methods/algorithms operate on more complex structured data, scalability is not guaranteed.
Applicability	▪ There are commercial products as well as widespread public domain and open source tools. ▪ There are applications that have shown a clear added value. ▪ Current solutions are sometimes too complex. ▪ Applications need expert users for definition of the problems and pre-processing of the data.
Costs	▪ Costs for setting up a KD app are high. ▪ Specialized software was until know quite expensive, but this changed recently because KD methods became part of standard software. ▪ Open source is upcoming.
Market and Reference Applications	▪ Business model for complex KD applications not clear. To prove the added-value of data mining is a challenging task. ▪ Market is focusing on straight forward KD, namely Reporting and OLAP. ▪ There is a market for simple KD solutions closely tied to data warehousing and simple reporting tools (sometimes labelled as "business intelligence"). ▪ Examples for mature commercial or open source tools are IBM’s Intelligent Miner, ISL’s Clementine, or the WEKA workbench.

Natural Language Processing

Dimension	Comments
Methods / Algorithms	▪ Shallow text processing approaches seem to offer the best effort-benefit ratio in current applications. ▪ Sometimes deep understanding and shallow processing is combined. ▪ Symbolic and stochastic techniques are used complementary. ▪ Combination of "shallow NLP" and ontology management is a promising approach for ontology building and evolution. ▪ In general, NLP methods offer useful preprocessing modules for manifold other technologies such as ontologies, Information Extraction, KDD, etc.
Standards	▪ No global standards for encoding dictionaries. ▪ Some activities going on, e.g. TEI. ▪ Some open source tools try to standardize tags.
Scalability	▪ Shallow text processing scales. ▪ Deep understanding does not really scale.
Applicability	▪ There are open source and commercial products. ▪ NL apps typically work well in closed domains, e.g. extracting information from finance information. ▪ No manual formalization of knowledge is needed during the exploitation (in contrast to any formal Knowledge Representation and Engineering approaches). ▪ Many convincing application scenarios have been demonstrated.
Costs	▪ Costs for setting up an NL application can be high. ▪ However, the cost of exploitation is low compared to some knowledge engineering and Semantic Web approaches. ▪ ROI and evaluation are complicated.
Market and Reference Applications	▪ Yes, there is a market. ▪ An example for Information Extraction application (IE, shallow processing) is www.FlipDog.com – a recruitment portal developed by WhizBang and owned by Monster. ▪ Some examples for companies offering commercial software solutions covering the whole range from very shallow to deep understanding approaches: Autonomy, Inxight (now Empolis), Insiders, Xtramind, L&C.

Mobility

<table>
<tr><th>Dimension</th><th>Comments</th></tr>
<tr><td>Methods / Algorithms / Main topics</td><td>Sensor technology, esp. positioning
Wireless Networking
Context-awareness in authoring, retrieval, and presentation of information</td></tr>
<tr><td>Standards</td><td>Different approaches to problems of mobility were introduced, but no standards have been established yet
WAP & i-Mode as protocol for mobile phones
CC/PP for describing mobile devices in profiles (UAProf provides the modelling)
3rd generation networks (GPRS, UMTS) facilitate high bandwidth data transfers
Concerning tracking of mobile users few standards are established (Cell ID, (A)GPS, Infrared) with different pros and cons</td></tr>
<tr><td>Scalability</td><td>We see different aspects of scalability:
number of users and devices in the system
reduced bandwidth due to resource sharing
amount of information/knowledge users want to access aware of the context/situation
scalability depends on database design
number of locations/situations the system should be aware of
no experiences yet, difficult to predict
Most systems are restricted to research labs, and scalability has not been investigated yet</td></tr>
<tr><td>Applicability</td><td>SMS (asynchronous messaging) showed to be a ‘killer application’, MMS
O2 home zone uses location information
LBS such as “find nearest” (restaurant, cinema, ATM)
As work gets more mobile, many scenarios are imaginable to apply mobile computing
Because of the existing and improving mobile devices and infrastructure for wireless communication, many of the prerequisites for the applicability are given. The biggest problem is the missing middleware enabling context-awareness.</td></tr>
<tr><td>Costs</td><td>Maintenance costs depend primarily on communication costs of network provider
Mobile devices are not upgradeable; when a new generation is presented, the whole mobile staff has to upgrade the devices
installation costs are high, as mobile applications have to be implemented more or less from scratch (no existing middleware standards) and mobile staff needs mobile devices</td></tr>
</table>

Market and Reference Applications	• as work gets more mobile, there is a market for mobile business solutions • mobile entertainment (tourist guides, GUIDE project), mobile gaming • mobile devices such as (smart-)phones and PDAs are well accepted

Groupware

Dimension	Comments
Methods / Algorithms	▪ There are no well-accepted methodologies, but there is lot of existing and ongoing work in this field in the scope of the CSCW research, particularly related to evaluation of HCI or group communication: “Heuristic evaluation” (HCI), “user testing” (HCI), “breakdown Analysis” (Computer Science / Philosophy), “lab experiments” (Cognitive/Social Psychology) etc. ▪ Methods for managing an integrated overall groupware do not exist (e.g. modularization, software versions, evolution, etc.)
Standards	▪ Standards are designed by the software industry. ▪ Standards are not well accepted. There are some languages, but it seems that the overall standardization process is still ongoing. ▪ Interoperability between different groupware applications is not given. ▪ TCP/IP is certainly the most universally supported communication protocol both over local and wide area networks. HTTP , HTML , XML , MIME, LDAP, and SMTP are Internet standards broadly used to in Groupware applications. ▪ Netscape and Microsoft are “inventing” non-standard extensions inside their software offering as a “fix” for their customers. ▪ Electronic Data Interchange standards (EDI) are moving towards XML and will, through that, join the Internet platform as the main vehicle for data interchange. ▪ DMA and ODAM are well accepted as the document management standards enabling universal access to documents, an essential feature for KM applications. ▪ Interoperability (referring to the ability of groupware to enable collaboration between those users that employ groupware applications of different vendors) is currently a critical issue that still needs to be solved. The wide-spread use of Microsoft technologies has provided significant improvement with regard to the interoperability of Groupware, but the main contribution to interoperability is currently expected to come from the Web-DAV standard. ▪ WfMC Workflow Standards are moving fast on top of Internet technology. This framework includes five categories of interoperability and communication standards that will allow multiple workflow products to coexist and interoperate within a user's environment. ▪ Market challengers are lining up with open-standards

	solutions. "Open standards" refers to a company's commitment to implementing a product based on agreed-upon standards that provide consistent interoperability rather than a proprietary, often incompatible, technology.
Scalability	▪ Groupware has already demonstrated that it meets the needs of businesses of all sizes. ▪ Scalability of groupware systems is one of the most important properties. Scalability provides flexible and dynamic changes between different states of the system, such as switching from synchronous to asynchronous interaction mode, or changing participants of a session.
Applicability	▪ Plenty of companies have already developed commercial products in the field. Products are already well-advanced. There is ongoing work in the field of interoperability of groupware with standard software like ERP, Desktop application, mobile and personalised access, project management, knowledge management and document management. ▪ Applications within research projects and industry are not really showing the full power of groupware, mainly focusing on simple things like document management. ▪ Interoperarable groupware is the grand challenge for the next 10-20 years ▪ Open source is upcoming.
Costs	▪ Costs for groupware platform are not high. However, the more complex is the underlying representation and the setting up of workflows, the more difficult will be the management and the higher will be the overall costs. ▪ Maintenance costs are well predictable. ▪ A key component of next generation groupware products is modularization. Companies are no longer willing to absorb the cost of a proprietary turnkey solution and will be looking for scalable, reliable low-cost solutions for commodity services such as e-mail or intranet. ▪ Interoperability costs with ERP or desktop applications will have to be reduced.
Market and Reference Applications	▪ There is a clear market right now. ▪ There are many commercial products that have shown a clear added value. ▪ People are very interested in the groupware vision. ▪ Concrete realistic problems defined for cooperation and knowledge exchange. ▪ Several convincing real-world application known to us: Lotus Notes and Domino, MS Exchange, solutions for real time collaboration (e.g. “NetMeeting“), GroupWise (Novel), solution for SMEs (e.g. “genesisWorld”, “CAS teamWorks”)

Processes

Dimension	Comments
Methods / Algorithms	▪ Process-oriented approaches on Knowledge Management methods are widely accepted and are seen as the "most promising approach in KM" (see [Delphi03]). ▪ But the integration of KM into business processes remains one of the most pressing issues. ▪ Several KM approaches have started to address this challenge and provide some practical methods (see Deliverable 2.1). ▪ Today's relatively far developed approaches are mostly consulting concepts offered by institutions close to research (like Fraunhofer IPK). Less widespread and practically consolidated approaches holistically comprise analysis and modelling methods and tools plus workflow support for process enactment. Typically, they were developed in IST RTD projects such as DECOR or PROMOTE. ▪ Although practical methods for the integration of KM into processes are under way, more practical tests with empirical validated design criteria are required.
Standards	▪ European standardisation bodies as well as ISO have proposed a framework and guidelines for enterprise modelling/engineering (ENV 40 003, DIS 15 704) and modelling constructs (ENV 12 204). ▪ The UEML Project funded by the European Union (IST–2001–34229) is working on further developments to achieve standardisation in the future. ▪ However, little in this area has been done to cater for the real needs concerning knowledge modelling. ▪ A project called K-UML (knowledge enabling unified modelling language) is going to be planned in order to fill this gap.
Scalability	▪ In principle the methods and tools for KM-oriented business process modelling are scalable for all sizes of organisations.
Applicability	▪ There are plenty and well advanced tools for business process reengineering ▪ In the area of practical solutions to support KM within the business process, development is still necessary
Costs	▪ Software itself is not expensive whereas the consulting service and the modelling itself can be time consuming and therefore cost intensive. Altogether the costs depend on the size and the complexity of the processes under consideration. ▪ The cost for maintenance of each process has to be considered. It depends on the stability of the process and the framework conditions. ▪ By combining all process oriented approaches in an organisation (Quality Management, cost-perfomance-analysis, Knowledge Management etc.) synergies reduce costs and improve the overall ROI. ▪ There is still potential for improvement and cutting costs by

	raising the efficiency of the investigation methods.
Market and Reference Applications	▪ There is a clear market for business process oriented KM-approaches in the field of business process optimisation.

The following chapter describes the subsequent matching of the consolidated and sorted user requirements against the identified and analysed KM key enabling technologies *Groupware, Knowledge Discovery, Mobility, Natural Processing, Processes and Semantic Web*, which we have already described in detail in deliverable D 3.2 (Final Version of the State-of-the-Art Report on Core and Extended Enabling Technologies). The matching has been realized by a working group consisting of

- The VISION Core partners
- Leaders of the VISION Special Interest Groups
- Experts from the VISION network and from outside of the consortium.

The results of the user requirements-technology-matching were later used as a basis for developing the four scenarios (see chapter 3).

2.4 Matching: User Requirements – Technologies

(a) Requirements to solve current knowledge problems in general	**Groupware**	**Knowledge Discovery**	**Mobility**	**Natural Language Processing**	**Processes**	**Semantic Web**
Acceleration of innovation processes	X	X				X
Acceleration of time-to-market		X	X	X		
Advancement of education / Improve employee skills / Increase of employee satisfaction			X		X	
Advancement of internal Know-how-Transfer	X			X	X	X
Avoidance information overload		X		X	X	X
Avoidance of brain drain				X	X	
Better decision making		X				X
Capturing and sharing of best practices	X				X	X
Capturing of tacit knowledge	X	X				
Defence and generation of strategic competitive advantage		X				
Development of new knowledge areas		X	X			
Faster access to knowledge resources	X	X	X	X		X
Fortification of core competencies of organisation					X	X
Fortification of personnel development					X	
Fortification of strategic competitive advantage					X	
Fortified identification of employee with organisation					X	
Guarantee availability of knowledge at any time	X		X			X
Improvement of CRM / Increase of customer satisfaction	X	X	X		X	X
Improvement of SRM (supplier relationship management)	X	X	X		X	X
Increase of productivity and profit / Reduction of costs, e.g. process costs	X	X		X	X	X
Increase of teamwork, e.g. internal communication and collaboration	X		X			

Knowledge assessment		X				
Knowledge sharing, e.g. identifying the knowledge bearers within an organisation	X	X		X		X
Reduction of process cycle time /processing time and concurrent operation	X			X	X	X
Reusability of already developed solutions	X			X	X	X

(b) Requirements to technology in order to solve knowledge problems	**Groupware**	**Knowledge Discovery**	**Mobility**	**Natural Language Processing**	**Processes**	**Semantic Web**
Capturing of implicit knowledge		X		X		
Integration of KM into business processes					X	X
Integration of text documents and databases into knowledge bases				X		X
KM technology framework: integrating human resource management, organisational management and information management	X				X	
Knowledge creation, knowledge selection and use of knowledge	X		X		X	X
Knowledge enabling; enabling knowledge management e.g. by using KM infrastructure	X		X		X	X
Knowledge-orientated data bases, e.g. structuring and integrating text documents and data bases into knowledge bases				X		X
Technology to share knowledge effectively		X	X	X		X
Terminology, e.g. definitions, taxonomies, classification and ontologies		X		X		X

(c) Requirements to the functionality / usability of a KM system today and in the future	Groupware	Knowledge Discovery	Mobility	Natural Language Processing	Processes	Semantic Web
Definable access rights	X					X
Supporting arbitrary database systems						
Individual adaptability of system			X			X
Standard Interfaces	X		X			X
Supporting arbitrary operating systems	X					X
System integration capability		X				X
System scalability	X	X		X		X
Usability / Ergonomic user interfaces	X		X		X	X
User driven concept	X		X			

2.5 Aggregated User Requirements

As an intermediate stage between the consolidated and categorized user requirements and the analysis of the four selected key scenarios (which is later described in chapter 3) we furthermore clustered all user requirements of the three main requirement categories *Requirements to solve current knowledge problems in general*, *Requirements to technology in order to solve knowledge problems* and *Requirements to the functionality/ usability of a KM system today and in the future.* As a result of this, we came up with the following 16 main requirements:

- Ambient Access Requirement
- Cost Requirement
- Decision Support Requirement
- Employee Competency Building Requirement
- High Precision Requirement
- Innovation Requirement
- Implicit Knowledge Requirement
- Integration Requirement
- Knowledge Infrastructure Requirement
- Knowledge Sharing Requirement
- Measurement/Confidence Requirement
- Modeling Requirement
- Process-Driven Requirement
- Productivity Requirement
- Reuse Requirement
- Usability Requirement

The clustering of the main requirements was done by the same working group which we have scheduled for the user requirements-technology matching (see chapter 2.3.3).

2.6 Analysis Summary

In chapter 2 we analysed user requirements with regard to next generation Knowledge Management by analysing relevant KM studies, consolidating them among each other and with the resulting requirements of the VISION User Requirements Report and by categorizing them with the help of predefined categories. Second we identified and analysed KM key enabling technologies and the required technologies to solve occurred problems/ identified deficits from our KM Core Show Cases by introducing analysis dimensions and by analysing the technologies according to the introduced dimensions. Finally we matched the consolidated and categorized user requirements against the identified and analysed key enabling technologies for ng-KM.

3 Scenarios

In this chapter we describe our integrated scenario management approach, as well as the selection and analysis of four key scenarios covering user requirements and key technologies with regard to next generation knowledge management. The selected scenarios are used as a means for reflecting the trends and directions of next-generation knowledge management in Europe as well as for identifying most pressing future research issues and for analysing gaps.

3.1 An Integrated Scenario Management Approach

One typical approach to describe the future is to create scenarios. Scenarios are pictures of the future. Scenario management is a method to systematically create pictures of the future. A detailed description is provided in [GFS96]. The overall method can be separated into 5 phases:

1. **Scenario Preparation**: The subject of the analysis as well as the time frame that has to be considered are specified. The outcome of this is the scenario-platform.

2. **Scenario Field Analysis**: Different influence factors are determined, describing the entire system that has to be examined. From these result influence factors with different development possibilities. From this large number of influence factors the substantial ones are picked out in order to go on working with them. They are called key factors.

3. **Projections**: For each key factor one has to consider the different existing projections meaning the developments in the future. For instance the key factor “development of the fuel costs” has the two possible projections “costs are remaining constant” and “costs are multiplying”.

4. **Scenario Building**: The compatibility of different projections from different key factors has to be specified. The compatibility is expressed by a consistency value from one to five (from totally inconsistent to strongly supporting each other). On the basis of this so called consistency matrix a list of projection bundles has to be defined. A projection bundle is a set of projections containing a projection for each of its key factors. These projection bundles are summarized into some homogeneous sets, from which the scenarios are developed.

5. **Scenario Transfer**: The different scenarios are examined and appropriate strategies are developed from them

3.1.1 Scenario Creation Process

The scenario-creation process consists of the three scenario management phases:

- **Scenario Field Analysis**
  Relevant influence factors are determined through a cross-linking of different parameters in organisations and their environment.

- **Projections**
  Based on the achieved influencing factors from the scenario field analysis several development possibilities are worked out

- **Scenario Building**
  The development possibilities are combined to consistent scenarios

Figure 8 shows the three different phases of the scenario creation process as well as their interaction.

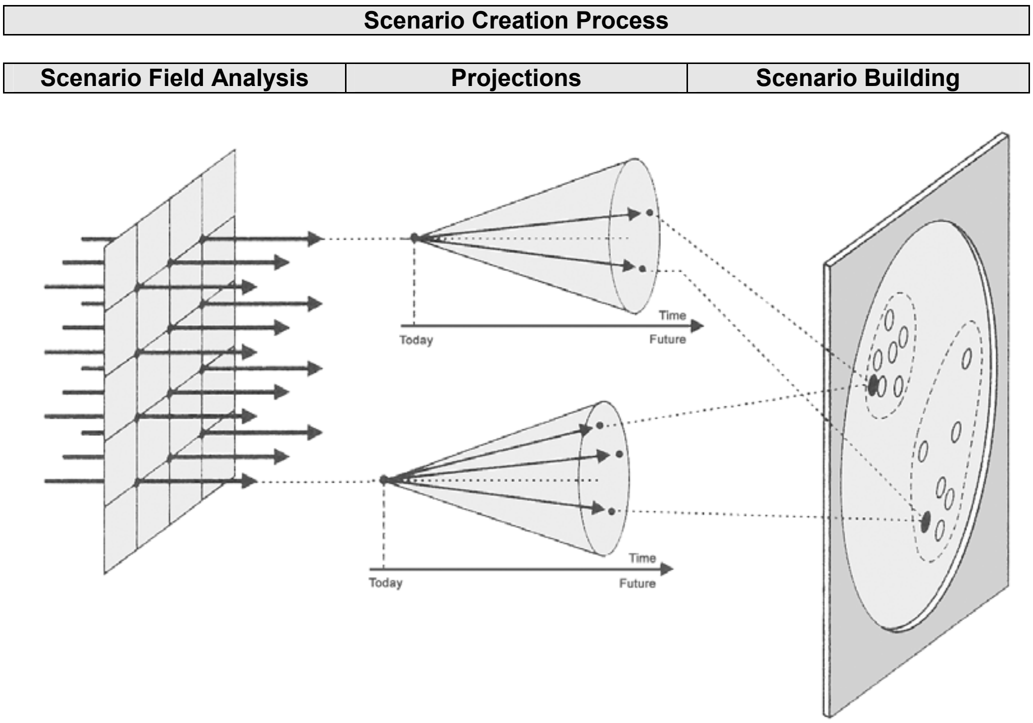


Figure 10: Schematic representation of the scenario planning process [GFS96]

3.2 The VISION Scenario Management Approach

3.2.1 Scenario Preparation

The scenario preparation describes the first phase of the scenario approach. In terms of the VISION scenario development the main objective is to develop disjoint key scenarios taking into account user requirements and key technologies with regard to ng-KM, and additionally considering a short-term (2003-2004), medium-term (2004-2007) and long-term (2008-2010) timeframe for the scenarios to be developed.

3.2.2 Scenario Field Analysis

The scenario field analysis prepares the "foresight" by detecting the influence factors. For defining the analysis dimensions we took as a basis the results of the *User Requirements Consolidation and Matching* (chapter 2.3) and extended them with selected analysis dimensions from the STEEP+C approach of the European KM Forum [EKMF01] which consists of the force field dimensions **S**ociety, **T**echnology, **E**nvironment, **E**conomy, **P**olitics and **C**ulture. Because of our main objective to build a technological-focused roadmap, we focused on technological and economic influence factors.

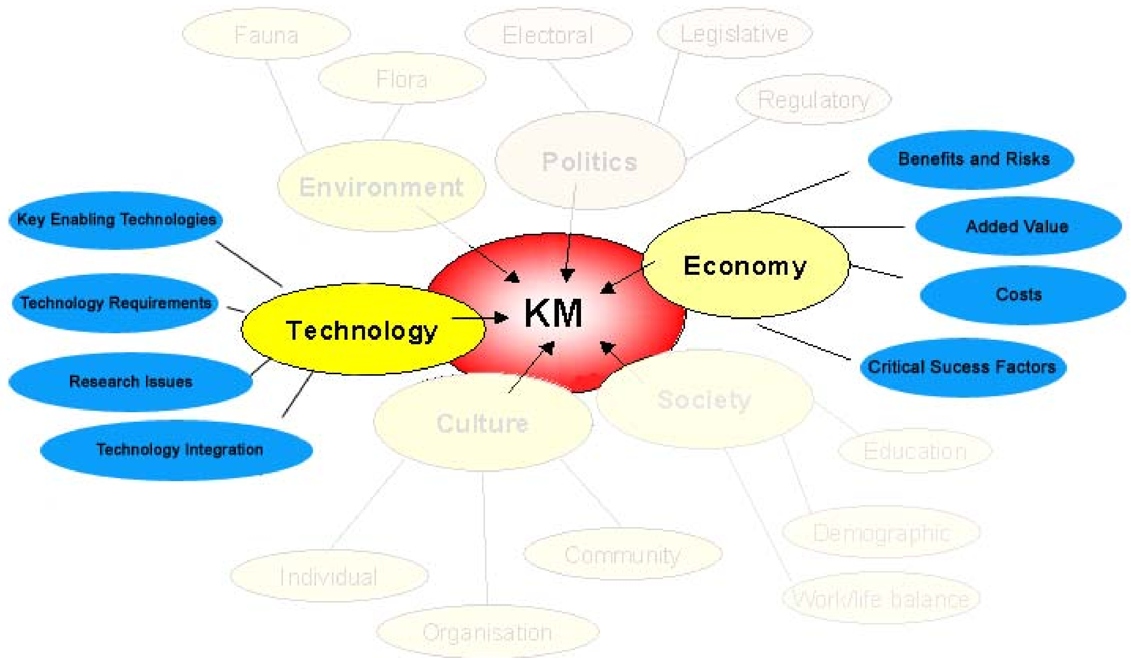


Figure 11: Adapted European KM force field (Source: [EKMF01])

Analysis Dimensions

The technological factors are categorized into three main categories, the key enabling technologies for realizing the selected scenario in general, further technology requirements and most pressing and challenging theoretical research issues considering the different time horizons as well as the required integration of the key enabling technologies. The economic factors are categorized into benefits, risks and added value for a specific technology/application, as well as into critical success factors and costs for research and implementation.

Technological Factors
Key Enabling Technologies
Technology Requirements/ most pressing and challenging theoretical research issues
Technology Integration

Economic Factors
Benefits, Risks
Added Value, Implementation/ Research Costs
Critical Success Factors

3.2.3 Projections

In this phase of the scenario management approach the real "foresight" takes place by acquiring future development possibilities for each key factor received from the scenario field analysis. This is the most important work step of the scenario management approach because the quality of the scenarios depends in the end on the quality of the developed projections.

3.2.4 Scenario Building

Because of the different future projections for the key factors from the projections phase the subject of the scenario building phase is to develop scenarios in which the alternative future projections fit well to each other. The scenario-building phase is divided into the following four sub-phases:

1. **Bundling of projections**
   In this sub-phase combinations of future projections are represented and evaluated concerning consistency and plausibility.

2. **Building of raw scenarios**
   The bundled projections are merged in order to receive "manageable" bundling groups by clustering them.

3. **Future area mapping**
   The future area mapping graphically represents the relations between future projections, projection bundles and raw scenarios.

4. **Raw scenario interpretation**
   This sub-phase determines the unique and alternative characteristics of the particular scenarios. Based on this data, the scenarios are afterwards described in free text.

3.3 The VISION Scenarios

In this chapter we describe the selection of four scenarios covering different aspects of the user requirements and key technologies concerning ng-KM and their analysis using the predefined analysis categories technology and economy. The following two tables show the minimized overlap of the four selected scenarios by the use of a scenario-technology matching as well as a scenario-requirements matching in order to receive disjoint scenarios considering the above mentioned time horizons. We have defined the following four levels of coherence which shall indicate how important / relevant a given technology area is for the respective scenario.

- Not important
- Low importance
- Medium level importance
- Highly important

	Enterprise Knowledge Portals in Action	Mobile Knowledge Access and Usage	Gathering Knowledge from the Web	Knowledge Sharing in Smart Organizations
Semantic Web				
Knowledge Discovery				
Natural Language Processing				
Mobility				
Groupware				
Processes				

Table 1: Scenario – Technology Matrix

	Enterprise Knowledge Portals in Action	Mobile Knowledge Access and Usage	Gathering Knowledge from the Web	Knowledge Sharing in Smart Organizations
Innovation Requirement				
Productivity Requirement				
Employee Competency Building Requirement				
High Precision Requirement				
Decision Support Requirement				
Ambient Access Requirement				
Knowledge Sharing Requirement				
Measurement/Confidence Requirement				
Cost Requirement				
Reuse Requirement				
Process-Driven Requirement				
Implicit Knowledge Requirement				
Integration Requirement				
Modelling Requirement				
Knowledge Infrastructure Requirement				
Usability Requirement				

Table 2: Scenario – General User Req. Matrix

We explicitly chose this way of making very rough qualitative statements in order to avoid detailed discussions about the „real“ relative importance of some technology for a given scenario. What we want to express is that we designed and described the several scenarios in such a way that they can serve as a detailed, illustrative hint about how to bring those technologies into use that are marked by the dark and medium green colour. This should not be interpreted such that no other technology could or should be employed in these scenarios. Merely, we see these technologies as really central for that topics illustrated in the scenario and we aimed at making this idea as clear as possible in the scenario description. Further we designed the scenario such that they point as clearly as possible to very few technologies such that people interested in a focussed presentation of possible future developments in some area can read exactly one or two scenarios which are then explicitly dedicated to these topics.

VISION Key Scenario I – Enterprise Knowledge Portals in Action

3.3.1.1 Scenario description - Enterprise Knowledge Portals in Action

Peter Miller is IT manager in a very large company. He coordinates a team of 30 people. Within the company an advanced intranet-based *KnowledgePortal* application has been introduced. The application helps Peter Miller in his daily management work with respect to human resources, project management, and controlling.

Currently, he is in the process of searching a new person for his team with specific competence in the field of XML query languages. Furthermore, the person should speak and write English and German fluently. Beside that, the person should not be older than 35 and should have more than 6 years job experience. Also soft skills like communication capabilities and team spirit are warmly welcome.

Last week he has published a textual job offer on the *KnowledgePortal*. As the *KnowledgePortal* is an advanced application, it has automatically extracted the required competency request according to a predefined competency catalogue. On this basis, the *KnowledgePortal* semantically compares incoming job applications from outside the company and checks if people inside the company with a matching profile search for a new position.

Peter Miller can check the offers via the *KnowledgePortal*. A semantic ranking shows him how good the different people match with his request. Unfortunately, there are not so many people that have competency in XML query languages, but many people know about XML and have competency in other query languages, e.g. like SQL. Furthermore, the other requirements are only matched partially. Many of the applications are younger than 35 and do not have 6 years job experience. The *KnowledgePortal* helps Peter to navigate through the information and supports his overall decision process.

The *KnowledgePortal* application also provides Peter with instruments to analyze the current state of his team with respect to its competences. A business intelligence component analyzes the competencies of each team member and generates a report for Peter. This report includes information like key figures, performance measures as well as clusters and associations of competencies. Every team member has also access to this tool and can generate a specific report about his own competency status. For example, a decision tree shows possible career paths and necessary requirements to go into these paths such as training in some areas, gathering experience at some positions, etc. On this basis, the *KnowledgePortal* application also recommends specific courses and provides links to relevant online learning resources. To summarize the *KnowledgePortal* application captures the whole development history of an employee in order to support the career planning. It works efficiently based on comprehensive knowledge about skills, occupations, and HR development taking into account all sort of relevant dependencies.

The *KnowledgePortal* is not only about human capital management. It also supports as mentioned above the team members in their daily work. The department in the company that

Peter is leading focuses on internal software projects together with production departments. Currently, Peter's department is running 14 projects. Within these projects, a lot of documents are generated. Those documents are not maintianede on a file server – they are uploaded to the *KnowledgePortal*. Uploading is quite easy, it's just another button beside the save button in the text processor which says "upload to *KnowledgePortal*". This means, the *KnowledgePortal* is not a just a new fancy, but separate application complicating the management of the documents. In order to assure maximum efficiency, it is integrated with all daily working tools, e.g. typical groupware applications and office applications like text word-processors and presentation tools.

Further, the *Knowledge Portal* helps the automation of the business processes managing all the project management and tracking related business objects:

- **Documents** with appropriate meta-information regarding their types (presentations, reports, etc.) dates, authors, versions, current status, etc.
- **Organizations**, including external ones. Business units and branches of the big organizations can also be handled. Organization-level contact information is kept. This helps Peter maintain information about his contact persons within the software vendors and consultants his branch works with.
- **People**, with their positions within the organizations and roles within projects. Skills and career details are maintained for the employees, but not for people in external organizations. Relevant contact information for the people is being managed.
- **Tasks**, with all the related information: who and when assigned this task to whom, when it is expected to start, what resources will be necessary, what is the current status. Braking down the tasks into sub-tasks is also possible. The information about tasks is also automatically recorded as experience of the person who accomplished the task. This supports the career tracking and planning functions of the portal.
- **Meetings**, with their locations, start time, estimated duration, etc. The Knowledge Portal takes care of the standard scheduling problems, including to avoid conflicts in the schedules.

Peter's organization is using a project management system suitable for big projects and teams which is introducing unnecessary complexity into Peter's relatively small projects. The *Knowledge Portal* is not trying to replace the project management system, but rather integrates with it and synchronizes the data on a regular basis. The *Knowledge Portal* is also integrated with the Payroll/ERP system of the organization, so, it can estimate/account for the total expenses associated with the tasks. This allows more optimal planning of the tasks as well as tracking the efficiency of the people.

The business objects within the portal can all be classified according to categories (subjects, classes) forming a multi-dimensional inheritance lattice. The objects are automatically classified when they get added to the portal or modified. Peter and his colleagues can override the automatic category – in such cases, the *Knowledge Portal* is learning on its mistakes and trying to avoid them in the future. Peter can also define business rules such as "All specifications (a category of documents) to be sent for approval to the database administrator". The later is specified in terms of position within the organization, so, when the DB admin get replaced, the rule does not need to be updated.

Users are special sub-set of the People known to the portal, which have some rights to work with the *Knowledge Portal.* The users can see and edit the business objects according to their privileges. Peter can easily define and manage comprehensive security policy allowing him to constrain or grant rights to classes or categories of objects, to specific objects, to specific relations and attributes and so forth. The appropriate roles and permissions should not be defined from scratch, the *Knowledge Portal* knows all the typical schemes and practices, so, there is no need Peter to define rule that allows the creators of the documents to modify them, disregarding are they allowed to play with this category of documents. It also automatically grants number of rights to the project leaders with respect to the tasks, meetings, documents, and generally all objects which somehow belong to the project. The security policy is based on the formal semantic description of the business logic which Peter is maintaining. For instance, some time ago, there ware series of problems related to urgent updates in software systems running in production mode which led to inconsistency in the corresponding databases. Than Peter introduced a rule that each software development task assigned, should pass through a "Ready for QA" state and be turned into "Ready for Production" state by the Quality Assurance engineer responsible for the project.

Comments can be assigned by the users to the business objects, so, efficiently there is a discussion list associated with each object. Using this mechanism, the employees can discuss in a series of comments the updates necessary within a document, specifics of some task, or organizational details (say the agenda) of a meeting. It is extremely easy to send these comments via email – the *Knowledge Portal* is integrated with the email server and automatically collects the messages.

As a basis for semantic integration, Peter's company has developed a general reference model describing the core concepts related to its business and used in documents. Beside this general reference model, Peter's department has developed a refined and specialized version to capture all necessary requirements and specific features of the department. The document metadata generation process according to the reference model relies on the text analysis capabilities introduced above and reduces the overhead for generating metadata manually.

The *KnowledgePortal* does not only support capturing knowledge in daily work, it also supports knowledge usage. Due to the common reference model and the integration with standard applications, users can ask complex questions and get concrete answers. Peter for example has defined a semantic bookmark that automatically generates an overview on project deliverables, associated people, associated topics and delivery dates with the constraint that the projects started in the first period of 2003 and will end in 2003.

Other team members typically ask for similar documents when starting to write a new document, e.g. a project report, to learn from existing reports. Another interesting feature is that the overall reference model of the company also includes the competency catalogue.

That means, when a person finishes a project that was about XML query languages, he will be asked to add this to his competency profile. This means that semantic references between the different heterogeneous applications are generated and explicitly represented.

In the past, before the *KnowledgePortal* application has been introduced, Peter spent a lot of time with the hard-to-use enterprise resource planning (ERP) tool and in specific with its finance module. The problem was that the finance module was designed for controllers and not for IT Managers, so it was quite complicated for Peter to do his work with this tool. As mentioned earlier, the *KnowledgePortal* application builds on an enterprise application integration framework which means that it allows for access and usage of the ERP system. A specific advantage of the *KnowledgePortal* application is that it hides the complexity of the ERP system by showing Peter only the information that he really requires, a semantic view on the ERP module is realizing this feature. The *KnowledgePortal* application allows Peter to align the costs of the project with the progress with respect to project planning and deliverables, which saves him a lot of time. Earlier, he had to collect this information from distributed systems. The *KnowledgePortal* application goes even further and computes business performance measures integrating the different views, from human resources, to the daily project work to controlling.

Finally, the Knowledge Portal is capable in notifying his users regarding specific changes. For instance, the users can ask to be notified each time when document with specific category and other features get added or updated. It is easy to customize the notification strategy, so, to avoid receiving too many notifications, but to ensure that important notifications are sent promptly.

3.3.1.2 Scenario Analysis – Enterprise Knowledge Portals in Action

The following table depicts the analysis results of the scenario *Enterprise Knowledge Portals in Action* with regard to the predefined analysis categories technology and economy which are later used as a basis for the development of the concerning roadmap.

Technology	**Analysis Results**
Existing Enabling Technologies	• Groupware, project management and other CSCW systems • Information retrieval and document management systems • Natural Language Processing platforms and tools for Information Extraction, Classification, Summarization • Data-mining tools and techniques • Semantic Web platforms and tools: semantic repositories
Key Research Areas	• Semantic Web • Natural Language Processing • Knowledge Discovery • Business Process Modelling, Management, and Automation

Technology Requirements/ most pressing and challenging theoretical research issues	• Semantic Storage, Reasoning and Querying with support for: o Scalable Instance Reasoning o Multiple Ontologies, including alignment and data translation/mediation/integration for the purposes of EAI o External procedural “oracles” (properly interoperating with the declarative semantics) o Decision-making related optimization methods (scheduling, logistics, resource planning, etc) o Access control based on formal and semantically sound business logic specification o Manageable and efficient integration with existing DBMS, including clear methodologies for re-use ER, UML, ORM models o Rule-based semantics (proper relation with the “static” Tarski style semantics) • Business Process Management: o Semantics-based models covering all ERP aspects o End-user business process modelling, including simulation o Cross-catalogue and multi-catalogues product classification and management, including catalogue integration • Data Mining for end users with application in the human resource field, as well as Relational Unsupervised Data Mining • Natural Language Processing o Automatic metadata extraction o Extraction and generation of project documentation o Document classification beyond basic taxonomic classification by example
Technology Integration	Combination of ontologies and natural language processing for competency extraction, Integration of Groupware Technologies and Semantic Web for Semantic Collaboration

Economy	Analysis Results
Benefits, Risks	Improved efficiency is an obvious benefit. Further, better usage and development of the human capital is also very important. Low precision may result in bad performance of the overall system. The multi-purpose ontologies necessary can become hard to design back of luck of a common sense (upper-level) ontologies.
Added value, implementation/ research costs	Better access to the information. High costs for setting up the application, which includes building quite complex semantic resources. The integration can appear quite hard/expensive
Critical Success Factors	Scalability, Integration, Manageability
Position of Europe	Advanced in ontology modeling, data mining and basic NLP. Lack of integration and interoperability

The analysis below is discussing general technology involved in Scenario I, however the SWOT is not limited to the functionality needed within the scenario.

SWOT Analysis				
	Strengths	**Weaknesses**	**Opportunities**	**Threats**
Semantic Web	Strong academic research which is capable in dictating the "fashion" based on European strengths in the related areas. Leadership regarding some of the basic technologies.	Relatively few companies doing basic SW technology with global visibility	To establish few major technology platforms developed. The multi-lingual environment in Europe can be a natural boost for more semantic-oriented (web) content management.	Two major threats: – The SW may not get wide acceptance; – To miss the momentum and let US fortify their leading position.
Natural Language Processing	Strong expertise and technology in multi-lingual terminology, machine	Relatively weaker on summarization and lexical semantics-based IR, while there	To become leader in enabling NLP-technology for the masses. The long-term winner will be	Total NLP means total AI. While the latter can not be expected soon, any NLP

	translation. Also strong IR and IE, but in competition with US	are number of commercial products in US. The NLP depends on common sense and Europe lacks projects like Cyc. Also, part of the applied research in US is funded and drove by major office software vendors – also missing in Europe.	the first who can offer a Java lib managing to add value to almost any software in an understandable and manageable way. This means to provide the engines for Knowledge portals.	technology is a wise compromise. So the threat is to fail defining a solvable task(s) and to fail communicating to the IT society.
Business Process Management	Number of companies with good positions (SAP, Siemens, ILOG) in related areas like ERP. Quite advanced academic research in BPM related to ontologies (knowledge acquisition and engineering) and (Semantic) Web Services. Also good research in automatic product classification.	Still the lead is in US, mostly because the concentration of huge corporations – the natural users. BPM is related (in technology terms) to e-Business which is weak in Europe. Not much tradition (apart from few companies) in rule-based systems.	To establish standards and technology leadership in Semantic BPM, which still in its baby steps. To establish industrial leadership in automatic product classification; this is critical for b2b environments and hence very important for BPM.	The major risk is to have new BPM platforms organically growing the b2b-related standards, where US has a lead. A failure in capturing the related supply-chain management, ERP and CRM trends can also be critical.

3.3.2 VISION Key Scenario II – Mobile Knowledge Access and Usage

3.3.2.1 Scenario description - Mobile Knowledge Access and Usage

Journalists repackage information to make understandable and interesting reports[2]. In radio journalism the tempo is usually high and little time is available for preparations. Reporting is also often conducted away from the radio station. The journalists will therefore have to report events on topics that they are not very proficient with. The need for mobile KM support in such situations is extensive.

The time is 11:00 am and John, who is working as a field journalist at a radio station, has just finished a report. As he walks to the car he receives a call on his mobile phone. It is his colleague, Robert, telling him that the board of the ice hockey club Frölunda Indians just announced that they are going to give a press conference.

John remembers an article from a morning newspaper "The Metro," where the club was accused of tax avoidance when paying salaries. Robert asks John to go there and do a report for the 12:30 news. He points out that an interview with the chair of the board would be great. John and Robert discuss the details of the task and while talking, John uses his handheld next-generation KM TOOL to make some notes. The notes are automatically annotated with metadata referring to John's personal ontology. Explain further?

John's task is now to report from the press conference and do an interview with an appropriate framing. John is neither an expert in taxes nor in ice hockey, but will be able to do a satisfying report if the background and framing comes in place. John takes a minute to structure his notes into an entry on the To Do tab of his KM TOOL. Thereafter, he connects his next-generation KM TOOL to the server via his mobile phone, activates the To Do entry and chooses Send to do in the Connect menu. A list of metadata items is returned and John chooses the ones that fit and clicks on the Accept button. A few seconds later the results arrive and the mobile phone disconnects. John takes a look at the Archives tab where a list of internal documents is displayed.

The metadata describing the documents gives John an overview of what has been done internally on the topic. It seems like economic crimes in the restaurant sectors are common and John also notes an article about well-known economic criminals. John realises that perhaps this kind of crime has spread to a new sector. This may be an interesting introduction to the report, John thinks. John continues through the tabs and looks at the External tab to see what the newspapers and other competitors have reported on the topic. Again, metadata helps him to focus his search and the large space of external information. "It's just the Metro article that is of value I suppose," John says to himself, realizing that he already knew that case. He also checks the People tab. His colleagues, who at present are on duty and have been working on the topic previously, are displayed here. The quality of John's report is likely to increase if he discusses the topic with someone more experienced. When John arrives to the press conference he plans to contact some colleagues who may

[2] Inspired by http://citeseer.nj.nec.com/417704.html

help him. Since Erik pops up on top of the People tab, he is regarded the most appropriate colleague for John to talk to. Erik is, however, out of the office and there is no answer on his mobile phone. Instead, John calls Annie, who is second on the list. Annie answers the phone. John knows that she has been working on white-collar crime. Annie and John discuss questions like, “are there any similar cases?” and “does any board member risk jail?” Annie thinks that the case is not clear enough to be talked about in matters of punishment yet. They agree, however, that he could ask about bad accounting practise. The communication between John and Annie results in that John becomes aware of some appropriate angles of the report from an accounting perspective.

John hangs up and enters the room where the press conference has just begun. There are a lot of other journalists and people from the ice hockey club there. The chair immediately states that “I will not give any interviews. We’re giving the press conference. That’s all.” The board’s main message is that they are not guilty, but that they have started an internal investigation. They will not further comment until the investigation is finished. John thinks: “OK, what to do now? I need to have something interesting to report. Let’s consult the next-generation KM TOOL.”

John sneaks outside and takes a look at the People tab. The third entry is the sports journalist Peter Svensson. “Oh Peter, of course,” John says to himself and gives Peter a call. They start a discussion about what has happened. John asks whom to talk to since the chair did not want to be interviewed. Peter mentions that the accountant of the club, Thomas Søderlund, may accept to be interviewed, “He is the next in line to be the chair of the club.” John agrees that Thomas Søderlund is suitable, because they really need an interview to complement the article in the Metro. John asks some more questions, e.g., “is it common with tax avoidance in ice hockey or sports in general?” and “is this the first case nationally?” Through the use of Peter’s expertise and John’s knowledge of local conditions the framing is collaboratively established. This kind of situated information is rarely accessible in a next-generation knowledge management system. Furthermore, the time constraint makes direct communication with Peter the best way for John to get the information. The press conference ends and John asks the accountant Thomas Søderlund if he minds being interviewed. Thomas accepts and John contacts Roy the technician at the studio to coordinate the broadcast. Roy tells him to be prepared to go on the air in a minute. John turns to Thomas and waits for Roy to tell him when to start.

Roy gives a sign and John opens by saying “What we are used to hear from the real estate and restaurant sectors has now entered the professional sports.” This framing of the news was derived from the timely information provided by the Next-generation KM TOOL. John continues by saying, “Here with us is Thomas Søderlund, the accountant of Frölunda Indians. Thomas, what do you think about these accusations?” Thomas replies, “We use a lot of agents internationally to contract players, and I cannot say for sure whether they have done anything illegal.” He continues with “We are doing an internal investigation, and I do not want to comment this further until the investigation isfinished.” After this John asks about the effect on the sport and they elaborate a bit on the question. Then he hears Roy in the earphone saying ten seconds left. John thanks Thomas and ends the interview.

The next-generation KM TOOL supported John in his efforts to make good quality journalism. He had not enough knowledge to be able to ask the right questions and frame the report. When the chair refused to be interviewed John used the next-generation KM TOOL to locate someone who could help him to find the second best interviewee. Furthermore, Annie and Peter helped John to find an appropriate angle for the report. A traditional Knowledge Management system that focus on problems would not have given John any of the support he needed to manage his task since he had no actual “problems.”

John walks back to the car. On his way the mobile phone beeps as he receives a text message. Apparently something that may affect John’s work has happened. John connects his next-generation KM TOOL and a bell is shown on the third To Do entry. He becomes aware that his work might not be unique in relation to some other activities at the channel. The channel’s repertoire must be considered as a whole as similar reports should not be broadcasted without different foci.

John activates the entry and checks the Match tab that uses semantic similarity measures. It appears as if Sue is planning to conduct an investigation involving a political scientist. John gives Sue a call and they both agree that two political scientists on the same day is too much. They agree that the best thing is to drop the political scientist from John’s program since Sue’s program is focused on politics. In this case the next-generation KM TOOL assisted to prevent a potential cross report. A negotiation had to take place to settle if there was a need to change foci or content of the reports.

This scenario provides an integrated view onto the field of mobile knowledge management and describes a possible application. The autonomous nature of mobile work makes central control unsuitable. The local and unique circumstances that people confront give them knowledge that is situated and local. Also, the actions of people give rise to new local knowledge and situated actions, thus the tasks evolve. In situations when the tasks of co-workers are overlapping, it is useful to interrelate the knowledge that each person possesses. In a mobile and distributed organisation it is never possible for anyone to have complete overview at any point. On the other hand, planning of potentially interesting tasks can be done by a common resource, e.g., an editor at a newspaper. Empirical research implies that people take notes to reduce the complexity of their tasks. Our empirical results suggest that task-related notes are useful in mobile situations to facilitate remembering. In this respect, the notes are a representation of a “prospective memory”. This suggests that a mobile knowledge management architecture should support the user’s tasks, as they evolve. It should also notify the users of interdependencies between tasks, and provide access to tasks that are potentially interesting.

Nota bene: as a side remark for all these four VISION scenarios, it should be noted that they aim at an as clear as possible, exemplary illustration of future technology usage. Hence we searched for application areas which could profit most from the respective technologies. Of course, this does neither imply that these are the only nor that they are the best application area one could think of. We just searched some illustrative figure to transport our ideas. Of course it is up the our readers to get the basic ideas of each scenario and then identify other useful application areas besides journalism etc.

3.3.2.2 Scenario Analysis – Mobile Knowledge Access and Usage

Technology	**Analysis Results**
Existing enabling technologies	• Groupware (including mobile access with sufficient bandwidth)
Key research areas	• Automatic semantic annotation • Semantic Querying • Semantic Indexing • Semantic Similarity • Information extraction and document retrieval technology
Technology Requirements/ most pressing and challenging theoretical research issues	• Semantically annotated documents and multimedia contents • Reasoning mechanisms (proof, trust, temporal logic, etc.) • Smart user interfaces • Heterogeneous Ontology Querying • Ontology Learning
Technology Integration	• Groupware extended with metadata • Integration of semantic technologies with groupware and other office applications • Mobile aspects and translation facilities between languages and formats)
Economy	**Analysis Results**
Benefits, Risks	Benefits: • Better information access allows for broader employment of journalist, beyond their fields of expertise • Higher professionalism through better information access • Faster, more opportunistic way of working: better and faster news • Pro-activeness: system comes with proposals and identifies needs and collisions in reporting autonomously Risks: • Journalist in the field depends on technology • Trust and proof: how trustworthy is the information which is annotated, how belief worthy are the authors of the information? • Temporal and chronological issues: especially in news scenarios it is important to have the right chronological sequence in events. Can the technology guarantee this? • Mobile access/mobile coverage: can a journalist really, fully depend on the technology? • Ease of use: if KM Tool appears too complex, time-constraints will prevent it from being used.

Added value, implementation/ research costs	Added value: • System leads to increase in efficiency, professionalism and time-usage • High costs for developing better Natural Language Processing tools in combination with automated semantic annotation • Ontology generation and utilization in groupware systems and real-world environments • Semantic based querying in real-time and on incomplete specifications
Critical Success Factors	• Issue of trust and proof well dealt with, user trust in place • Good mobile coverage, 100% uptime
Position of Europe	• Mobility: relatively good, not perfect • Semantic technology: in the forefront of global research, upper layers of the semantic model (trust and proof) still have to be resolved

Status Report – projects and products

Within Europe, there exists research on many of the aspects regarding mobility issues related to sharing of (sensitive) information within (future) KM. On issues like security for data and communication, several industrial initiatives have led to technical solutions for securing communication[3]. However, many issues regarding trust and privacy are not solely to be solved on the technical level, but remain on the level of politics. In 1980, the OECD published the OECD Guidelines on the Protection of Privacy and Transborder Flows of Personal Data. In 1995, the European Commission issued the Data Protection Directive (EU Data Protection Directive 95/46/EC (DPD 95/46/EC: 1995) to harmonise data protection legislation in Member States. In 1998 the new privacy law became effective within the EU. If it comes to privacy and trust, a number of research projects can be found.

Some EU funded projects on privacy and trust:

- The Privacy Incorporate Software Agent (PISA) project, which aims at building a privacy guardian for the electronic age. The PISA-project produced a Privacy and PET for ISAT and a PISA-agent as shareware.
- IST project: Cybersecurity and dependability of information technology systems (JRC Italy). A comprehensive set of initiatives to trust and privacy in networked environments.

[3] See f.e. the EU granted EWIS-Forum (European Warning and Information System) and AMSD (Accompanying Measure on System Dependability) project.

- IST project: RAPID: Roadmap for Advanced Research in Privacy and Identity management, aimed at developing a R&D roadmap for research in privacy and identity management.
- IST project: GUIDES: developing a set of guidelines for assessing the compliance of Internet based data processing technologies to the EU Data Protection Directives.

Commercial solutions to the issue of Trust and Privacy of data are few. Large enterprises like Microsoft have solutions aiming at making trust and privacy easy to handle by the layman (which seems to be an initiative to follow), they are nearly not based on more generally accepted solutions or open source. However, there is currently one non-profit initiative by a network of sponsors (mainly large, international enterprises) which starts to become a kind of standard, eTrust. ETrust is a US based non-profit privacy initiative, promoting “privacy seals”. Technology adopted by both AT&T, EU Safe Harbor Privacy Seal and others. The technology is freely available for those who want to use it. It provides guidelines plus licences and “quality logos” for those who reach the required privacy levels staked out.

On the other hand there are several large institutions dealing with the issue of privacy and trust. With the W3C originating P3P initiative as an important initiative, there are some smaller projects known from other standardisation organs (like ISO), but these are seldom as coordinated and focused as the P3P initiatives.

Strengths	Weaknesses	Opportunities	Threats
Several smaller initiatives within Europe.	Standardisation in P3P coordinated by US –based W3C	Bringing together current European initiatives might deliver necessary momentum in global standardisation efforts	US lead initiatives like P3P form a potential thread for EU policies on security, if EU fails to show presence within such initiatives.
Privacy an issue that is thoroughly dealt with by the Commission on a political level already. Good directives available.	No major European initiatives for practical application and use (cf. US – based eTrust)	Bringing together current KM initiatives, mobility initiatives and privacy & trust initiatives could ensure and enhance Europe’s position within global negotiations on policies and agreements.	US lead networks and initiatives dominate further development and standardisation.

Most Member states have a clearly defined policy on personal privacy, often reinforced by law.	Finding agreement on a global level is typically a painstaking and slow process.	Europe has some experience with multi-cultural negotiations on important issues from other fields (agriculture, monetary union, etc.)	Difficulty to provide globally acceptable and usable solutions to privacy and trust might harm future KM initiatives and uptake.

3.3.3 VISION Key Scenario III – Gathering Knowledge from the Web

3.3.3.1 Scenario description - Gathering Knowledge from the Web

Over many decades the proportion of knowledge workers has been rising, whilst the numbers of those working in, for example, manufacturing and agriculture has been falling. All the evidence suggests that this trend will continue well into the new century. Indeed, as more and more nations join the club of the developed world, this trend may even accelerate. Wealth will increasingly be created by the manipulation of knowledge.

All knowledge workers share certain characteristic activities; be they historians, physicists, financial advisors, or simply the private individual researching a topic for his own personal reasons. One of the chief amongst these activities is the need to locate relevant information rapidly. In this respect the World Wide Web has been a great boon to knowledge workers. From the office, home, or even coffee bar, it opens up a vast library of information to the knowledge worker.

However, the current WWW has very little metadata to describe its information. This gives rise to a number of limitations. In particular, for the knowledge worker, the search process lacks precision; based as it is on a search for matching text strings. Let us say we are searching for an article we believe was written recently by Tony Blair, the British Premier, on some key issue, say the current situation in Zimbabwe. The search will inevitably return many articles written by others about Zimbabwe, which mention Tony Blair. It may even return articles mentioning Zimbabwe, and written by a quite different Tony Blair – “My cycling tour of Zimbabwe”, by Mr Tony Blair of Neasden. In the worst case there may be so many ‘hits’, that finding relevant articles will be very time-consuming.

We want to know that the author of an article is Tony Blair. We want to know that the author is the Tony Blair, who is currently Prime Minister of the United Kingdom. We also want to locate articles written by a Mr. Anthony Blair, who also happens to be the British Premier.

The Semantic Web will enable this vision. In this next generation of the WWW much, possibly most, of the information will be semantically marked-up. At the very least articles will identify their author, their date and their subject matter. This identification will not be by means of a text string which can be ambiguous, as in the above example of two different individuals with the name ‘Tony Blair’. Instead, it will be by means of a ‘uniform resource identifier’ (URI), which will be unique to Prime Minister Tony Blair. Imagine a political scientist, Sally, working anywhere in the world, who wants to research the extent to which Tony Blair’s stance on Zimbabwe has changed over the space of a year, and what factors may have created that change. In the world of the Semantic Web, Sally will be able to search for everything written by Prime Minister Tony Blair over a specific time-period. She may also be able to search for transcripts of his speeches. Moreover, mark-up of information will not stop at the level of distinct articles or reports, but will also be present at the level of sections within articles. So Sally will be able to locate articles written by political commentators which contain transcripts of Tony Blair’s speeches within in them.

Having located and read everything she can find which Tony Blair has written and said, Sally wants to move on to consider how others have been reacting to, and possibly influencing, his stance on Zimbabwe. She can, of course, do this by searching for articles on Zimbabwe by other leading figures which mention Tony Blair. One such leading figure might be Mr. Iain Duncan Smith, the Leader of the Opposition within the British parliament. Again, she can ensure that she only locates articles written by that particular Iain Duncan Smith. Moreover, she can ensure that in the articles located in which Mr. Iain Duncan Smith refers to Tony Blair, he is, in fact, talking about Prime Minister Tony Blair, and not some other namesake. In Sally's case this latter occurrence is hardly likely. However, as has already been noted, Sally could be physicist, historian, lawyer, accountant or whatever, and the subject matter could be anything at all. So the ability to ensure that a reference to a person or thing really is a reference to the person or thing of interest, is valuable.

As Sally moves through the key world political figures to determine their attitudes to Tony Blair's Zimbabwe stance, she is faced with a great deal of reading which does not sit easily with the deadline for the article she is writing. She starts to request summaries of each article. She can request a reduction in word-length to 10% of the original article. If she is interested in a particular piece, she can request a further summary at 50%, say, and if she remains interested she may then read the whole article. Technology to do this exists today, but with semantically-annotated information, the process of summarisation will be done more intelligently.

Sally has now searched for articles about Tony Blair and Zimbabwe written by all the key actors on the British political stage. She wants to open up the search for articles on this topic without being specific about their author. Even the Semantic Web will start returning many more hits than she can deal with. Sally wants to visualise all that has been written on this subject. She wants to understand the relationships between the articles, e.g. which articles appeared in the same journals or newspapers. She wants to understand the relationships between the authors, e.g. who have worked together or published jointly, or are members of the same organisations. She wants to understand how these relationships have changed with time. Her Semantic Web browser enables her to do just this. She can visualise these relationships in 2 or 3 dimensions and navigate her way through the information space. This enables her not just to understand these relationships and how they have influenced particular individuals' views on the topic, but also to identify clusters of similar articles, and also articles which appear to be unique. This ensures that whilst she cannot read everything, she does read something representative of every viewpoint. Sally can not only visualise relationships, but her Semantic Web software toolset also uses inferencing algorithms to make deductions about these relationships. As Sally continues searching, her system will have the capability to enhance her defined search strategy with metadata extracted from the documents she finds most interesting. The system will often know better than Sally how to precisely define her interests.

Sally is also keen to know what other workers in her field have found valuable. A collaborative environment accessible via her software toolset enables Sally and her co-workers to share interesting articles, indexed using the metadata embedded in each article.

When Sally wants to share an article, she no longer needs to explicitly think about which of her colleagues would wish to read it. She merely saves the article, or rather its URL, to a collaborative space where the metadata embedded in the article will identify a potential readership. She can, of course, also link in her own comments on the article. So, conversely, Sally can look for articles which her colleagues have found interesting and which are relevant to her current work. The software identifies the *relevance* of an article, strictly in terms of its relationship to Sally's interests. It is Sally's colleagues who decide that a document has sufficient *value* to be worth spending time reading it. Of course, some of Sally's colleagues and co-workers may be sitting in the same building as Sally, or they may be on the other side of the globe.

Besides all this, Sally needs to be sure that the information she is accessing is accurate. She is working on the public WWW and the scope for hoaxes, and simple mistakes, is enormous. Her browser uses technology such as public key encryption to ensure that when she accesses a respected newspaper, she is not the victim of a hoax web-site. Even when she is certain of the provenance of what she is reading, can she really trust it? Can she trust the comments by a political observer unknown to her, perhaps on the other side of the globe? Outside of the world of the WWW, Sally has built up a web of trust. She has long learned to trust a particular writer, having read many of the man's books and articles and even having met him on a number of occasions. This particular individual now speaks highly of a young political scientist, who has not yet written very much. So when Sally sees an article by the newcomer, she is inclined to trust its accuracy. Sally now finds that this same philosophy is being incorporated into the Semantic Web. Chains of trust are being developed automatically, and trust is even being quantified. In Sally's domain, individual political scientists ascribe a trust factor to particular piece of work, or to a particular individual's work. Sally can view these trust relationships and even determine to what extent there are warring camps amongst workers in her field.

Of course, none of this comes for free. Sally is able to do all this because of the wealth of semantically-annotated information available to her. Much of this information has come from so-called 'legacy' data, which existed prior to the development of the Semantic Web. Software tools will be used to help mark-up up this legacy data. Ideally such tools would be fully automatic. In reality they will be semi-automatic, requiring some human intervention.

In Sally's particular case she is interested chiefly in topical information created since the development of the Semantic Web. Much of this information will have been created using annotation tools which encourage the insertion of metadata by the documents' authors. This will be done in part by making it very easy and natural to insert metadata, and also by using semi-automatic metadata extraction tools to suggest metadata to the author as a document is being created. Sally has to play her own part in this process, whilst she is writing her own articles.

When data is annotated, whether semi-automatically or fully manually, this is done against a framework, known as an ontology. Some ontologies will be applicable to all knowledge, e.g. to describe the properties of a document such as its author, creation date etc. Others will be created for specific topics, e.g. to describe the British political constitution. However, there will also be specialised ontologies, perhaps to describe current events in Zimbabwe, which will be generated by a semi-automatic learning process. This might be applied to legacy data, or it might be applied to data as it is being created. Moreover, ontologies need to evolve over time. As the practicalities of the British constitution change, so will the ontology describing its change. As Sally and her colleagues are creating new documents, the document creation tool will develop and evolve the specialised ontologies, by making suggestions about modifications to them. While an ontology is evolving, metadata describing existing documents using the ontology will need to be updated, to reflect the changes in the ontology. This same ontology learning process will be used to develop and evolve ontologies in the collaborative environment described above. So when she and her colleagues are working on a topic of common interest, an ontology can be precisely tuned to describe the topic.

As an intelligent and highly trained knowledge worker, Sally will probably have some understanding of the concepts underlying the use of ontologies. However, she will not want to think about the details of ontology implementation, and this is all the more true for the many less highly trained knowledge workers who will use the same knowledge access tools. Hence all the details of ontology implementation will be shielded from the user by easy-to-use interfaces.

When Sally has finished for the day she goes home to the flat she shares with her partner Simon, a research biochemist who is intent on finding a cure for cancer. Simon works for a large pharmaceutical company and is also clearly in the camp of ‘knowledge workers’. They sometimes discuss their work and its similarities. Simon uses the same or similar software tools to Sally. In Simon’s case he does not just search the WWW for information, but also specialist databases maintained by his company in-house or available from third-party information providers. However, the problems Simon faces and the approaches he uses are very similar. The information which Simon is seeking is to be found in articles and brief reports across a company intranet or extranet, using much the same technology as is used for the WWW. Simon is seeking to understand the relationship between chemical compounds, and the effects they have on individuals. He needs to review reports of experiments critically, and he wants therefore to understand relationships between the authors of particular reports. He is overwhelmed by data, and he needs to have it summarised and to be able to visualise it.

Simon is also very impressed by the inferencing capabilities of his software toolset. He tends to use this facility much more than Sally. Like the information which Sally is seeking, the compounds which Simon studies, their relationships and their effects, have been described using so-called ontology languages. These languages permit rich relationships to be described, which is particularly valuable in Simon’s work. Simon is able to use the inferencing algorithms, incorporated into his Semantic Web software toolset, to make deductions about these compounds. At the simplest level, compound X is of type P. Type P compounds are know to have a certain effect on patients also taking a quite different compound Y, possibly for an altogether different illness. Therefore compound X should not be taken in conjunction with compound Y. Simon finds these inferencing capabilities, which give him access to a vast distributed expert system, invaluable.

The training which Simon brings to bear on the information he locates is very different from Sally's; but the process of locating and critically assessing information is not so different, and requires the same or very similar tools. Indeed, all over the globe millions, if not billions, of knowledge workers will be using the Semantic Web to do their jobs more accurately and more swiftly.

3.3.3.2 Scenario Analysis – Gathering Knowledge from the Web

Technology	**Analysis Results**
Existing enabling technologies	• Basic Internet technologies • Information retrieval and document management systems
Key research areas	• Ontology languages, ontology creation, management, evolution and mediation • Human language technologies • Inferencing techniques • Knowledge visualisation • Contextualized Collaboration • EX Post/Ante Semantic Web Object Identity • Usability • Trust
Technology Requirements/ most pressing and challenging theoretical research issues	• Robust inferencing techniques • Natural Language Technologies for metadata extraction • Understanding the usability issues of how people can best use semantically-based knowledge technologies for knowledge searching and knowledge sharing. This will probably include the use of knowledge visualisation techniques. • (Longer term) Understanding theoretical and practical aspects of implementing proof and trust systems on the Semantic Web
Technology Integration	• Integration of Semantic Web Technologies with Natural Language Technologies • Integration of semantically-enabled KM technologies into proprietary IT solutions, e.g. for CRM.
Economy	**Analysis Results**
Benefits, Risks	• Ability to obtain the precisely required information quickly • Ability to share information on the basis of precise interests, i.e. without overwhelming the collaborating parties • Risk of accepting information from uncertified sources – need for proof and trust mechanisms

added value, implementation/ research costs	• Added value in speeding knowledge work, and making possible new ways of working.
Critical Success Factors	• Integration of the three core technologies (ontologies, knowledge discovery, human language technologies) • Understanding of usability issues and integration with 'business as usual' for knowledge workers
Position of Europe	• Good research activities in core technologies • Empolis GmbH (part of Bertelsmann group) is a key commercial exploiter of semantic technology. • Europe has a number of SMEs who have good expertise in exploiting the core technologies. • Standardisation dominated by W3C, which is headquartered in the U.S. • I.T. industry in general dominated by U.S. companies.

Technological Requirements of the Scenario

We already have some of the pieces in place. The Resource Description Framework (RDF) has now been defined by the World Wide Web Consortium (W3C). Building on XML, this provides a data modelling framework for knowledge, using a structure based on triples of subject, verb, and object. The Resource Description Framework Schema (RDFS) then provides mechanisms to describe ontologies, using concepts such as classes, sub-classes, sup-properties, domains and ranges. This, however, is limited and various attempts[§] to extend this by defining a richer ontology language are coming together to create the Web Ontology Language (OWL) which is about to be finalised by the W3C[4i].

At the same time, tools and software components are appearing. The Protégé project (http://protege.stanford.edu/) at Stanford University has constructed a tool which enables the user to construct a domain ontology and enter domain knowledge. In the commercial arena a number of companies are offering products. Empolis (http://www.empolis.com) has developed its k42 knowledge server, based on Topic Map technology, which is a forerunner to and analogous to RDF. k42 includes a knowledge author to create and maintain knowledge in the form of Topic Maps.

[§] Chief amongst these are DAML (the DARPA agent markup language) in the U.S. and OIL (Ontology Inference Layer) in Europe

[4 4] A brief overview of the technologies underlying the Semantic Web is given in: The next steps for the WWW – putting meaning into the Web, Paul Warren, Computing and Control Engineering, IEE, April 2003

The European 5th Framework project On-To-Knowledge[5] has generated a number of tools which help take a further step towards the vision. These include a search engine, QuizRDF, which combines an ontological approach with standard text-based search facilities. This is necessary in part because for a long time, if not permanently, a great deal of information on the Web and in intranets will not be semantically-annotated, and also because it is believed that users will find a search strategy based on using both techniques valuable. Another tool developed within On-To-Knowledge is Spectacle, for visualising ontologies.

In reality what has been done so far represents only a very few initial steps. There is considerable work to be done before achieving the full vision.

There is a need for a creation and editing tool which generates and populates OWL-based ontologies. This is likely to include a visualisation facility, to help overcome the abstract nature of the ontological approach.

End-users need a search engine which can inference over OWL statements, e.g. using equivalences and other relationships to identify required information. Underlying this is the need for inferencing techniques which are scaleable and which can take account of the inconsistencies which will be found in heterogeneous globally-distributed knowledge bases. One issue to be resolved is whether tool developers can work with the full OWL language, or whether for efficiency reasons they will need to use a restricted version, known as OWL Lite.

Currently, the effort needed for the modelling of ontologies and the specification of metadata is the main obstacle for introducing ontology-based KM applications into commercial environments. A promising approach for reducing this overhead is through the semi-automatic learning of ontologies and the semi-automatic generation of metadata from various sources, especially texts and databases. This will enable the initial setup of a KM application by using a rather light-weight ontology and then refining the ontology step by step. In that way, the entry barrier for such KM applications could be reduced drastically. These semi-automatic techniques will make use of a combination of knowledge modelling, language technology and data and text mining.

This semi-automatic approach can, of course, be applied to the great corpus of Web data which is created without markup, including the legacy data which exists before the Semantic Web comes into being. However, there is also a need to generate metadata as a side-effect of performing usual business tasks. One approach is, of course, to use contextual information available as the task is being undertaken, but this can also be supplemented by semi-automatic ontology learning and metadata generation techniques.

The development of semi-automatic techniques for ontology learning will be an ongoing task over a number of years. Current research activity is aimed at well-structured data, i.e. data which contains a consistent structure. The focus of research will move on to semi-structured data. At the same time the issue of scale will need to be addressed, with techniques

[5] The results of the On-To-Knowledge project are described in: Towards the Semantic Web, Davies, N.J., van Harmelen, F. and Fensel, D (eds), Wiley, U.K., 2003

designed for increasingly larger knowledge bases. Research is also needed to investigate how to use these techniques on the so-called ‘hidden Web’, i.e. knowledge which is not easily accessible to web-crawlers because it is embedded in databases and only retrievable against specific queries.

Once created, the ontologies and their related metadata need to be maintained. Methods and tools are required for keeping the effort needed as low as possible and for providing suggestions for updating the ontologies and metadata. The exploitation of usage mining for the adaptation of ontologies to their actual usage is one approach to this. Another approach is the identification of new concepts and relationships that are missing in the ontologies when compared to the current text and data sources.

Switching between the handling of the business task and the usage of KM support often distracts the user from his or her task. A smooth integration of KM support into the handling of business tasks would avoid this distraction. Seamless integration is required both at the process and systems level. One issue to be addressed here is how to learn user profiles for making push services user-specific. Another issue is the identification of relevant content and / or activities that might activate the push service, e.g. recognition of names, important concepts, etc.

The full vision described requires the implementation of webs of trust. At the moment there is little work in this area, the current focus of the Semantic Web being at the ontology and logic layers. There is currently work in the academic community on trust inference calculi across distributed information systems. This is an area for research, both into formal mechanisms for establishing trust and into the human and psychological aspects of how such mechanisms can be used.

3.3.4 VISION Key Scenario IV – Knowledge Sharing in Smart Organizations

3.3.4.1 Scenario description - Knowledge Sharing in Smart Organizations

As groupware, technology designed to facilitate the work of groups, addresses the vast area of collaboration, human-computer interaction, and human-human interaction, it is nowadays considered as one of the main enabling technology for KM across individuals, teams and organisations. The following VISION key scenario called "Knowledge Sharing in Smart Organisation", based on the Smart Organisations concept, stresses the central role of groupware and business processes in the Next Generation KM for supporting the process-orientated knowledge exchange within teams, organisations and networks. It shows as well that groupware will play a key role in KM systems interoperability issues. This scenario is taking place at the enterprise level and focuses on:

- quick cooperation implementation between the SMEs
- managing interorganisational business processes by understanding the support role of knowledge
- helping SMEs to concentrate on core competencies and to put resources together.

The "Smart Organisation" concept will play a key role in the next decade for SMEs. It addresses basically needs for flexibility and customisation and the current market move from tangible products to services. This will as well especially allow the development of trans-European co-operation that will constitute an important business opportunity for SMEs to compensate for their lack of size:

- This approach will help them to face authoritarian international control in management practice applied by large companies
- Cooperation will become the method for SMEs to establish themselves in new markets
- This approach will help them to become internationally competitive in global markets
- SMEs won't need budget to copy the acquisition strategies of large corporations and to develop the classic strategy of crossborder activities by setting up production and/or distribution facilities in other European countries

Our scenario consists of five SMEs - Martin S.A., Meyer GmbH, Jørn A/S, Thijs B.V. and Brown Ltd – that are respectively coming from France, Germany, Danmark, the Netherlands and the UK. They are aiming at cooperating temporally for the development and the commercialisation of a new software product and each of them provides very specific competencies (CRM, mobile technologies, agents, localisation and ASP).

The grouping wish to collaborate to grow the market for their products in Europe by exploiting new project opportunities, especially in market sectors where the partners is not widely used today. They have declared their cooperation as European Economic Interest Grouping (EEIG) called "EU-Net". Traditionally the co-operation took place with the usual communication means (phone, emails, fax, post), based on decentralised activities planning and execution, and using not interoperable infrastructures. In order to make the collaboration successful next generation KM-based groupware will be employed. The co-operation framework, the knowledge exchange and monitoring and the inter-organisational processes will be electronically supported by the "Smart Organisation Manager" (SOM).

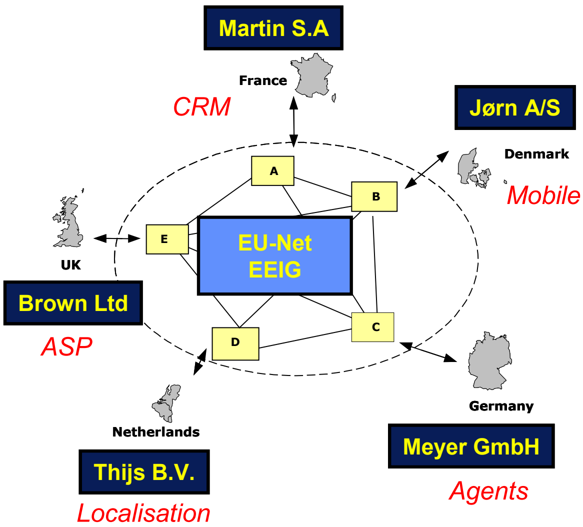


Figure 12: EU-Net EEIG - Trans-European Smart Organisation

The "**knowledge-based smart organisation**" of EU-Net will consist of networks of workers and organisational units, linked by the Smart Organisation Manager, which will flexibly co-ordinate their activities, combine their knowledge, skills and resources in order to achieve common goals but without very much by way of traditional hierarchical modes of central direction or supervision. Such arrangements will form and reform as problems arise so providing a flexibility of response to changing circumstances and organisational needs.

The Smart Organisation Manager will address the needs of EU-Net at the following level:

- Network knowledge exploration: EU-Net actors will be able to access to dynamic knowledge continuously growing based on actors' contributions – the "EU-Net knowledge world" - and to follow EU-Net activities by themselves and according to their needs. This exploration room will not be as usual limited to individual company frontiers but will also **cover the network co-operation room**.
- Knowledge communication: EU-Net actors will get **access to direct knowledge support on-demand** everywhere and every time. Contact persons are easy to find and different communication references are available. Translation communication service will also be proposed. Synchronous groupware applications will particularly serve the socialization process by supporting people communicating in real time over distance (e.g Video conferencing).
- Knowledge collaboration for inter-organisational business processes: the Smart Organisation Manager will support collaboration between EU-Net employees to synchronise activities (extern communication, appointments, documents sharing etc.). They will facilitate identification and creation of communities of interest, best practice and

expert systems within a single intuitive user interface. Implementation of such communities will be led in the framework of virtual departments or projects for instance. Further those groupware will support better and faster knowledge exchange across boundaries and support for the use of information and the capture and sharing of knowledge inside communities. Knowledge co-operation will be enhanced through **interorganisational workflow**.

- Knowledge presentation: the Smart Organisation Manager will offer to all the users from EU-Net a self-controlled knowledge acquisition allowing users to decide when and how to get the information. Presentation will be also related to the specific business processes that are taken into account. It will allow **a personalised single and simple point access** to relevant EU-Net information and offer **multilingual access** (French, german and English) to the employees. There are currently 11 official languages of the EU and the need for multilingual products and services will increase particularly taking in account the next enlargement of the European Union. The Smart Organisation Manager will address this European language diversity.

Furthermore, the Smart Organisation Manager will achieve knowledge **transparency** within EU-Net while guarantying data security. During the last years it was established that trustworthiness, in terms of both quality and delivery, was a prime factor in smart organisation membership. Collaborations may result from existing relationships where trust has been developed through direct experience but this would reduce a lot the potential of smart organisations development. These trust developments are directly linked to important human factors and trusting the other is essential to create new smart organisations. The solidarity and the congruence of objectives are not achieved by legal contracts but are based on a common business comprehension, dialog and transparency. EU-Net actors **need to know each other, to be aware of individual responsibilities, knowledge and business processes roles and to be able to monitor the activities of each other**. The Smart Organisation Manager will help them to manage interorganisational business processes by understanding the support role of knowledge.

Moreover, working within smart organisations requires intensive knowledge co-operation capability **anytime and everywhere**. The Smart Organisation Manager will be accessible from any place en Europe in order to guaranty to EU-Net efficient and on-time co-operation and communication. Co-operations between EU-Net companies geographically far way from each other require a high level of individual reachability to compensate the physical meetings difficulties. Moreover, the increased mobility of EU-Net employees at the regional, national and international level also means that communication capabilities with the Smart Organisation Manager will be available everywhere. The Smart Organisation Manager will group working features available in a mobile environment to the workers, managing staff and administration forces.

The creation of EU-Net implies gathering knowledge and competencies. Thus each member of EU-Net will **concentrate on its core competencies** and pursue a strategy of intensive outsourcing. In this way the EU-Net manager will manage EU-Net with regard to the competence of the different partners and individuals available. The Smart Organisation Manager will support the specifications and the description of knowledge, knowledge areas and responsibilities in relation to business processes. It will enable the dissemination of all those information through EU-Net. Thus, at the early stage of EU-Net, the organisational and individual partnerships will be first defined at the competence distribution level in order to cover the life cycle of the co-operation project. Discussion between EU-Net actors will lead to the specification of inter/intra-organisational teams as well as the specification of different individual responsibilities to be implemented into the Smart Organisation Manager. These teams will support intensive co-operation between employees working on similar area (financial, development, management etc) or linked at the business processes level.

Finally, an efficient and reliable EU-Net network will be not only dynamically operated but also **dynamically reconfigured**. EU-Net configurations will change during its lifecycle in response to knowledge needs and constraints or business processes changes. Thus a real ”On-Time Knowledge Organisation” is provided with the Smart Organisation Manager. It will address this need for flexibility and dynamic management and offer easy reconfiguration capabilities.

Concrete Scenario Sample

Following is a concrete scenario presentation of the efficient set-up and running of the EU-Net, based of the network example described before.

- ***EU-Net EEIG Setting using the SOM: React Quickly to Business Opportunities to Build International Partnership***

- Martin S.A declares a new initiative called „Eu-Net“ (objectives and needed partners/knowledge) within its SOM. A 1rst EU-Net platform is generated.
- The SOM searches and identifies online potential partners (pre-selection) by checking their online accessible information on profile/knowledge/competencies.
- Pre-selected companies/responsibles are invited to join the EU-Net initiative platform to discuss with multilingual as-/synchronous systems (recorded) and provide inputs about cooperation possibilities.
- After discussion and partners validation, the SOM generates semi-automatically a cooperation scenario and send the partners the EU-Net EEIG offer based on:
    - the collected information on companies profile/knowledge/competencies
    - and information coming from discussions and new inputs.
- After agreement and adjustment, the SOM generates a cooperation contract (EEIG) electronically signed and then directly sent to the related registration office
- The platform moves to an effective cooperation structure within „few clicks“:
    - Select competent persons for the EEIG office and overtake of the platform by the office
    - Generate a virtual multilingual inter-organisation platform for all people involved (communities of interest, competencies, virtual departments or sub-projects)
    - Specify individual access rights
    - Implement necessary workflows structure between all actors and link them to available knowledge

EU-Net EEIG Running

- 8:00 A.M - Task status analysis: Mr Durand, member of the RTD team of the EU-Net EEIG Office, starts its personalised SOM. He notice his task for today: „an update of the technology state of the art related to the current NEWTOOL prototype" (to be submitted to the EU-Net business manager). Previous State of the Arts are shown as well as all preliminary necessary expert contacts and previously used documentation.
- 9:00-10:00 A.M - Resources exploration and uptake: Mr Durand collects and validates first knowledge resources to be used for the task:
    - Explore the partnership knowledge network
    - Check previous reference documents for eventual update
    - Find some additional new related papers and reports.
    - Use translation facilities that are offered by the SOM.
- 10:00-11:00 A.M - Expert knowledge collection configuration: Mr Durand organises multilingual video conferences with selected EU-Net technology experts to get inputs:
    - He allows them to access the current status of this task and the associated knowledge resources.
    - He requests for specific inputs which suggestions may be done directly in the task working area.
    - After validation, those sub-tasks are direcly integrated into the own experts' working plan.
- 11:00-16:00 A.M - Expert knowledge exploitation, evaluation and validation: Experts start providing comments and remarks and recommend/submit additional resources:
    - Various communication means are used (smart phone, chat, emails, etc).
    - Everything is recorded, translated and retranscribed as valuable text (if necessary), and directly put together as knowledge input for the task.
- 16:00-17:00 A.M - Mr Durand integrates all inputs with editor facilities. The first document is shared for experts feedback and short corrections. It will be sent one day latter to the business manager to help him prepare his task: to make strategic decisions for further prototype development in cooperation with all partners.

3.3.4.2 Scenario Analysis – Knowledge Sharing in Smart Organisation

Technology	**Analysis Results**
Existing enabling technologies	• Basic Mobility Support • Business Process & Workflow Management
Key research areas	• Groupware • Semantic web • Advanced process management
Technology Requirements/ most pressing and challenging theoretical research issues	• Interoperability of groupware systems • Integration of semantic web in groupware • Linkage between groupware, processes and KM approaches • Multilingual content management
Technology Integration	Integration of: • Business processes modelling • semantic web technologies in the global groupware framework to support flexible inter-organisational collaboration
Economy	**Analysis Results**
Benefits, Risks	Benefits: • Efficient trans-European SMEs collaboration opening new business opportunities and increasing competitiveness • Reduction of collaboration costs Risks: • Difficulties in ROI evaluation • Solutions non adapted to SMEs needs • Multilingual barriers not enough addressed
added value, implementation/ research costs	The expected economic added value is high for: • Individual SMEs: it enables them to develop new offers partnerships and enter new market. • The global European SMEs marketplace: It allows the building of a coherent collaborative SMEs environment supporting the European knowledge economy leadership. Research cost could be high to ensure interoperability of groupware, address correctly security issues and offer multilingual environment. An important research effort still have to be done to link groupware, processes and KM approaches.

Critical Success Factors	• Achievement of an interoperability framework for groupware systems • Cooperativeness level of SMEs to overcome knowledge or leadership losing fears. • Successful economic demonstration of the “Knowledge Sharing in Smart Organisation” scenario to overcome the uptake gap and stimulate investments.
Position of Europe	Interoperability, standardisation, scalability, integration
Culture	**Analysis Results**
Individual	Fast access to knowledge in the network increasing work efficiency and understanding of individual role and competencies.
Organisation	A high level of cooperativeness from SMEs is needed to overcome corporate culture seeing knowledge transparency as dangerous.
Community	The development of a coherent collaborative SMEs knowledge environment will support a high uptake of KM approaches.

SWOT Analysis				
	Strengths	**Weaknesses**	**Opportunities**	**Threats**
Groupware	Knowledge and technologies for multilingual environment	No real concrete evaluation method of ROI Solutions still not enough adapted to SMEs needs Multilingual barriers not enough addressed	• Efficient trans-European SMEs collaboration opening new business opportunities and increasing competitiveness • Get a key position in the multilingual groupware market.	Leadership of US with non-multilingual solutions that do not really respond to European market needs
Semantic web	European academic research which are capable of influencing standardisation activities Leadership of Europe regarding some	No standards for companies profile/knowledge/competencies description Not enough global Semantic Web technology Standardisation activity dominated by W3C,	To establish few major technology platforms developed. The multilingual European environment can boost the development of semantic-oriented (web) content	Delay to develop agreements agreement in Europe on Semantic Web leading to reinforce IT leading position of the US. US-centric nature

	of the basic technologies.	which is U.S. based organisation	management. Consolidate leading position of European knowledge-intensive industries, e.g. finance, pharmaceuticals overtake dominant non-European I.T. companies with European semantic web technology	of W3C could lead to U.S. commercial dominance. Technology complexity may discourage uptake. Dominant U.S. I.T. companies could buy up semantic web technology, wherever it is developed, to strengthen their existing position.
Processes	Number of companies with good positions (SAP, Siemens, ILOG) in related areas like ERP. High knowledge in process modeling methods and solutions (SemTalk, ARIS, etc) Quite advanced European academic research in Business process Management related to	The e-Business technologies, supporting Business Process Management, are weak in Europe Not enough modeling for relation between business processes and needed knowledge Europe is fragmented into many national markets. This is the case for both Business- to-Consumer and Business-to-Business.	To establish standards and technology leadership in Semantic BPM, which still in its baby steps. To establish industrial leadership in interorganisation processes management; this is critical for b2b environments and hence very important for BPM. To bring together ERP, CRM, SCM and groupware technologies into the scope of inter-organisational processes.	Results in Business Process Management could strengthen the e-Business and b2b technology leadership of the US. Failure in harmonising SCM, ERP, groupware and CRM trends and standards.

	ontologies (knowledge acquisition and engineering) and (Semantic) Web Services.			
Mobility	Homogenous European market (GSM, GPRS, upcoming UMTS)		Homogenous European technologies allowing development of global solutions, strong impact and large technology exportation Play a key role in standardisation activities	US-centric nature of W3C could lead to U.S. commercial dominance.

4 Roadmap

4.1 Introduction

Given a set of user requirements as well as a set of key enabling technologies, the process of defining a roadmap provides a way to develop, organise, and present information about the critical technology requirements and performance targets that must be satisfied by certain time frames, if an organisation is to meet the demands of future markets. The roadmap also identifies technologies that need to be developed to meet those above named targets and finally provides the information needed to make trade-offs among different technology alternatives.

4.2 Roadmap Methodology

A *Technology Roadmap* identifies alternate technology "roads" for meeting certain performance objectives. A single path may be selected and after that a concrete plan has to be developed. If there is high uncertainty or risk, multiple paths may be selected and pursued concurrently. The roadmap identifies precise objectives and helps to focus resources on the critical technologies that are needed to meet those objectives. This focusing is important because it allows increasingly limited R&D investments to be used more effectively.

4.2.1 Roadmap Types

Kostoff et al. [KS99] broadly classified roadmap applications as follows:

- S&T (Science and Technology) Maps or Roadmaps
- Industry Technology roadmaps
- Corporate pr Product-Technology Roadmaps
- Product/ Portfolio Management Roadmaps

Furthermore there exist two fundamental roadmapping approaches, the *expert-based approach* and the *computer-based approach* as well as the determination of the *prospective* and *retrospective* approach. The different approaches are described in the following:

Expert-based approach
In the expert-based approach nodes, attributes and links are identified and developed by a group of experts. The paradox of this approach is that the adequate expertise is available not until the completion of the roadmap. Therefore Kostoff et al. strongly recommend an iterative roadmap development process.

Computer-based approach
The subject of this approach is to analyse large textual databases (published papers, reports, memoranda, letters, etc.) that are describing science, technology, engineering, and end products by the use of generic computerized methodologies. The relative importance of the areas as well as their relationship is estimated and quantified. The advantage of the

computer-based approach is to get more objectivity because of not having preconceived limitations, constraints, biases and personal and organizational agendas of the experts.

In VISION we mainly pursued an iterative expert-based approach. Further we can distinguish:

Retrospective roadmaps:
Retrospective studies begin with a successful final product, given target technology or project and go backwards in time in order to identify the characteristics of successful research and development.

Prospective roadmaps:

> **Technology-push prospective roadmaps**
> This roadmap type starts in the present with existing research projects, looks forward in time by filling in "the remainder of the roadmap to identify the diversity of capabilities to which this research could lead" [KS99].
>
> **Requirements-pull prospective roadmaps**
> The approach of this roadmap type is to begin with favoured products and filling in "the remainder of the roadmap to identify the S&T which is necessary to arrive these products" [KS99]

Retrospective-prospective roadmaps:
Retrospective-prospective roadmaps combine the development of a technology in the past "with a vision of where the technology is headed" [KS99].

Hence we followed in VISION mainly a retrospective-prospective approach inspired by our Consortium vision of ngKM.

4.2.2 Benefits of a Technology Roadmap

A Technology Roadmap

- can help develop a consensus about a set of needs and the technologies required to satisfy those needs
- provides a mechanism to help experts forecast technology developments in targeted areas
- can provide a framework to help plan and co-ordinate technology developments within a consortium.

The main benefit of a technology roadmap is that it provides information to make better technology investment decisions by identifying critical technologies or technology gaps. These gaps must be filled to meet next generation knowledge management performance targets and to identify ways to leverage R&D investments through coordinating research activities either within a single company or among alliance members.

In addition technology roadmaps can inform science and technology policy and program expenditure decisions across government and promote longer-term thinking on technology, innovation and R&D issues. They can furthermore

- influence major research and innovation founders to focus on the priorities identified in roadmaps
- encourage a multi-disciplinary approach to resolve key non-technical barriers
- increase technology transfer across sectors
- foster industry cost sharing in government projects and encourage dissemination of technologies once developed
- identify current national capabilities and gaps in knowledge infrastructure to deliver critical enabling technologies
- highlight areas of national expertise where there is potential for emerging industries to evolve

4.2.3 Elements of a Technology Roadmap

- **Skills/Science/Know How**
  Required to deliver the technologies. Again these may or may not be resident within the organisation.
- **Deliverables**
  Desired or expected performance. Associated with this will be knowledge of the benefits of achieving the targets and recognition of the impact of external influences on the company.
- **Resources**
  All aspects of human, intellectual, physical and financial assets, together with the identification of the internal and external sourcing requirements. This part of the TRM is the expression of the costs.
- **Time**This dimension can be adapted to suit the particular situation in terms of time horizon. Space on the roadmap can also be allocated for vision and very long range considerations, together with the current situation, to define the gap between the current position and the visionThe groupings and interactions of technologies needed to permit the deliverables to be attained. Each in its turn will provide the objectives of the programme of supporting projects, either directly or through a hierarchy of sub-TRM's.

4.3 The VISION Roadmap

In this chapter we describe the four expert-based roadmaps which we have developed on the basis of the selected and analysed scenarios from chapter 3. The roadmaps provide an expert-based consensus view of the future science and technology landscape concerning next generation knowledge management. We have defined the following three levels of evolution of specific technologies along a timescale from now until the year 2010:

- Basic Research
- Applied Research
- Software Technology

In the following four subsections we derive from our four VISION scenarios the respective technology roadmaps.

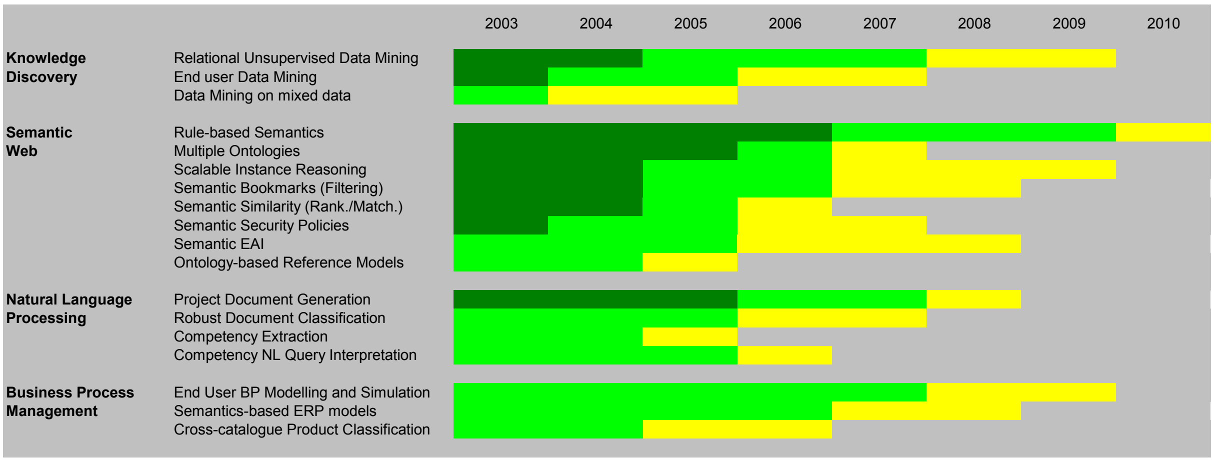
4.3.1 Roadmap for VISION Key Scenario I - Enterprise Knowledge Portals in Action

There are two characteristics of the scenario which affect the technology roadmap. On one hand, the technologies involved are quite diverse. Although there are obvious synergies possible (like for instance between the Semantic Web and NLP), their development is by far not aligned and concerted, even more, the basic research often takes place within academic communities which are relatively isolated, so, the knowledge and technology transfer can take a long time.

On the other hand, portals are a quite well developed niche in the KM market – there is a wide variety of products which share functions and objectives with the hypothetic one described in this scenario. Those products vary a lot in complexity, maturity, price and function – from an ordinary static web-portal labelled as "KM solution" to systems based on complex semantic representation and/or mature linguistic technology.

Due to the nature of the market, the existing products have a strong position. Building of a knowledge portal requires quite a lot of implementation effort on behalf of the enterprise. It also requires quite a lot of specific skills and extensive customer-tailored integration work. For this reasons the effect of locking of the customers to their technology providers and system integrators is relatively strong. Thus, the natural expectation for development of the market would be that the existing products and solutions will be organically developed and enhanced taking benefit of the new technology when it becomes available. This means that the technologies can be expected to penetrate into the products via OEM-like schemata when they become available as easily understandable and manageable components. Thus the following scenarios are unlikely to have big impact (i) a completely new product providing the functionality of this scenario or (ii) different pieces of the technology offered directly to the end-users.

Thus, the forecasts below can only indicate when specific functionality can be expected to be added to the products already on the market.



A more informal and general analysis on the short-, mid- and long-term perspectives follows in the subsections below.

Phase1: Short-Term Future (2003-2004)

Within the next couple of years, none of the research areas can be expected to have considerable impact over knowledge-portal like applications. The basic reasons are discussed below.

The **Semantic Web** is still more a vision than a mature technology. Although the vision is nice and it got relatively wide-acceptance, its development is limited by the necessity of more meta-data and formal structure regarding the content. It can hardly be expected that a critical mass of formal semantics can be gathered manually, i.e. during the process of authoring the content or via some sort of post-processing. The first is unlikely; the second is too expensive and questionable in terms of accuracy. For this reason any sort of major development in the Semantic Web is locked by the development of technologies which can more or less automatically gather the semantics and the structure from unstructured, under-structured and miss-structured content. This means the Semantic Web depends on the development of NLP and Knowledge Discovery.

There is quite a lot of potential to be used based on **NLP** techniques at the level of applied research at present. However, at the level it presently is, this sort of technology has few major problems:

- After the enthusiasm about the stochastic methods for NLP in the 80s and 90s of the previous century, it becomes obvious that those bear some natural limitations. So, the expectations that those will easily solve the problems at a price much cheaper than the symbolic systems vanished.

- To deliver what the people expect, NLP requires basic common sense reasoning in a manageable and efficient wrapping, which is unlikely to happen soon. Without this, all products and implementations are relatively limited either in scope either in accuracy, which makes them in the worst case either non-reusable (so, labour extensive) or in-efficient.
- The existing technology is still too far from its break-even point. The vast amount of effort invested in applied research and development still hasn't paid off, which combined with the high efforts per implementation answers why the products using it are considered “haute couture”. Having limited penetration, NLP-related technology can hardly mature and develop further.

Within the **knowledge discovery** area, the major problem is the pre-processing of the data – there are many systems which can deliver interesting results if there is an expert to define and implement the proper pre-processing (which often requires NLP). Although some recent trends such as FCA and others are trying to offer solutions, this cannot be expected to happen in the scope of a couple of years.

Business Process Management is probably the most important research area regarding the efficiency of the Enterprise Knowledge portal, as it is defined in Scenario I. However, the development within this area is hard to predict due to the reasons listed below:

- BPM is an interdisciplinary area; its core is formed within a number of economical sciences and not in the information or computer science.
- Although a lot of research is being done, the level of formalisation of the results is still too low in order to allow efficient modelling and automation.
- The interest in investments in applied research and technology for BPM was quite high during the dot-com and eCommerce booms. As a reaction, in the present situation in the most developed countries, the investments are relatively low.
- In many cases, the computational complexity of the models necessary for BPM prevents their implementation due two lack of storage and reasoning infrastructure to support it at the proper scale. It often happens what a BPM system requires scalable instance reasoning combined with rule-based semantics.

In summary, the **short term tendencies** regarding the Enterprise Knowledge Portal are that the existing products will start slowly but surely be enriched in the following directions:

- The knowledge representation and engineering infrastructure already available in the Semantic Web community is getting to the point of efficiency and maturity where semantic repositories will start taking the places of the relational and the OO databases, offering more flexibility and more comprehensive access to the data.
- Some light-weight NLP techniques are already making their way into the “classical” information retrieval and document management systems. For instance, functionality such as indexing and classification of documents with respect to the real-world entities referred within them is already knocking at the door and can be expected to appear in Enterprise knowledge portals soon.

Phase2: Mid-Term Future (2005-2007)

In addition to the specific problems forecasted in the diagram, within the scope of 3-5 years, a number of more general changes in the landscape can be expected to affect the Enterprise Knowledge Portals:

- The Semantic Web can be expected to mature and get out of the deadlock. Because of this the underlying infrastructure can be expected to become more robust and allow easy development in number of KM areas which benefit from the same basic technology (say, the organizational memory);
- The Semantic Web Services (SWS) can be expected to develop, so, to make the EAI an easier task. This will depend mostly on the proper consolidation and development of the enormous number of currently competing standards and initiatives. Development in the SWS area will be a major boost for the BPM technology.

Phase3: Long-Term Future (2008-2010)

It is extremely hard to predict the development of the related research areas in such scope. Here follow few aspects which can be expected to have impact on the scenario in general:

- A critical mass of research can lead to break-through in the common sense modelling. This will have impact on both NLP and Semantic Web technologies. A system with basic common sense will better analyse the sentence ”Due to the death of X he became a QA on project Y” – it is obvious that X is not taking the QA position, but the existing NLP systems can make such mistake, because they cannot formally distinguish between “dead”, “success” and “experience”. In the Semantic Web (and a general reasoning) context, a system with common sense will be able to properly respond the query “What people does John know in company C?” if it knows that “John is spouse of Mary” and “Mary is marketing assistant in C”. Unfortunately, most of the existing systems do not “know” that if one person is a spouse of another s/he obviously knows him;
- If the hardware is developing with the same or similar rate, it will become possible for the semantic repositories to more and more take the place of the databases. At present, one of the major problems with the semantic repositories is the insufficient efficiency with respect to the hardware which is currently in use. For instance, a machine with 100GB of RAM is likely to be capable to mange in graph-like structures in its memory all the information typically managed in RDBMS our days.

4.3.2 Roadmap for VISION Key Scenario II - Mobile Knowledge Access and Usage

Phase1: Short-Term Future (2003-2004)

Mobility:
"By 2004/5, we expect 65%-75% of enterprise to deploy extension to mission critical applications for wireless and/or pervasive platforms, and expect 75% of corporate knowledge workers to be mobile at least 25% of the time."

MetaGroup, trends in mobile future 2001

As can be concluded from this citation of the MetaGroup, the inclusion of real mobility within business applications and scenarios is to be expected sooner rather than later. There is a clear trend towards inclusion of mobile devices into daily working life of people, where wireless applications allow for an incredible flexibility if the prerequisites are taken care of (see further details below).

Groupware
Currently Groupware is integrated in many of the open source projects, a wide variety of platforms are supported and software is generally available on good conditions. This means that there is a good and robust basis for fast further development of Groupware in order to be included in the scenario on mobility. Many Groupware vendors have already realised that mobility is going to be a major feature for Groupware systems in the nearby future and are thus extending their products with necessary functionality.

Natural Language Processing (NLP)
Within the field of KM, quite soon we are likely to see more intelligent applications popping up that make use of voice control on mobile platforms. However, already now such technology is integrated within telephone services, cars, mobile phones, laptops, etc. But NLP is more than voice recognition alone. It is also expected that the systems of the nearby future will start to show a rudimentary understanding of what a written document is actually all about. Systems will need to be able to read, understand and act based on information (knowledge?) that is found in a variety of documents and databases. Those systems need to be able to also combine spoken with written words.

A not clearly separated problem within the world of NLP deals with multi-linguality. Due to the low threshold for people to work within other European countries, an increasing need for translation services, or simply multi-lingual availability of important documentation, will be important. A profound example is the CORDIS database, maintained by the commission. CORDIS contains all important funding-call documents in all official languages of the European Union. Such databases are not easily searched through using semantic search engines that exist today. Another example is the availability of laws for the construction of buildings in Norway. Very many (of the) construction workers in the country are from Sweden and Denmark and can in principle communicate verbally, but experience problems when it comes to the understanding and knowledge about and of Norwegian law.

Knowledge Discovery (KD or KDD)

Only recently the fields of Data Mining and Text Mining have begun to merge into a more unified field. Whereas previously the focus was much more on pure data analysis tasks, there is a current trend towards embedding mining techniques within applications and devices where they where previously not found. This trend is probably coordinated with the personalisation trend in the device industry in general. Already a few years ago, a user could buy voice recognition software that, by reading some well-known fairy tale aloud to the system, showed the capability to adapt to the user's voice. More recent initiatives include the mining of user context (e.g. Advertisement adaption according to User profiles or their general behaviour as in Google, Amazon.com etc.).

Knowledge Discovery becomes incredibly powerful if combined with the earlier mentioned natural language processing techniques. It provides the power to automatically analyse, annotate and restructure/reindex document in databases or distributed amongst various machines. On the short term it is expected that this kind of technology will go through the “hype” phase, where many applications will be identified and probably prototypically implemented. Certainly in combination with the semantic web and web services technology, it is expected that this hype will live until the middle/end of 2004. Applications for (semi-) automatic annotation of documents on the web are available from various sources and applied in numerous trial projects. Not so many approaches are actually performing fully automated processing and annotating of such documents, and those that usually employ technologies from the areas of knowledge discovery and data mining.

Semantic Web

The semantic web initiative has so far just started. The international Semantic Web Conference goes into its second round in 2003 and already there is a variety of technologies available that can support the semantic web. Although no generally accepted standard is yet defined, both W3C and ISO are doing their best in order to come up with some standards that can be used for this purpose. There are still a few severe shortcomings of the semantic web, of which the most important might be the lack of fast and robust inferencing (A-box reasoning) and semantic query engines. Some academical approaches exist, but no real scalability tests have been made so far.

Phase 2: Mid Term Future (2005-2007)

Ideally, short term visions gradually transfer into long term visions. For the mobility scenario this implies the following:

- it is important to start initiatives to deal with the challenges identified in the long term,
- while also taking into consideration the outcomes of short-term technical and theoretical improvement

This seems to be a rather well known trade-off in business. If it comes to the 5 factors (mobility, Groupware, NLP, KD and Semantic Web) we have identified for the roadmap for mobility scenario, we can identify the following:

Mobility
In the short term it is expected that many devices become available dealing with mobility aspects and improving the ability to communicate in dynamic and mobile scenarios. These applications and solutions will then lead to the identification of a few key issues that will have to be tackled next (cf. “long term future” section below). It might also lead to a few changes in focus, most probably an increased focus on the issue of security, privacy, trust and proof will arise. Besides, it is expected that a number of “context aware” mobile scenarios will learn us that context is more than sensor data and temporary user profiles only, but in order to interpret context in the right way, one needs to take into account knowledge about the context's context (such as cultural differences, national and geographical differences in ethic questions and the like). It is expected that these and related issues will be more clearly defined and taken into consideration in the mid term future.

Groupware:
Current Groupware technology is becoming more “mobile” than ever and many people already use virtual private networks to hook up their mobile devices with their office. A logical continuation of this will be the inclusion of groupware and office applications in the short term future. In order to get to the complete, ambient and context aware virtual organisation in the long term future there is a need to tackle the issues concerning context sensitivity, knowledge about the world and related “meta-context” knowledge on cultural and ethical differences. Without these technologies planned for in the mid term, the long term scenario will not become available in the foreseeable future.

Natural Language Processing, Knowledge Discovery & Semantic Web

The three fields of NLP, Knowledge Discovery and Semantic Web are normally regarded as rather close. It is not unthinkable that these three areas integrate into one common, new area of research in the mid term future. In order for a Semantic Web to be applicable and be both machine- and human understandable, natural language interfaces are extremely important. In the short term, improvements in technology are to be expected, such as the support for more and different platforms, migration of technology to smaller mobile devices and integration in other applications as seen today. In the long term, a complete integration is foreseen within an embedded environment, probably interconnected through the semantic web. In between there is the period where NLP technology will grow out of the box and become rather standard technology to include in whatever applications one can imagine. This will certainly co-incide with the appearance on the market of powerful chip technology that can be integrated in small devices. During mid term, it is foreseeable that these numerous applications lead to insight about the applicability of NLP in specific situations, thereby focusing more on the social/psychological aspects of taking into use this kind of technology.

Similar prospects holds for the field of Knowledge Discovery. Matured during the late 90's and early 00's, the area of KD has delivered numerous systems and prototypes showing the applicability and inapplicability in a variety of settings. Recently the fields of KD and NLP started to merge and deliver systems that learn/extract information in a variety of ways from documents and spoken words. In the midterm it is predicted that these applications will show their usability in semantic web scenarios as well indicate more areas for research. It will become more and more necessary to take into consideration natural language interfaces to any technology hooked up to the complex context-aware, semantic web based technology, mainly in order to not exclude people from the “knowledge based society” and to overcome the identified threat of creating a “gap” within the information society. These issues need to be planned after first experiences are collected on the short term, so that mid term research can identify answers and directions to go in order to finally reach the long term goals.

Phase 3: Long Term Future (2008 – 2010)
Long Term Future forecasting is an extremely difficult task when it is easy to loose contact with (current) reality. For the mobility scenario we have interviewed several veterans in the area of Knowledge Management, Groupware and CSCW in addition to the reports provided by the Commission within the Futures project[6]

[6]http://futures.jrc.e

Groupware & Mobility

Rapid advances in digitalisation will allow exponentially larger amounts of information and data to be moved and accessed instantly. ICT technologies will become more integrated and seamless. This will have major effects across all aspects of life. For instance in the world of work <u>it will be possible for corporations to operate as virtual organisations which incorporate the talents and skills of employees and other associates not only within Europe but also from a broader global context.</u> This in turn will internationalise the diverse cultures of Europe and, as a consequence, will reinforce the diverse mosaic of people s work patterns and lifestyles. This trend will be enforced by transformations of the provisions of home entertainment services whereby <u>citizens will have access to entertainment and education services</u> that are offered in a global context and made available without passing through filters of government regulation. New cultural preferences - the growing popularity of American baseball in Italy and Australian rules football in the UK - are but instances of the fragmentation of national cultures, that is emerging.

Demographic and Social Trends Issue Paper:Mosaic Living
The Futures Report, IPTS, 1999

When it comes to internationalisation, it is clear that the long term mobility scenario not only has to take into consideration the “moving” of users, but at the same time has to be clearly aware of the fact that workers will be distributed around the globe. On the long term, Virtual Enterprises will recruit the best people from all over the world, having them work in their respecting countries and only meeting face-to-face once in a while, since it is not expected that all aspects of socialisation can be taken over by technical groupware solutions (f.e. consider the different aspects of life: working life, education, leisure time and every day matters). People will have access to generally available, global resources for education and learning, communication and even cultural preferences are expected to mix. Whereas it is not difficult (although it seems “far away”) to imagine a complete ambient environment with technical equipment fitted in most of the artefacts surrounding us performing many different tasks for us, we are not (yet) similarly aware of the cultural impacts this can have on society in general and, probably most important, by the gap between the information “have's” and “have nots”. There will be an extreme pressure on people to become part of the “information” society and people that are unwilling or unable to take that step will eventually suffer from exclusion of knowledge. If combined with the threats caused by an all-digitized society to the privacy of persons and organisations, it becomes clear that technology is currently running faster than cultural and ethical guidelines and principles. There is a need on the short term to initiate discussion on this issue in order to be able to tackle the possible long term negative effects.

Finally, and crucially as regards technology trends, there are strong expectations of growth in communication demand.[....]
[....] it is not guaranteed that the technical standards of ubiquitous computing (especially the source code of operating systems needed for software development and the protocols used to interconnect devices) will remain open, given the potential competitive advantage of proprietary ownership over such intellectual assets. This is a serious issue for policy makers, even though it is open to doubt whether single firms will be able to dominant key standards, in the very large and heterogeneous market for ubiquitous computing, in the way that Intel + Windows system has for Desktop PCs.

Information and Communication Technologies and the Information Society Panel Report, TECS/Future Program, IPTS 1999

As already seen in earlier discussions, the issue of “open systems” has to be tackled. Introducing additional hurdles for general and low-threshold use of communication and information distribution technology easily contributes to the “great divide” between the “have's” and “have nots”. It can be risky to allow a few commercial enterprises to sit with the Intellectual Property Rights (IPR) and technological know-how to deal with the security and privacy of data from millions of global citizens. There is a clear need for robust support for the development of encoding and encrypting technologies, embedded in a robust juridical environment. It will be important to find a compromise between regulations and personal freedom to share and distribute across the globe. If this balance is not found, a serious decline in progress and globalisation of work can be expected.

Natural Language Processing, Knowledge Discovery & Semantic Web

Techniques (such as re-useable software libraries, component-based programming techniques or automated program assembly). The software industry is working hard in all these areas, and although there is a constant demand for more resources, the ultimate constraints on the rate of innovation may be given by the rate at which the software sub-systems can be constructed. Rates of developments are determined more by levels of innovation diffusion and learning rather than raw investment in technological invention.

Information and Communication Technologies and the Information Society Panel Report, TECS/Future Program, IPTS 1999

Current trends in Natural Language Processing and Knowledge Discovery seem to favour statistical and machine learning based techniques. Most of the statistical techniques are corpus-based techniques that try to extrapolate from large datasets and predict some kind of categorization or annotation of the input data. Although machines in the coming years are expected to become so powerful that they can actually deal with complex tasks like speech recognition and natural language analysis, there are few factors that hold back expectations. Academic as well as industrial R&D have delivered systems that are actually integrated into parts of today’s technology.

The drawback that most of these systems still suffer from is a drawback already known in the early 80's, in the time of the “expert system” wave: NLP and KD systems recapitulate very much “idiot savants” in that they show “intelligent” behaviour in one particular area, but are often lost in adjacent or complete different areas.

For the long term future in NLP processing we see a light at the end of the corridor in the form of integration of NLP systems with the “semantic web” as a global knowledge base. Not feasible on the short or even mid term, it is regarded as realistic that on the longer term the “semantic web”, with its knowledge of rather diverse areas made available in machine processable form, and today's NLP systems integrate. As soon as this happens, the NLP systems can overcome their serious drawback of being “unaware” of much of the real-world context in which words are written or spoken in.

Context awareness definitively will become a major area for future systems. Semantic web services are expected to seriously enhance and elevate the future of mobile solutions in relation to Knowledge Management (KM). As NLP services, together with machine processable knowledge about the world we live in, become available as web services, the whole area of context-dependent computing is expected to boost.

Finally, we will conclude this section with a few citations from a report by Cambridge University, where the long term aspects of NLP research are discussed. These issues still largely hold, and in that sense there is a significant standardisation job to do in the NLP community in the upcoming years:

The long-term research challenge is to derive lexicons and grammars for broad coverage natural language processing applications from corpus evidence.

A problem with attaining this long-term goal is that it is unclear whether the community of researchers can agree that a particular design of lexicons and grammars is appropriate, and that a large scale effort to implement that design will converge on results of fairly general utility [Lib92].

In the short-term, progress can be achieved by improving the infrastructure, i.e. the stock of intermediate resources [....]. Data collection and dissemination efforts have been extremely successful. Efforts should now be focused on principles, procedures and tools for analyzing these data. There is a need for manual, semi-automatic and automatic methods that help produce linguistically motivated analyses that make it possible to derive further facts and generalizations that are useful in improving the performance of language processors.

While there is wide agreement in the research community on these general points, there seems to be no shared vision of what exactly to do with text corpora, once you have them. A way to proceed in the short and intermediate term is for data collection efforts to achieve a consensus within the research community by identifying a set of fruitful problems for research (e.g., word sense disambiguation, anaphoric reference, predicate argument structure) and collecting, analyzing and distributing relevant data in a timely and cost-

effective manner. Funding agencies can contribute to the consensus building effort by encouraging work on common tasks and sharing of common data and common components.

*Survey of the State of the Art in Human Language Technology.
Cambridge University, 1996 (ISBN 0-521-59277-1).*

General issues in all 3 phases of Scenario II – Mobile Solutions

Trust & Proof
General for all the three phases there is the important issue of trust & proof. Without this requirement resolved, it is hard to imagine this Roadmap scenario being implemented.

As increasing numbers of users utilize wireless applications, new privacy concerns are coming to the forefront. Concerns arise not only from being able to track user's preferences, purchasing history or browsing preferences, but also from the capability to track user's physical location while using wireless devices. Consumers, policymakers, law enforcement and the business community continue to work to develop new approaches to privacy, to find the appropriate balance that will enhance consumer confidence yet provide both business and law enforcement access to the information that each requires. Consumers, worried about the collection and use of personally identifiable information without their knowledge, may not have confidence in wireless providers without sufficient effort by the business community to develop user-friendly approaches to privacy. Of particular concern is the use of location information generated from the appliance's interaction with the network. Some consumers fear the unauthorized use or disclosure of such data, and as a result, some privacy advocates are demanding opt-in or even prohibitions on the use of such data. But like most consumer data, location-based information could provide a wide variety of services and benefits to consumers if used appropriately and in a manner consistent with consumer preferences. Without the freedom to explore these options with consumers, companies may not be able to develop, implement and rollout robust new services.

*Excerpt taken from: Assessing a wireless future,
The Software & Information Industry Association, 2001*

Privacy
It is not only the legal “actors” in mobile scenarios which form a threat to users. Since data in mobile applications is transmitted through “open space”, the handling of security and privacy matters are important to be tackled. Secure protocols that are complex enough to guarantee a certain amount of security, but are also applicable on handheld devices with limited capacities form one of the major challenges that have to be resolved in phase I (short term).

Bandwidth
A restriction that is taken seriously is available bandwidth. Needless to say that too many players on a limited number of frequencies will severely limit the number of devices that can communicate, let alone the issues of security and privacy that come up when too many personalised data is broadcasted in a relatively small communication band.

Technological Constraints
Mobile KM scenarios, of course, completely depend on the existence of a great diversity of supporting, mobile equipment. PDAs, cellular phones, projecting goggles, they have all one thing in common: they are electronic and need power. Therefore one of the major factors that influence this scenario is really the availability of powerful, lightweight and fastly rechargeable energy cells. Currently much of the technical possibilities can not be used in mobile scenarios due to the constraints on wireless connection, data storage and computing power caused by available power.

Referring to the VISION maturity model, the privacy and trust initiatives, services and products available within the EU at the moment remain on level n+4 and n+3 (cf. V-KMMM).

4.3.3 Roadmap for VISION Key Scenario III - Gathering Knowledge from the Web

Phase1: Short-Term Future (2003-2004)

The OWL language is close to being finalised (the last call was issued on 1/04/2003). This paves the way to attempts at technology to software for creating OWL-annotated data, and for inference over OWL, or at least OWL Lite. Initial annotation and inferencing software is likely to be available during 2004. By the end of 2004 inferencing software is likely to be built into some query engines.

Phase2: Mid-Term Future (2005-2007)

Knowledge discovery software for ontology learning will emerge from the research phase into the development phase towards the end of this period. The same will be true of human language technology for metadata generation. By the end of the period, some products will be available based on the integration of these technologies.

In parallel with this, work on ontology management, ontology mediation and ontology evolution will move from research into development, and will be incorporated into products by the end of the period.

A deeper understanding will emerge of how to integrate semantically-enabled knowledge technologies with normal business processes. This will begin to be incorporated into products. This could involve new knowledge visualisation techniques.

Research on inferencing over OWL will pay particular attention to the problem of inferencing in the presence of inconsistencies, and inferencing which is scaleable to the kind of situations which will be found in the semantic web. This work will move to the development phase towards the end of this time period.

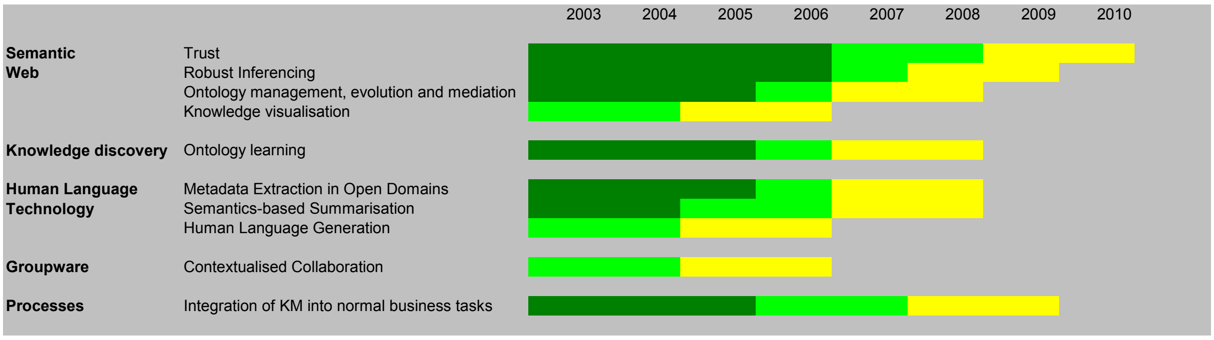
During this period there will also be research, and later development activity, concerning the problem of semantic annotation of objects in the ‘deep web’, i.e. within databases accessed through the web.

Research on proof and trust mechanisms in the semantic web will begin during this period. This will build on previous work on trust in distributed systems.

Phase3: Long-Term Future (2008-2010)

Products utilising knowledge discovery and human language technologies for ontology and metadata learning, along with ontology maintenance and evolution, will become well-established during this period. Such products will be incorporated into proprietary IT packages for normal business processes, e.g. for CRM. This will enable seamless and invisible incorporation of semantically-enabled knowledge management into normal business processes.

Towards the end of this period, proof and trust mechanisms will be incorporated into semantic web applications. This will be built on standardisation, chiefly at the W3C.



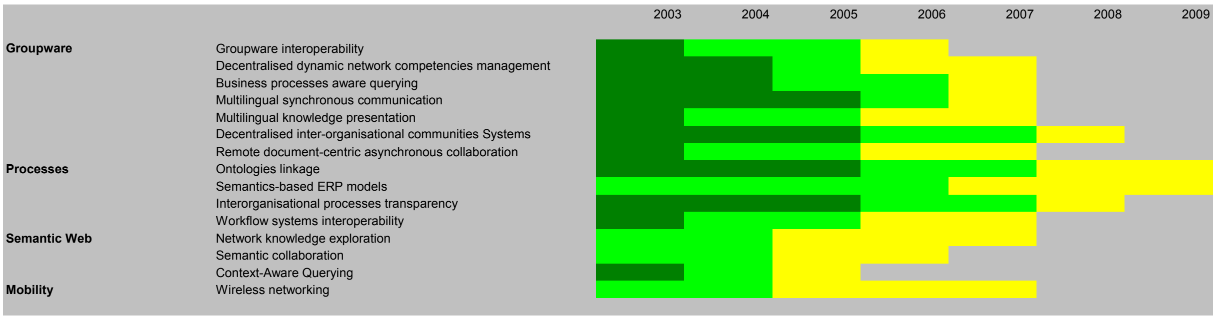
4.3.4 Roadmap for VISION Key Scenario IV - Knowledge Sharing in Smart Organisations

Two global characteristics are affecting the technology roadmap of this scenario:

- On one hand, the involved technologies and knowledge are very diverse. Synergies are possible (like for instance between the Groupware and BPM) but developments are currently not aligned and concerted. The basic research in very knowledge intensive areas often takes place within academic communities, and the knowledge and technology transfer process is usually long.
- On the other hand, the groupware systems are quite well developed in the KM market. There is a wide variety of groupware products which share functions and objectives with the hypothetic one ("Smart Organisation Manager") described above in this scenario. Those products differ a lot in complexity, maturity, price and function. They go from ordinary document magagement systems presented as "KM solutions" to systems based on complex team interactivity with workflow, semantic representation and mature linguistic technology.

In fact, existing products on the market already have a very strong position regarding the development of this scenario. Customers are already strongly locked to their technology providers and system integrators. Therefore, the natural expectation for development of this scenario would be that the existing products and solutions orientate in the next year towards this smart organisation vision, taking over new technology as soon as it becomes available and looking for interoperability.

Thus, the forecasts below can only indicate when specific functionality can be expected to be added to the products already on the market.



More informal and general analysis on the short-, mid- and long-term perspectives follows in the subsections below.

Phase1: Short-Term Future (2003-2004)

Within the next couple of years, key research areas that can be expected to have considerable impact over knowledge sharing in smart organisation are groupware, semantic web and interorganisational BPM. The basic reasons are discussed below.

Groupware
Interoperability referring to the ability of groupware to enable collaboration between those users that employ groupware applications of different vendors is currently a major issue. The wide spread use of Microsoft technologies has provided significant improvements in this area and will obviously support it further. But the main contribution to interoperability is currently expected to come from the Web-DAV ("Web-based Distributed Authoring and Versioning") standard. This set of extensions to the HTTP protocol will allow in the next future users to collaboratively edit and manage files on remote web servers. In order to provide the Web with a more (asynchronous) collaboration-friendly Internet protocol, IETF (Internet Engineering Task Force) put forward this new Internet protocol, which offers a new possibility to construct Web-based, interoperable groupware systems. WebDAV will be used as a replacement of HTTP at protocol level with the particular purpose of improving the interoperability of groupware systems.
A lot of work will be done in the coming years at the research level in order to provide solutions for decentralised inter-organisational communities systems. Researchers working to solve many of the most difficult scientific problems have long understood the potential of such shared distributed computing systems. Development teams focused on technical products, like semiconductors, are already using Grid Computing to achieve higher throughput. Likewise, the business community is beginning to recognize the importance of distributed systems in applications such as data mining and economic modelling. Efforts in this area will growth rapidly.

Multilinguality will stimulate the impact of groupware technologies while allow for broad community applications. Automating translation of any kind of contents will be a key issue at two levels: asynchronous and synchronous. All this work will relate to issues taken into account in Natural Languages Processing.

A lot of basic research will have to be done in the **Semantic Web** area that is still not a mature technology. As already mentioned in Scenario I, the key problem will be to address automatisation issues in order to develop market acceptable product. But the specific issue for the knowledge sharing in smart organisation will be using semantic for the linkage between knowledge and business processes.

Streamlining **business processes** in smart organizations will involve two imperatives:

- trust among business partners and agreement on standard ways of working
- and agreement on common data exchange standards that facilitates dialogue on mutual business events over the Internet.

Traditional electronic data interchange (EDI) based on protocols like EDIFACT requires dedicated software to translate and integrate business data. The view is usually focused on replacing paper based transfer by electronic data transfer. The data transfer is mostly made in a bilateral way or provided by expensive Value Added Network (VAN) services. Web information systems will enable new forms of business and commerce. Web-based business will not adapt existing business models and organizations any longer, but will invent fundamental new ones only realizable with a almost ubiquitous communication technology like the internet. Compared with the restrictions of EDIFACT protocols, internet communication based on XML standards is more flexible and will offer in the next years a better way to adjust technology support to business processes. XML increases flexibility and expandability because of its separation of syntax and content. As a result the integration of new business partners will be much easier than with a bilateral VAN based EDI solution. The predominating developing environment Java enables distributed applications in which two or more components are cooperatively operating over process boundaries. The simplest form of Java distributed computing are two Java applications passing data over a TCP/IP network connection. The more complex form will be the exchange of Java objects.

Number of European companies with good positions (SAP, Siemens, ILOG) in the ERP area are already working in the area of interorganisational processes. Enterprise resource planning (ERP) solutions already provide support in areas such as accounting and controlling, production and material management, quality management and plant maintenance, sales and marketing, project management, and human resources. SAP is by far the largest ERP vendor. With its MySAP.com initiative, it is moving quickly into e-business area, combining SAP standard business applications with standard Internet technologies. ERP and e-business integration defines new information systems architecture of smart organizations, which can be described as ERP based e-business. ERP based E-business will improve in the next future business performance by using information technologies and open standards to connect suppliers, partners and customers at all steps along the value chain. These information systems can significantly improve business performance by strengthening the linkages in the value chain between businesses, and between a business and the ultimate customer.

Internet-based procurement is an attractive area of ecommerce in the business-to-business (B2B) sector. An example is the SAP B2B procurement component. It supports the procurement of indirect goods and services such as office supplies and travel services. Suppliers list their products in electronic catalogues. Beside the advantage of a quick and reliable conducting based on current information, this component offers additional information, e.g. availability inspection, and multimedial presentation. Such applications should facilitate the communication of business objects based on XML standards. XML increases flexibility and expandability because of its separation of syntax and content. As a result the integration of new business partners will be much easier than with a bilateral VAN based EDI solution.

Finally, WfMC Workflow Standards are moving fast on top of Internet technology. This framework includes five categories of interoperability and communication standards that will allow very soon multiple workflow products to coexist and interoperate within a user's environment.

Phase2: Mid-Term Future (2005-2007)

Within the scope of 3-5 five years, several major changes in the technology landscape are expected to contribute to the achievement of the "Sharing Knowledge in Smart Organisation" scenario:

- The Semantic Web is expected to mature and get out of the deadlock by its integration within workflow systems. Because of this the Semantic infrastructure will become more robust and allow easy development in many KM areas
- A global framework for interoperability between different groupware should become available and enable the development of decentralised workflow management systems and knowledge/competencies management systems supporting smart organisation implementation.
- Services supporting both multilingual communication and knowledge management will come onto the market, streamlining the international cooperation efforts and allowing SMEs for taking easilly place into trans-European networks.

At this time, Europe is expected to get important benefits of its high knowledge in process modelling methods and solutions (SemTalk, ARIS, etc) and its good position on the ERP market. A key issue will be the establishment of standards and technology leadership in Semantic BPM, which is today still in its baby steps. Therefore, it will be necessary at this stage to bring together ERP, CRM, SCM and groupware technologies into the common scope of inter-organisational processes management.

As already mentioned in scenario I, during this period, considerable research on the semantic web technologies (e.g. relating to ontologies, inferencing and trust) will take place and will globally move from the basic to applied research phases. On the other hand, work on multilingual knowledge presentation is expected to become quite mature and to be implemented into products before the end of the period.

Phase3: Long-Term Future (2008-2010)

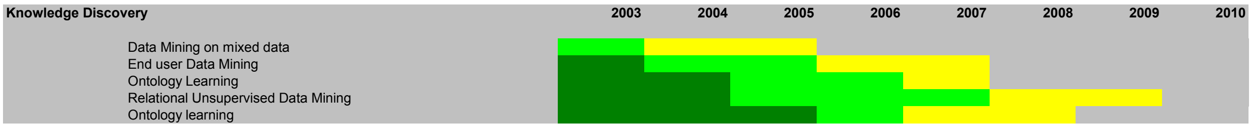
As all these technologies mature, they will increasingly be incorporated into proprietary IT packages for normal business-to-business operations, e.g. for CRM. This will enable seamless and invisible incorporation of knowledge management into normal interorganisational business processes. The "Knowledge Share in Smart Organisation" technological scenario will basically become reality even if the technologies will have to be further upgraded in order to improve quality of services. The main left problems for implementations will probably not take place at the technogical level but at the trust, confidence and organisational levels.

4.4 Roadmap Consolidation

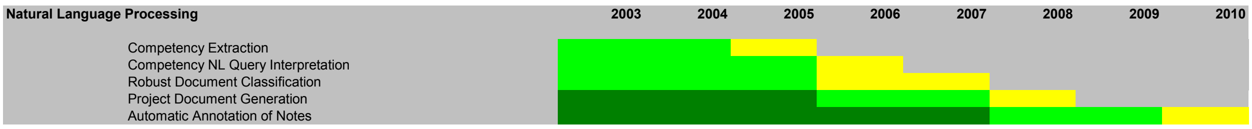
After the analysis of all scenarios and the development of the corresponding roadmaps for each scenario we have extracted and sorted all technology prognoses for each key enabling technology in order to finally achieve a consolidated technology showing future prognoses towards next generation Knowledge Management. The following figures depict the extracted, categorized technology prognoses from each of the four roadmaps sorted by required research activities (basic research, applied research, software technology).

4.4.1 Semantic Web Technology Roadmap

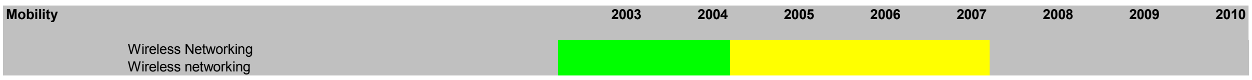
4.4.2 Knowledge Discovery Roadmap



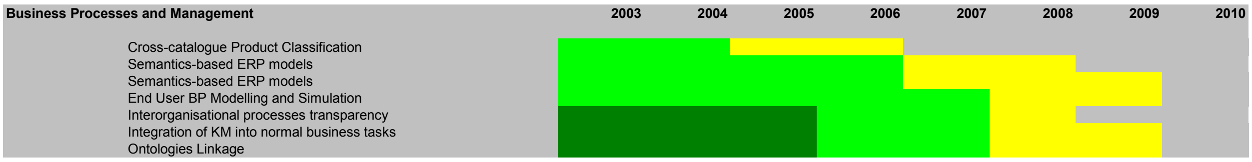
4.4.3 Natural Language Processing Roadmap



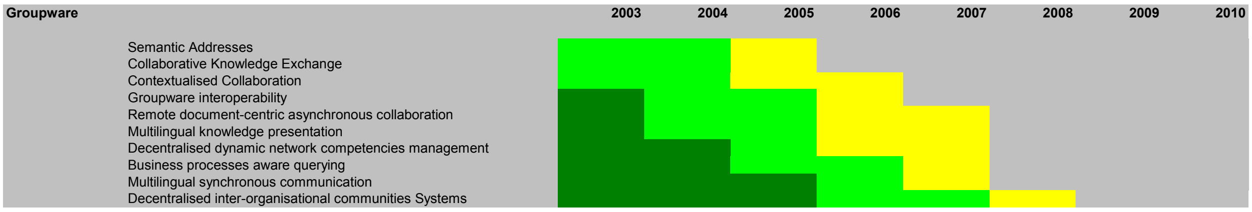
4.4.4 Mobility Roadmap



4.4.5 Business Process Management Roadmap



4.4.6 Groupware Roadmap



The following tables show the expected years of research time (sorted by basic research, applied research and software technology) for each of the key enabling technologies until now with regard to the selected scenarios.

4.4.7 Semantic Web Technology - Required research Time

Technology Prognosis	**Basic Research**	**Applied Research**	**Software Technology**	**Cumulated research time before retrieving an application**
Semantic collaboration	0	2	2	4
Knowledge visualisation	0	2	2	4
Network knowledge exploration	0	2	3	5
Semantic EAI	0	3	3	6
Context-Aware Querying	1	1	1	3
Semantic Similarity	1	2	1	4
Semantic Security Policies	1	2	2	5
Semantic Similarity (Rank./Match.)	2	1	1	4
Ad-Hoc Querying based on Uncomplete Info	2	2	1	5
Semantic Bookmarks (Filtering)	2	2	2	6
Scalable Instance Reasoning	2	2	3	7
Ontology management, evolution and mediation	3	1	2	6
Multiple Ontologies	3	1	1	5
Heterogeneous Ontology Querying	3	2	1	6
Robust Inferencing	4	1	2	7
Trust	4	2	2	8
Rule-based Semantics	4	3	1	8
Average time for application to be expected				5,5

4.4.8 Knowledge Discovery - Required research Time

Technology Prognosis	Basic Research	Applied Research	Software Technology	Cumulated research time before retrieving an application
Data Mining on mixed data	0	1	2	3
End user Data Mining	1	2	2	5
Ontology Learning	2	2	1	5
Relational Unsupervised Data Mining	2	3	2	7
Ontology learning	3	1	2	6
Average time for application to be expected				5,2

4.4.9 Natural Language Processing - Required research Time

Technology Prognosis	Basic Research	Applied Research	Software Technology	Cumulated research time before retrieving an application
Competency Extraction	0	2	1	3
Competency NL Query Interpretation	0	3	1	4
Robust Document Classification	0	3	2	5
Project Document Generation	3	2	1	6
Automatic Annotation of Notes	5	2	1	8
Average time for application to be expected				5,2

4.4.10 Mobility - Required research Time

Technology Prognosis	Basic Research	Applied Research	Software Technology	Cumulated research time before retrieving an application
Wireless Networking	0	2	3	5
Wireless Networking	0	2	3	5
Average time for application to be expected				5

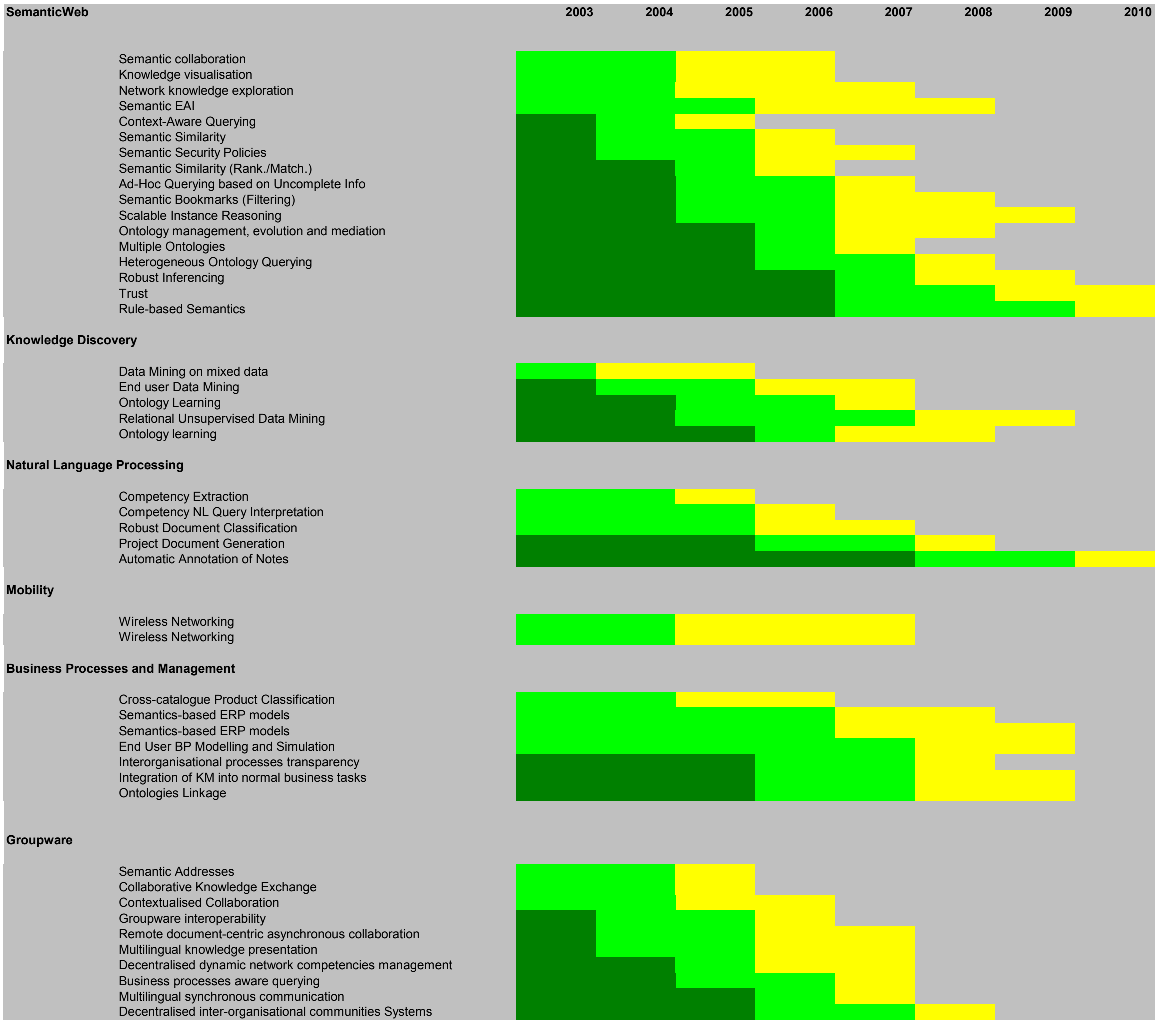
4.4.11 Business Process Management - Required research Time

Technology Prognosis	Basic Research	Applied Research	Software Technology	Cumulated research time before retrieving an application
Cross-catalogue Product Classification	0	2	2	4
Semantics-based ERP models	0	4	2	6
Semantics-based ERP models	0	4	3	7
End User BP Modelling and Simulation	0	5	2	7
Interorganisational processes transparency	3	2	1	6
Integration of KM into normal business tasks	3	2	2	7
Ontologies Linkage	3	2	2	7
Average time for application to be expected				6,8

4.4.12 Groupware - Required research Time

Technology Prognosis	Basic Research	Applied Research	Software Technology	Cumulated research time before retrieving an application
Semantic Addresses	0	2	1	3
Collaborative Knowledge Exchange	0	2	1	3
Contextualised Collaboration	0	2	2	4
Groupware interoperability	1	2	1	4
Remote document-centric asynchronous collaboration	1	2	2	5
Multilingual knowledge presentation	1	2	2	5
Decentralised dynamic network competencies management	2	2	2	6
Business processes aware querying	2	2	1	5
Multilingual synchronous communication	2	2	1	5
Decentralised inter-organisational communities Systems	3	2	1	6
Average time for application to be retrieved				4,6

The following picture depicts the consolidated roadmap comprising all technology prognoses sorted by KM key enabling technologies.


SemanticWeb
2003
2004
2005
2006
2007
2008
2009
2010
Semantic collaboration
Knowledge visualisation
Network knowledge exploration
Semantic EAI
Context-Aware Querying
Semantic Similarity
Semantic Security Policies
Semantic Similarity (Rank./Match.)
Ad-Hoc Querying based on Uncomplete Info
Semantic Bookmarks (Filtering)
Scalable Instance Reasoning
Ontology management, evolution and mediation
Multiple Ontologies
Heterogeneous Ontology Querying
Robust Inferencing
Trust
Rule-based Semantics
Knowledge Discovery
Data Mining on mixed data
End user Data Mining
Ontology Learning
Relational Unsupervised Data Mining
Ontology learning
Natural Language Processing
Competency Extraction
Competency NL Query Interpretation
Robust Document Classification
Project Document Generation
Automatic Annotation of Notes
Mobility
Wireless Networking
Wireless Networking
Business Processes and Management
Cross-catalogue Product Classification
Semantics-based ERP models
Semantics-based ERP models
End User BP Modelling and Simulation
Interorganisational processes transparency
Integration of KM into normal business tasks
Ontologies Linkage
Groupware
Semantic Addresses
Collaborative Knowledge Exchange
Contextualised Collaboration
Groupware interoperability
Remote document-centric asynchronous collaboration
Multilingual knowledge presentation
Decentralised dynamic network competencies management
Business processes aware querying
Multilingual synchronous communication
Decentralised inter-organisational communities Systems

4.5 Summary and Outlook

4.5.1 Summary

For the first version of the roadmap document we started with the analysis, consolidation and categorization of user requirements and key enabling technologies and matched the achieved requirements against the analysed key enabling technologies. Based on these results we have selected four key scenarios covering aspects of the user requirements and key technologies. Moreover, we have analysed the achieved scenarios with regard to technological and economic aspects and developed specific technology roadmaps for each of the analysed four scenarios. For the final version of the roadmap we have elaborated and validated the scenario management approach, the roadmap approach as well as the developed scenarios and roadmaps with the help of senior experts from industry, research and education.

4.5.2 Outlook

Based on the results of WP4, we develop the “VISION Knowledge Management Maturity Model” (V-KMMM) combining two dimensions of maturity levels (RTD oriented and organisation oriented) into a single model to be applied and quantified for each user community in order to apply the V-KMMM for next generation KM scenario development and implementation. This will be done by:

1. The Extraction of Technology Prognoses from each Scenario which we have developed and analysed in the VISION Roadmap Document D4.1;
2. the consolidation and sorting of technologies;
3. the Definition of Maturity Levels;
4. the Development of Technology Life Cycles for each technology.

Furthermore we propose a structure for integrated projects within the area of knowledge management technologies as part of the European 6th Framework Programme based on the results of WP4.

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6 Contributing Stakeholders

This strategic roadmap for future developments with regard to next-generation knowledge management has been developed, elaborated and validated by the VISION Core partners, the leaders of the VISION Special Interest Groups, by several senior experts and furthermore by the completion of questionnaires through the involvement of the VISION network members. The VISION network currently comprises 40 organisations from industry, education and research.

In the following we list all people and institutions involved in the VISION discussion processes. We thank all of them for their valuable input and provisionally apologize for the case that we forgot somebody.

Core Roadmapping Group (Consortium & SIG Leaders)

- BT British Telecommunications Plc.
- CAS Software AG
- CognIT AS
- FZI Research Center for Information Technologies
- IDP Srl, Pescara-Bruxelles
- NTUA National Technical University of Athens
- OntoText Lab, Sirma AI Ltd.
- Fraunhofer IPK Berlin
- Planet Ernst & Young
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- Fraunhofer-Institute for Secure Telecooperation
- Free University of Bozen-Bolzano
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- Intelligent Software Components, S.A.
- Isik University
- Kdm SOFTWARE AG
- Language & Computing nv
- Learning Lab Lower Saxony
- Libera Università Internazionale degli Studi Sociali G. Carl
- Meta4 Spain S.A.
- METAREAD SA
- Norwegian Computing Center
- NOMOS SISTEMA S.p.A
- ontoprise GmbH
- Ordnance Survey
- PLANET ERNST & YOUNG
- Rodan Systems S.A.
- SchlumbergerSema sae
- SSIS Scuola Interateneo di Specializzazione per l`Insegnamento Secondario - University Cà Foscari of Venice
- Technology Application Network Limited
- The Athens Laboratory of Business Administration
- Triple H Technology Partners
- TXT e-Solutions SpA
- United Nations Thessaloniki Centre
- Universidad de Murcia
- University of Aberdeen
- University of Applied Sciences Pforzheim Institute for Applied Sciences
- University of Economics, Prague
- University of Karlsruhe
- University of Sheffield
- USU AG
- Vereniging voor Christelijk Wetenschappelijk onderwijs (Vrije Universiteit Amsterdam)
- XtraMind Technologies GmbH