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**D 2.4 Driving Objectives and High-level Requirements for KP-Lab Technologies**

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### Abstract

One of the central goals of the KP-Lab project is to co-design pedagogical methods and technologies for knowledge creation and practice transformation in an integrative and reciprocal manner. In order to facilitate this process user tasks, driving objectives and high-level requirements have been introduced as conceptual tools to mediate between technological design empirical research as well as theory development.

The user tasks describe the generic activities users should be able to perform interactively with KP-Lab technology, based on the perspective of dialogical learning. The driving objectives are derived from the KP-Lab design principles of dialogical learning, the results obtained from empirical investigations that were performed in the pedagogical work packages as well as the reviews and analyses of available technologies and their potentials carried out by technical partners. In short, the driving objectives provide overall scope and direction for the technology development based on KP-Lab theory and practice. They encapsulate the high-level requirements which provide more detailed descriptions of technology support for supporting knowledge creation and practice transformation.

This deliverable provides an updated overview of driving objectives and high-level requirements for guiding the technological design and implementation of the KP-Lab system. The document highlights also particularly the added value of semantic services from a user's point of view as well as the use of respective applications in different research cases. This document supersedes the current list of driving objectives and high-level requirements as documented in DoW3.1 (KP-Lab, 2008b).

The document is focused on the description of user tasks, driving objectives and high-level requirements. An in depth discussion of the objectives and requirements from a theoretical, pedagogical and technological perspective is beyond the scope of this document. For respective accounts the reader is referred to D3.3 (KP-lab, 2008c), the reports on empirical studies carried out by WP8-10 as well as the technical specifications provided by WP4-6.

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## 1. Introduction

KP-Lab system aims to provide support and affordances for collaborative knowledge creation in a variety of educational and workplace settings. The KP-Lab system thereby includes the entirety of technologies developed and used within KP-Lab, it covers both end-user tools, underlying services as well as the software infrastructure. From an end-user's point of view the KP-Lab system provides the so called Knowledge practices environment (KPE), which includes the Shared Space and its highly integrated tools, as well as a set of specific tools with supplementary functionalities such as Map-It, SMAT and CASS. Altogether these tools enable and support the execution of five main user tasks relevant to collaborative knowledge creation processes. These user tasks cover the deliberate and sustained creation, management and analysis of epistemic artefacts, the initiation and coordination of collaborative activities, the management of networking activities as well as the monitoring and analysis of actual working practices around these artefacts.

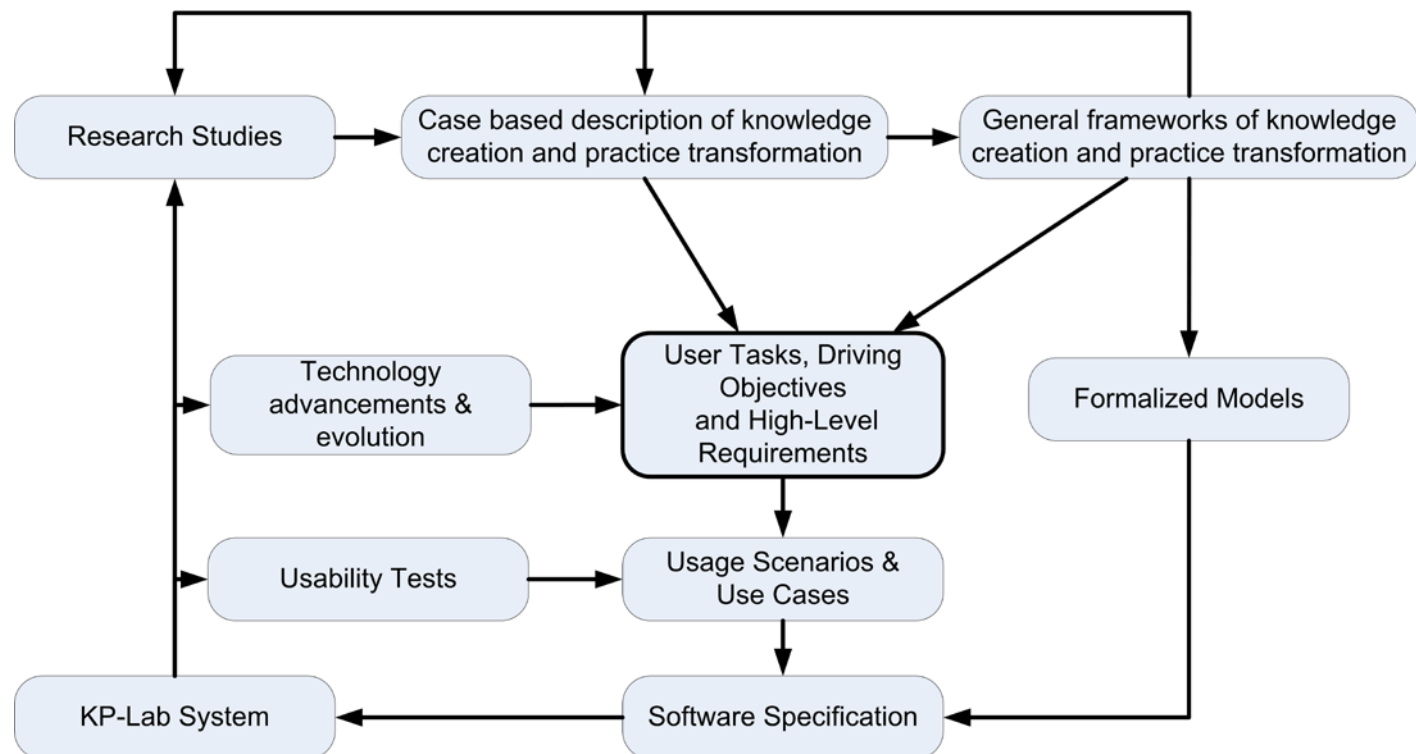
Due to the heterogeneity of application domains, covering both educational and workplace settings, there is, however, a considerable variation in users' needs, the type of activity to be enabled and supported as well as particular insights and also constraints arising from the different contexts of use. In order to accommodate differences and yet to create an integrated system, which is in line with the overall theoretical ideas of the project but also flexible and extensible towards different needs, driving objectives and high-level requirements have been introduced as a boundary object mediating the different contexts of use and the technical system to be developed.

This document describes common user tasks, driving objectives as well as high-level requirements for the development of the KP-Lab system identified so far. These objectives and requirements are not fixed but evolve dynamically based on changing needs, new insights on what works and new technological options. Accordingly, this document presents a snapshot of our current understanding and will be updated into new versions as work goes on.

The document is organized as follows: In chapter 2, we describe the overall procedure that led to the specification of user tasks, driving objectives and high-level requirements and briefly discuss the role of driving objectives and high-level requirements as conceptual tools within the KP-Lab co-design process and its relation to the KP-Lab research strategy. Chapter 3 provides the actual set of user tasks, driving objectives and high-level requirements while in chapter 4 we elaborate on the added value of semantic services from a user's point of view. Finally, in chapter 5 we outline the next steps foreseen to apply and validate the driving objectives and high-level requirements empirically as well as theoretically.

## 2. Driving Objectives and High-Level Requirements as Conceptual Tools for Co-Design

Driving Objectives and high-level requirements constitute an important conceptual tool at the intersection of empirical research and technology development. They provide an account of basic user needs with regard to knowledge creation activities as well as desirable behaviours and properties KP-Lab system should provide. The importance of driving objectives and high-level requirements is also reflected by their central position in the KP-Lab co-design framework (fig.1), which provides an integrated view of the main R&D activities.



*Fig. 1: Overview of the KP-Lab co-design framework.*

In this section we describe the overall procedure for the generation and update of user tasks, driving objectives and high-level requirements which resulted in this document. Furthermore, we discuss the role of driving objectives and high-level requirements as conceptual tools at the intersection of empirical research and the technology design and development.

### 2.1 Generation and Update of User Tasks, Driving Objectives and High-Level Requirements

User tasks and driving objectives as conceptual tools for co-design have been introduced as a means to provide concrete scope and direction for the technology development. They were based on the insight that the triological approach as well as the KP-Lab design principles, which are aimed to guide the development of pedagogical and professional practices, do not provide sufficient guidance for tool development.

Furthermore, as KP-Lab tools were evolving, we were in need of means to cluster the high-level requirements identified so far in an efficient and meaningful way.

In general the user tasks, driving objectives and high-level requirements for technology development are based on the theoretical foundations of KP-Lab project, the results of research studies carried out in the pedagogical work packages as well as the reviews and analyses of available technologies by the technical work packages. Besides this, they reflect the ideas for tool support generated in the different working knots as well as the design-principles, which guided the selection, set up, and analysis of the KP-Lab research cases.

The specification of user tasks, driving objectives and high-level requirements has been organized as an iterative process in which new theoretical and empirical insights as well as technological options feed into the revision and update of the existing specifications. The cycle of reasoning and analysis for the two iterations carried out so far, can be sketched as follows:

### **Iteration 1: Generation of the initial set of user tasks and driving objectives and high-level requirements (fall 2007 – winter 2008)**

The first iteration followed a bottom-up approach in which all research studies and pedagogical scenarios in KP-Lab were analysed in order to identify knowledge practices and tasks relevant from a technological perspective. The knowledge practices and tasks mentioned on the case level were then grouped and generalized into so called “user tasks”. The specification of user tasks was aimed at describing core activities users should be able to perform interacting with KP-Lab technology. Thereby they provide an account of knowledge practices and tasks relevant across research studies and application domains.

Starting from the user tasks and descriptions of the research studies, a first list of objectives for technology development and expected benefits was generated, taking into account also the tools developed so far. These objectives were then clustered as driving objectives.

Afterwards the needs for technology development were described in more detail and mapped against the high-level requirements identified previously by pedagogical partners and working knots. This process led to an updated list of high-level requirements, clustered according to driving objectives.

User tasks, driving objectives and high-level requirements were then revisited to check for consistency and to avoid redundancies. Furthermore, reference to KP-Lab Design Principles was rechecked with WP3, in order to ensure, that driving objectives and user tasks still reflect the dialogical approach.

The outcomes of the first iteration are documented in DoW3.1 (KP-Lab, 2008b).

### **Iteration 2: Update of user tasks, driving objectives and high-level requirements (spring - summer 2008)**

While the first iteration was based on the documents available in fall 2007 and hence could not take into account the outcomes of the usability tests and field trials with KP-Lab tools, the second iteration already started in spring 2008. This iteration builds on the outcomes of the following activities: (1) Usability studies, field trials with KP-Lab tools as well as research studies carried out in fall 2007 and spring 2008, (2) the analysis of KP-Lab technology from a theoretical perspective as documented in D3.3 (KP-Lab, 2008c) as well as (3) the state of the art review for KP-Lab technologies carried out by the Working Knots as documented in DoW3.1 (KP-Lab, 2008b).

The second iteration started with a review and cross-check of the existing driving objectives and high-level requirements against the outcomes of the usability studies, field trials and research studies carried out until the end of spring 2008. All pedagogical partners were asked to contribute to this collaborative exercise and

back-up or question the existing driving objectives and high-level requirements based on their empirical findings. Furthermore, they were asked to propose new driving objectives and/or high-level requirements if necessary.

In a second step the contributions from pedagogical partners were reviewed by the working knots in order to check for clarity as well as possible inconsistencies and redundant entries. Working knots were also asked to update the list of tools related to a particular requirement.

Afterwards, comments were compiled in a proposal for an updated version of user tasks, driving objectives and high-level requirements, which was then again circulated among the leaders of the pedagogical work packages as well as working knot chairs until consensus was reached.

## ***2.2 The Technology Design and Development Perspective***

From a technology design and development point of view user tasks, driving objectives and high-level requirements outline the problem domain and describe the general goals for technology development. In this sense they provide a point of reference for planning as well as evaluating the technical tools, services and infrastructures. Even though they do not dictate how a possible solution would look like, they provide overall scope and direction for the design and development process.

While KP-Lab design principles and the dialogical approach (KP-Lab, 2006) provide guidance on an abstract level, driving objectives and high-level requirements are more contextualized in the sense that they are produced by reflecting the actual context of use, typical breakdowns as well as ideas on how perceived problems could be overcome. As user tasks, driving objectives and high-level requirements are described on the level of observable, they are easier to understand and discuss for both technical and pedagogical partners.

From a design and development perspective the driving objectives and high-level requirements serve a few highly intertwined purposes:

- Taken together user tasks, driving objectives and high-level requirements enable designers and technical developers **to generate an understanding of the problem domain** and the statement of expected features/characteristics allows them to acknowledge the kind of added value and benefits the developed technology is supposed to offer.
- As goals they provide general means for the **evaluation of products** both regarding their usability as well as practical utility. Driving objectives and high-level requirements are used as basic evaluation criteria in the respective studies.
- Furthermore, they provide a means for the **monitoring of the development process**, reflecting on changing and evolving needs as well as recent accomplishments. Towards this end driving objectives and high-level requirements are periodically assessed, reviewed and updated by the Working Knots in collaboration with pedagogical partners.
- The driving objectives allow **organizing and clustering the high-level requirements** in order to identify possible synergies and to break down the technical development into manageable groupings that can be handled by a Working Knot. Decisions on the organization and clustering of the high-level requirements are made in close collaboration between WP2 and the Working Knots.
- Finally, the driving objectives provide a point of reference for the exploration and identification of new technological options as well as changing user needs and hence are an important starting point for **envisioning innovative solutions** beyond the current state-of-the-art.



### **2.3 The Research Perspective**

From a research point of view driving objectives and high-level requirements can be understood both as outcomes as well as design hypotheses:

- Driving objectives and high-level requirements constitute an outcome in the sense that they are built on prior insights on users' needs as well as evaluative findings on what works for whom and under which circumstances. For example field trials as well as other research studies indicate that both students and teachers are in need of awareness features that allow them to track what has happened in the collaborative working environment since their last visit or even to get notified if changes occur. Even though these features are not innovative as such and might not be in the focus of research, they are important requirements for the tools as otherwise user acceptance or performance would suffer or users' practices would differ.
- On the other hand driving objectives and high-level requirements also form design hypotheses insofar as they depict researchers' assumptions about what might work for whom under the given circumstances. In this case the researcher might have good reasons, based on insights obtained from theory and empirical research, to believe that a certain feature would have some interesting or useful effects, but whether this is indeed the fact is an open (research) question to be answered yet. For example some of the requirements described later on are built on the assumption that the collaborative annotation of documents (texts, video, etc.) will support the group in reflecting on a particular phenomenon at stake. Whether this actually will be the case is one of the questions to be answered in the KP-Lab research studies.

The distinction between viewing driving objectives and high-level requirements as outcomes or as design hypotheses is important to understand the different ways driving objectives and high-level requirements are utilized in research practice. While in the first case the requirements as such are not of direct interest for research, but provide a criterion for the evaluation of tools, the validity of requirements becomes a research question on its own in the latter case.

This difference is also reflected in the strategic measures foreseen in the KP-Lab Research Strategy (KP-Lab, 2008a). On the one hand, tools will be subject to thorough usability testing, in order to assess whether and how HLRs are appropriated in foreseen ways. On the other hand, dedicated research studies and design experiments will be carried out to investigate specific assumptions and expectations regarding tool usage and what their implications are for knowledge creation.

### 3. User Tasks, Driving Objectives and High-Level Requirements

This chapter provides a comprehensive overview of the actual set of user tasks, driving objectives and high-level requirements identified in KP-Lab.

#### 3.1 User Tasks

Based on prior analysis of KP-Lab research studies and theoretical reflections (cp. KP-Lab, 2008c) the following five user tasks had been identified as core activities to be supported by the KP-Lab system. Even though a particular user task might be more or less relevant to a given research case, the user tasks are not mutually exclusive but in fact highly interrelated as they relate to different types of mediation (cp. KP-Lab, 2008c). The aim of the KP-system is to support the user tasks in an integrative fashion making it easy for the user to switch between tasks or to carry them out simultaneously. An example of integrative support for knowledge creation practices in higher education is provided for example in Sins, Bauters & Damsa (2008):

##### **User Task 1: Organizing shared artefacts<sup>1</sup> and collaborative tools**

The management and organization of shared artefacts as well as the selection, customization and invocation of collaborative tools constitute basic prerequisites for collaborative work and learning in general as well as knowledge creation in particular. This task includes the setup, appropriation, maintenance, but also re-use of a collaborative environment allowing people to share and organize documents, contact and communicate with each other, and work together in well-defined contexts. The task also covers the adaptation and tailoring of the environment to meet its users' evolving needs and practices.

##### **User Task 2: Modifying the content of the shared artefacts individually and collaboratively**

This task relates to the collaborative creation and working with knowledge artefacts, i.e. artefacts that explicate and crystallize jointly produced ideas, knowledge and understanding. Typical artefacts relevant to KP-Lab research cases include simple sketches and notes, various kinds of texts and video-files, discussion transcripts, work plans as well as conceptual models and domain ontologies. This task covers the creation, revision, and utilization of these artefacts within but also across groups' activities.

##### **User Task 3: Management and organization of collaborative work processes**

The management and organization of collaborative work processes is focused on the procedures of collaborative work and aims to ensure that collective objectives will be achieved. This task covers the planning, coordination, monitoring, and evaluation of collaborative work processes. As project management is often up to the students or knowledge workers themselves, division of labour, specification and scheduling of milestones and deadlines but also analysis and reflection of work processes become important tasks for the group.

##### **User Task 4: Creating contacts, communicating and networking**

Creating contacts, communicating and networking within but also across groups constitutes another important prerequisite for knowledge creation. This task covers activities such as the search for external stakeholders, clients and experts, the formation of groups, synchronous and asynchronous communication as well as the dissemination of results. This task becomes particularly challenging if groups are not co-located or in case external expertise is required.

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<sup>1</sup> Throughout this document the term artefact is used to refer to all information assets the user can create or work with in the KP-Lab system. Artefacts therefore include for example, documents uploaded to a shared space, sketches, notes, wiki-pages, annotations, task-descriptions, chat-logs, comments, user profiles, visual models, vocabularies, and modeling languages.

**User Task 5: Investigation and development of knowledge practices**

This task is focused on the collaborative analysis, reflection and development of the knowledge practices itself and hence constitutes a kind of meta-activity. Depending on the scenario this task can be carried out by a working group themselves, in a participatory mode with external experts, or by a third party only (e.g. researchers). The task covers the collection of data on current practices, the analysis and interpretation of data as well as the envisioning and actualization of new practices.

As discussed in D3.3 (KP-Lab, 2008c), these user tasks can be understood in relation to different types of *mediation*, i.e. epistemic mediation related to creating and working with knowledge artefacts (UT2), pragmatic mediation related to organizing knowledge-creation projects and processes (UT3), collaborative mediation concerning building and managing networked communities required for carrying out knowledge-advancement efforts (UT4), and reflective mediation in terms of making visible, reflecting on, and transforming knowledge practices (UT5). UT1 is not directly related to a specific type of mediation but provides the basic prerequisites for other user tasks and allows the users to customize the system to their particular needs.

**3.2 Driving Objectives and High-Level Requirements**

In the following the driving objectives and high-level requirements are described in detail. For each Driving objective the underlying design principles, its rationale as well as the expected benefits are provided. Besides this, a brief description of the high-level requirements itself, references to related tools and research studies are provided in a tabular format. This table only lists end-user tools, i.e. those tools the user directly interacts with, are listed. Table 1 provides an overview of all KP-Lab tools planned until M42. For more detailed descriptions the reader is referred to the respective technical specifications as well as KP-Lab (2008b).

**Table 1: The KP-Lab tools planned till M42 (The functionality groupings 1-5 form the so called Knowledge Practices Environment, KPE).**

Functionality grouping	Tools	Description
1. Shared Space and Common Tools	Shared Space and User Management	Managing shared spaces as well as users/groups and their access rights to shared spaces.
	Shared Space Network View	Accessing and creating shared spaces.
	Re-use Library	Storing and reusing different parts of previously used shared spaces in libraries.
	Awareness	Information and notification about users' actual activities as well as logging of activities or changes in artefacts.
	Search	Faceted and flexible search user interfaces for the semantic metadata and free-term search services
	Help	help functionalities, such as a help forum, a FAQ, context sensitive display of help documents
	Data Export	Export of information from the KP-Lab system for use e.g. in statistical analysis packages.
	Import/export service for SCORM/IMS packages	Re-use of resources from selected educational and professional applications and import to KPE
2. Management and Analysis of Complex Knowledge Structures	Commenting	Interactive commenting of objects within shared space
	Semantic Tagging	Annotation of artefacts based on lightweight ontologies.
	Visual Model editor	Creation, editing, comparison, versioning of visual models based on predefined visual modelling languages (e.g. Conceptual maps).
	Visual Modelling Language editor	Creation, modification, versioning of visual modelling languages (used in building visual models with the Visual Model editor).
	Tag Vocabulary Editor	Creation and maintenance of tag vocabularies used in semantic tagging
	Content View	Visualisation of artefacts (content items, tasks, users) as well as their relationships.
	Tailored View	User defined view for working on selected subsets of artefacts.
3. Process Management and Analysis	Knowledge Process	Planning and visualizing knowledge processes (in terms of tasks, their relationships, resources, and responsibilities)
	To-Do	Planning and managing of individual user's work.
	Calendar	Integrates external calendar service or application for publishing and coordinating events.
	Knowledge Evolution Analysis	Visualising and analyzing the history of content development and work process advancement based on the data stored in the Knowledge Repository
4. Networking and Community Building	Chat	Context aware synchronous text based communication
	Community View	Building, managing and visualizing user communities (or groups) and social networks.
5. Document Centred Collaboration	Note Editor	Simple text editor for producing "note" type artefacts
	Drawing tool	Simple graphics tool for sketching and "white-boarding" purposes.
	Semantic Wiki	Integrated Wiki engine (Media Wiki) with semantic extensions
	Real-Time Collaborative Document Editing	Integrated Web-based application (Google Docs) for synchronous collaborative editing or text documents.
6. Activity Systems Design Tool (ASDT)	ASDT Service	Features for operating on ASDT-specific objects in the Knowledge Repository.
	ASDT Shared Space plug-in	Features for working with ASDT-specific objects (i.e. a CL process and its content) in a tightly integrated manner within the Shared Space GUI.
	Virtual Whiteboard	Features for conducting ASDT sessions by allowing users to manipulate ASDT-specific content items as well as to classify any content items into the ASDT conceptual framework.
	ASDT Analysis	Visualizing analysis data in the context of the ASDT conceptual framework.
7. Semantic Multimedia Annotation Tool (SMAT)	SMAT Scenario Management	Defining and processing multimedia annotation scenarios
	SMAT Collaboration	Synchronisation of SMAT clients for creating and accessing concurrently semantic data
	SMAT Awareness Management	Creating, changing and processing the co-operation rules of annotation activities
	SMAT Analysis	Analysing annotations, annotation events, and annotators statistically and structurally.
	SMAT Search	Semantic search based on data created during multimedia annotation activities.
	SMAT Ontology Mining And Mgt.	Modifying, restructuring, managing and mining user domain ontologies.
8. Meeting and Conferencing Support	Map-It	Asynchronous (preparation, reflection) and synchronous (discussion/argumentation/social interactions capture, collaborative reflection) work in meeting settings.
	M2T - Meetings Management Tool	Administration and preparation of meeting templates and integration with KPE.
9. Mobile Tools	CASS Query	Sending and administering survey-type questions to mobile devices
	CASS Memo	Accessing KPE and its core tools from mobile devices

By related research studies we refer to those studies that investigate (among others) the use of tools that target the specific high-level requirement. The tools to be used in these studies do not necessarily have to be those developed within KP-Lab but the study is supposed to provide insights into the appropriateness of the particular requirement in a certain context. The numbering of research studies is based on their description in Annex 1 of D3.2.2 (KP-Lab, 2008a)

For an overview figure 2 depicts the current set of driving objectives in relation to the user tasks. In addition table 1 provides.

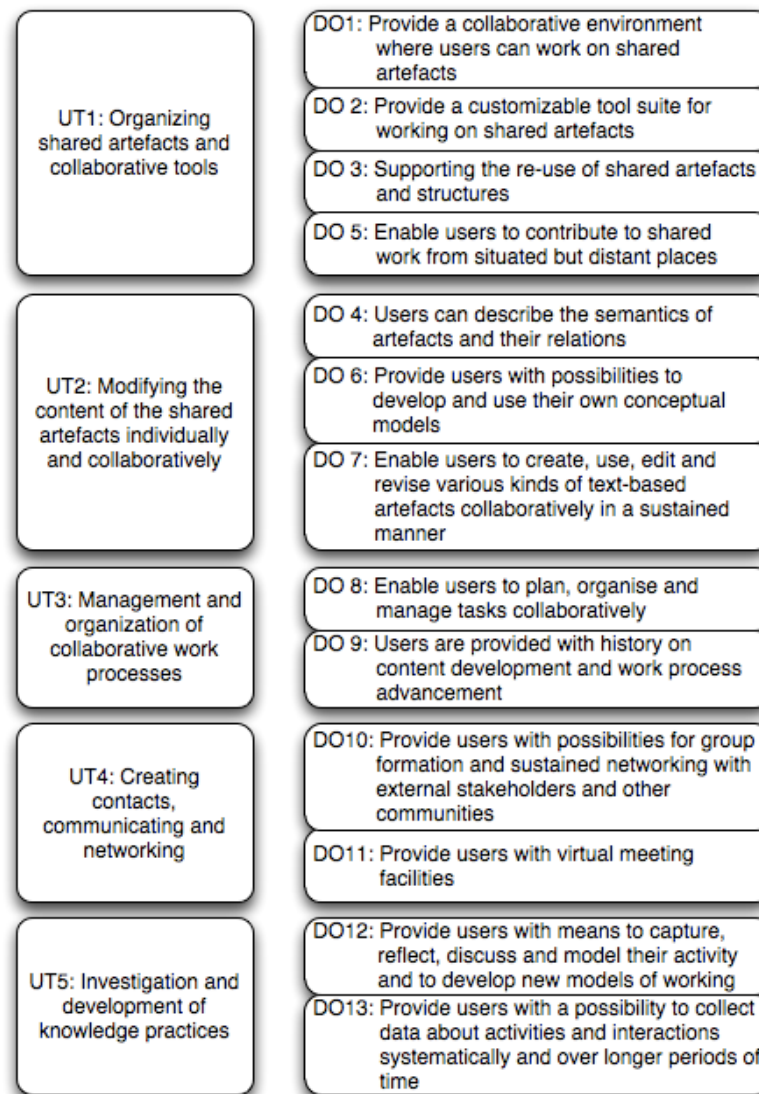


Fig. 2: Overview of driving objectives in relation to user tasks.

## DO1: Provide a collaborative environment where users can work on shared artefacts

**Rationale:** Enabling users to work on shared objects in one place shall allow them to perceive and handle shared objects, knowledge representations and respective processes in an integrated way. And providing access to all resources and tools in a single place reduce avoid extra workload and breakdowns due to moving between different environments.

### Expected Benefits:

- Users are able to work in an integrative manner (e.g. no need to switch between non-interoperable applications)
- Users can easily get an overview of the resources and tasks shared by the group or community.
- Allows users to work in a protected environment when needed (i.e. users can restrict access to the environment in order to ensure confidentiality).
- Users can to search from messy information and detect overlaps.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels

**Table 2: High-level Requirements related to DO1.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR1.1	Users can create structure and share various artefacts (e.g. sketches, various kinds of texts, video and audio-files, models as well as ontologies) in one place.	<ul style="list-style-type: none"> <li>• KPE (M24)</li> <li>• ASDT</li> <li>• Map-It -v1.5 (M22)</li> <li>• SMAT (M24)</li> </ul>	8.13, 8.14, 8.1, 8.2, 9.1.1-9.1.3, 9.2, 8.17, 10.5, 8.9, 8.10, 8.11
HLR1.2	Users are able to view the artefacts and their relations from different perspectives.	<ul style="list-style-type: none"> <li>• SSp Tools: Content view (M24)</li> </ul>	8.13, 8.14, 9.1.1-9.1.3, 9.2, 8.17, 8.9., 8.11
HLR1.3	Users can select and invoke the tools they want to work with from one place.	<ul style="list-style-type: none"> <li>• KPE (M24)</li> </ul>	8.13, 8.14, 9.1.1-9.1.3, 9.2, 8.17, 10.5
HLR1.4	Users can search artefacts within and outside the shared environment using full text, metadata or domain ontologies.	<ul style="list-style-type: none"> <li>• Search (M36)</li> <li>• SMAT (M42)</li> </ul>	8.1, 8.2, 8.9
HLR1.5	Users can create and work with selected subsets of artefacts (e.g. a user might select all content items relevant for a certain task at hand).	<ul style="list-style-type: none"> <li>• SSp Tools: Tailored View (M36)</li> <li>• Map-It (M33)</li> </ul>	8.13, 8.14, 8.9, 8.11
HLR1.6	Users are able to collaboratively decide on who can access which artefacts and the operations they are allowed to perform on these objects.	<ul style="list-style-type: none"> <li>• Shared Space and User Management (M24)</li> <li>• SMAT</li> <li>• Map-It (M24)</li> </ul>	8.13, 8.14, 8.1, 8.2, 9.1.1-9.1.3, 9.2, 8.16, 8.17
HLR1.7	Users can coordinate and organize the shared use of artefacts (e.g. by back-up retrieving or re-cycle bin, by locking items and their places, or by automatic ordering of items)	<ul style="list-style-type: none"> <li>• SSp Tools: Content view (New Proposal)</li> </ul>	8.9, 8.17

## DO 2: Provide a customizable tool suite for working on shared artefacts

**Rationale:** Providing users with a customizable tool suite shall allow them to tailor the working environment to their particular needs, avoiding unnecessary complexity due to irrelevant tools but also providing sufficient flexibility for advanced application scenarios. Furthermore, tools should be integrated in a way that information can be accessed and re-used easily.

### Expected Benefits:

- Users are not restricted to a predefined use of tools.
- Users can tailor the environment to their particular needs.
- Users are not restricted to a predefined user-interface but can customize the interface towards their particular needs, for example when they have to organize their work on different projects
- Users can learn about the affordances of tools and share their experiences of tool usage.
- Supports the integration, structuring and organizing of knowledge produced by different tools; fosters the examination of a phenomenon, topic, or practices from various perspectives.

### Related Design Principles:

- DP6 - Cross fertilization of various knowledge practices across communities and institutions

**Table 3: High-level Requirements related to DO2.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR2.1	Users are able to customize the GUI to support different contexts of use	<ul style="list-style-type: none"> <li>• KPE (M 36)</li> <li>• SMAT(New Proposal)</li> </ul>	9.1.1-9.1.3
HLR2.2	The tools are generic enough to allow users to use them in various ways of working, e.g., personalization of the tools and adaptation to different domain knowledge.	<ul style="list-style-type: none"> <li>• All tools!</li> </ul>	8.9, 8.14
HLR2.3	Users are able to select which tools they want to work with (i.e. they can choose from the set of tools integrated or supported by the system)	<ul style="list-style-type: none"> <li>• All tools!</li> </ul>	8.1, 8.2, 8.10, 8.11, 8.14, 9.1.1-9.1.3, 9.2, 8.16, 8.17
HLR2.4	Provide users with possibilities to comment and discuss on artefacts	<ul style="list-style-type: none"> <li>• Commenting (M24)</li> <li>• SMAT (M24)</li> </ul>	8.9, 8.10, 8.11, 8.14, 9.1.1-9.1.3, 9.2, 8.16 - 8.17, 10.5
HLR2.5	Users can import and export artefacts and access data across the tools integrated or connected to the KP Environment.	<ul style="list-style-type: none"> <li>• All tools!</li> </ul>	8.9, 8.14, 8.16 - 8.17
HLR2.6	Users are provided with help for using the tools (typical scenarios, frequent actions, wizard, help; setup templates, typical setup examples...)	<ul style="list-style-type: none"> <li>• Help (M44)</li> </ul>	8.13, 8.4, 9.1.1-9.1.3, 9.2, 8.16, 8.17, 10.5

### DO 3: Supporting the re-use of shared artefacts and structures

**Rationale:** Providing support for the re-use of resources including knowledge objects, work plans as well as customized work spaces enables users to systematically build on previous work as well as to disseminate and share effective knowledge practices.

#### Expected Benefits:

- Supports users in long-term information management.
- Enables users to re-use and build on existing work plans and customized work spaces.
- Reduced workload and dissemination of good practices among users due to use of templates.

#### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels
- DP3 - Eliciting individual and collective agency

**Table 4: High-level Requirements related to DO3.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR3.1	Users can re-use process structures and artefacts.	<ul style="list-style-type: none"> <li>• Map-It - v2.2 (M32)</li> <li>• Re-Use Library (M48)</li> </ul>	8.9, 9.1.1-9.1.3, 9.2
HLR3.2	User can create, browse and use templates from libraries to support their work.	<ul style="list-style-type: none"> <li>• Re-Use Library (M48)</li> <li>• Map-It – v2.2 (M32)</li> </ul>	8.9, 9.1.1-9.1.3



## DO 4: Users can describe the semantics of artefacts and their relations

**Rationale:** Enabling user to describe the semantics of artefacts and their relations in an easy and intuitive way, providing them with the possibility to explicate and question their current understanding as well as to analyze larger sets of content items and data systematically.

### Expected Benefits:

- Allows users to analyze larger sets of content items and data systematically, e.g., by identifying common patterns or recurrent issue.
- Provides users support to negotiate about their perspectives of the semantics of the representations produced to eventually create a shared understanding.
- Enables users focusing on or explicating particular aspects of the phenomena at stake.
- Enables users to annotate on-the-fly during work.
- Users are/can be provided with scaffolds to guide their collaborative activities.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels
- DP4 - Fostering long-term processes of knowledge advancement
- DP6 - Cross fertilization of various knowledge practices across communities and institutions

**Table 5: High-level Requirements related to DO4.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR4.1	Users can categorise, classify and cluster artefacts in different manners.	<ul style="list-style-type: none"> <li>• Semantic Tagging (M24)</li> <li>• Search (M40)</li> <li>• SMAT (M36)</li> </ul>	8.10, 8.11, 8.14, 9.1.1-9.1.3, 9.2, 8.16-8.17
HLR4.2	Users can use semantic descriptions to collaboratively work on the structure and meaning of artefacts as well as their relations (including using sound and schemata for adding semantic descriptions).	<ul style="list-style-type: none"> <li>• Semantic Tagging (M24)</li> <li>• Visual Model Editor (M32)</li> <li>• Map-It - v1.5 (M22 – sound in local settings) - v3.0 (M36 - sound in Internet settings)</li> <li>• SMAT (M24)</li> </ul>	8.9, 8.10, 8.11, 8.16,8.3, 8.4
HLR4.3	Users can work with multiple conceptual models (vocabularies or visual modelling languages) in parallel.	<ul style="list-style-type: none"> <li>• Semantic Tagging (M24)</li> <li>• Visual Model Editor (M32)</li> <li>• SMAT (M36) simultaneous use of multiple domain ontologies</li> </ul>	8.3,8.4
HLR4.4	Users are able to save and share conceptual models (e.g. vocabularies and visual models)	<ul style="list-style-type: none"> <li>• Visual Model Editor (M32)</li> <li>• Re-use library (M 48)</li> </ul>	8.3,8.4, 8.10
HLR4.5	Users are able to compare and integrate different knowledge representations/visual models.	<ul style="list-style-type: none"> <li>• Visual Model Editor (M32)</li> </ul>	8.10,8.3,8.4
HLR4.6	Users can annotate contents of documents (text, audio and video files as well as wiki-pages) using tags, vocabularies and ontologies and link contents via specific anchors	<ul style="list-style-type: none"> <li>• Basic video annotation (M32)</li> <li>• Multi-user collaborative annotation (M36)</li> <li>• Audio and text annotation (M36)</li> <li>• Semantic wiki (M44)</li> </ul>	8.16, 10.5, 8.7
HLR4.7	Users are provided with functionality for suggestions of semantic descriptions for artefacts and suggestions for amendments to the vocabularies based on text-mining analysis.	<ul style="list-style-type: none"> <li>• Semantic Tagging integrated with text mining services (M 44)</li> <li>• SMAT – ontology mining (M48)</li> </ul>	8.11

## DO 5: Enable users to contribute to shared work from situated but distant places

**Rationale:** Providing access to shared working environment from situated but distant places (e.g. by mobile phone) enables users to collect and share data in situ but also to stay in touch with their colleagues and access shared document while being “in the field”.

### Expected Benefits:

- Provides users with an opportunity to capture various events, immediately at the moment when they are taking place as well as write down and share their own reflections with regard to them.
- Provides users with extended manner, i.e. in action to collect multi-media materials into the shared environment from various actual situations and sources.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels
- DP6 - Cross fertilization of various knowledge practices across communities and institutions

**Table 6: High-level Requirements related to DO5.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR5.1	Users can record audio, video, pictorial data and write notes or memos with a mobile tool/device, which is compact enough to be used ubiquitously.	<ul style="list-style-type: none"> <li>• CASS memo client (M36)</li> </ul>	8.1, 8.2, 8.11, 8.9
HLR5.2	Users can endow recorded files with metadata within their mobile device.	<ul style="list-style-type: none"> <li>• CASS memo client (M36)</li> </ul>	8.9
HLR5.3	Users can transmit sound- and video-recordings as well as pictures (together with respective meta-data) to the collaborative environment and save them on the selected places there.	<ul style="list-style-type: none"> <li>• CASS memo client (M36)</li> <li>• Map-It (M36)</li> </ul>	8.1, 8.2, 8.11, 8.9
HLR5.4	Users are able to view/browse knowledge objects in the environment by using mobile devices.	<ul style="list-style-type: none"> <li>• CASS memo client (M36)</li> </ul>	8,12, 8.9
HLR5.5	User are able to tailor and select what notifications to receive and in what frequency to their mobile device.	<ul style="list-style-type: none"> <li>• CASS memo client (M36)</li> <li>• Real-time awareness (M32),</li> <li>• History&amp; Participation awareness (M36)</li> </ul>	8.9

## DO 6: Provide users with possibilities to develop and use their own conceptual models

**Rationale:** Providing users with intuitive and flexible tools for developing and using their own conceptual models allows them to design and apply their own cognitive tools suitable for their task at hand. Being able to build on existing models and trace their evolution enables to systematically build on existing work.

### Expected Benefits:

- Provides users with intuitive (and or habitual) and flexible tools for modelling.
- Allows users to adapt given ontologies to their own and evolving needs.
- Allows users to develop different perspectives on a certain phenomenon at "runtime".
- Users are/can be provided with scaffolds for argumentation and negotiation activities.
- Supports the development of knowledge practices for conceptualization and abstraction.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels
- DP3 - Eliciting individual and collective agency

**Table 7: High-level Requirements related to DO6.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR6.1	Users can modify existing or create new visual modelling languages, ontologies and vocabularies.	<ul style="list-style-type: none"> <li>• Visual Modelling Language Editor (M36)</li> <li>• Tag Vocabulary Editor (M32)</li> </ul>	8.3,8.4
HLR6.2	Users can refine, make proposals and give objections on modelling languages, ontologies and vocabularies while working on the respective knowledge representations and visual models.	<ul style="list-style-type: none"> <li>• Visual Modelling Language Editor (M36)</li> <li>• Tag Vocabulary Editor (M32)</li> </ul>	8.3,8.4, 8.7
HLR6.3	Users can share and integrate different visual modelling languages, ontologies and vocabularies.	<ul style="list-style-type: none"> <li>• Visual Modelling Language Editor (M36)</li> <li>• Tag Vocabulary Editor (M32)</li> <li>• SMAT (M36)</li> </ul>	8.3,8.4, 8.7

## DO 7: Enable users to create, use, edit and revise various kinds of text-based artefacts collaboratively in a sustained manner

**Rationale:** Text-based artefacts, ranging from simple notes and sketches to sophisticated papers and reports, provide a crucial means for the explication and joint production of ideas, concepts, arguments, and theories, proposals, summaries .... Enabling users to track back the development process and to see how this work is produced along other activities can foster reflection and development of related knowledge practices. The use of templates can provide an additional scaffold both for the production as well as the analysis of documents.

### Expected Benefits:

- Allows users to collaboratively write, comment, and analyze text-based artefacts.
- Allows users to plan, brainstorm and draft text-based artefacts.
- Helps users to develop ideas, comments, and arguments related to produced texts and objects as well as to keep traces of decision-making, of tasks/actions elicitation.
- Users are provided with or can create their own scaffolds.
- Helps users to learn and analyze expert-like knowledge practices with templates.
- Templates allow productive interaction, e.g. discourse and a process unfolding in and around the text collectively being built, will be supported when applying guiding/structuring templates.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels
- DP3 - Eliciting individual and collective agency

**Table 8: High-level Requirements related to DO7.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR7.1	Users can insert comments into text-based artefacts.	<ul style="list-style-type: none"> <li>• Wiki (M24)</li> </ul>	8.9, 8.13, 8.14, 8.17, 9.1.1-9.1.3, 9.2, 10.5
HLR7.2	Users are able to produce and develop ideas, plans, sketches, etc. collaboratively and track their history	<ul style="list-style-type: none"> <li>• Note editor (M24)</li> <li>• Drawing tool/Sketch pad (M36)</li> </ul>	8.1., 8.2, 8.9, 8.11, 8.13, 8.14, 8.17, 9.2, 10.5
HLR7.3	Users can collaboratively create and edit text-based artefacts both synchronously as well as asynchronously.	<ul style="list-style-type: none"> <li>• Wiki (M24)</li> <li>• Google Docs integration (M36)</li> <li>• Note editor (M24)</li> </ul>	8.1, 8.2, 8.9, 8.11, 8.13, 8.14, 8.17, 8.16, 9.2, 10.5
HLR7.4	Users are able to check changes from past versions of the text-based artefact and build new versions based upon these checks (e.g. a fusion of history and track changes).	<ul style="list-style-type: none"> <li>• Wiki (M24)</li> <li>• Google Docs integration (M36)</li> <li>• Note editor (M24)</li> </ul>	8.9, 8.17, 9.2
HLR7.5	Users are able to create links between text-based artefacts and/or sections contained within them with a possibility to add semantic descriptions into these.	<ul style="list-style-type: none"> <li>• Semantic wiki (M44)</li> </ul>	8.13, 8.14, 8.17, 9.2
HLR7.6	Users are able to semantically describe and analyse text-based artefacts (or sections) according to the structure and content of the document.	<ul style="list-style-type: none"> <li>• Semantic wiki (M44)</li> </ul>	8.9, 8.17, 9.2
HLR7.7	Users can create and use templates to scaffold the production of text-based artefacts (e.g. to create reports or document experiences systematically)	<ul style="list-style-type: none"> <li>• Partially semantic wiki (M44)</li> <li>• Re-use library (M48)</li> </ul>	8.2, 8.9, 8.14, 9.2

## DO 8: Enable users to plan, organize and manage tasks collaboratively

**Rationale:** Enabling users to plan and manage tasks collaboratively allows them to actively plan, decide, and reflect on the way they want to organize and structure their work, taking into account also users obligations outside the actual working context.

### Expected Benefits:

- Allows users to plan, monitor, and evaluate their self-directed object related activities.
- Enables users to perceive the processes, shared objects and different representations of knowledge in an integrative way.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP2 - Supporting interaction between personal and social levels

**Table 9: High-level Requirements related to DO8.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR8.1	Users are able to define and modify the tasks and responsibilities throughout the process lifetime.	<ul style="list-style-type: none"> <li>• SSp Tools: Process view (M24)</li> <li>• SSp Tools: Content view (M24)</li> <li>• SMAT (M36) scenario management</li> </ul>	8.1, 8.2, 8.9, 8.14, 9.1.1-9.1.3, 9.2,10.5
HLR8.2	Users are provided with individual and collective time and work management possibilities.	<ul style="list-style-type: none"> <li>• To-Do-List (M36)</li> <li>• Google Calendar Integration (M36)</li> </ul>	8.1, 8.2, 8.9, 8.13, 8.14, 8.16 - 8.17, 9.2
HLR8.3	Users can comment tasks.	<ul style="list-style-type: none"> <li>• Commenting (M24)</li> </ul>	8.9, 8.13, 8.14, 9.2
HLR8.4	Users are provided with advanced awareness affordances and can request notifications of users' interactions (e.g. users can manage various awareness levels and collaboration rules).	<ul style="list-style-type: none"> <li>• Real-time awareness (M32),</li> <li>• History &amp; Participation awareness (M36)</li> <li>• CASS memo client (M 36)</li> <li>• SMAT (M42)</li> </ul>	8.9, 8.11, 9.2
HLR8.5	Users can mark and annotate knowledge objects to structure and organize their own work processes. (E.g. a user can mark all those notes s/he wants to read or has already read).	(New proposal)	8.3,8.4
HLR8.6	Users can search the content and metadata using full text or semantic metadata search for planning and reflecting on activities.	<ul style="list-style-type: none"> <li>• Search (M36)</li> </ul>	8.14, 9.2
HLR8.7	Users are provided with a customized analysis of groups' working processes (e.g. identification of typical sequences of actions or interesting rules).	<ul style="list-style-type: none"> <li>• Knowledge Evolution Analysis (M48)</li> <li>• SMAT (M42) annotation analysis</li> </ul>	8.9, 9.2
HLR8.8	Users can choose between different types of process structure visualizations (e.g. project based or progressive inquiry)	<ul style="list-style-type: none"> <li>• SSp Tools: Process View (M40)</li> </ul>	

## DO 9: Users are provided with history on content development and work process advancement

**Rationale:** Providing users with the possibility for tracing and monitoring the history and evolution of contents and work processes, allows them to reflect and negotiate on respective knowledge practices.

### Expected Benefits:

- Support for analysis of documents created over a prolonged period of time (e.g. diaries, field notes).
- Supports users' learning from past projects by tracing back planned and actualized work processes.
- Supports users in sharing and disseminating knowledge practices.

### Related Design Principles:

- DP3 - Eliciting individual and collective agency
- DP4 - Fostering long-term processes of knowledge advancement

**Table 10: High-level Requirements related to DO9.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR9.1	Users can track the evolution and changes of knowledge objects and find out their authors and contributors (sequences of performed steps in time, incl. versioning)	<ul style="list-style-type: none"> <li>• Knowledge evolution analysis (M48)</li> <li>• Content item versioning (i.e., community view) (M44)</li> </ul>	8.9, 8.10, 8.14, 8.16 -8.17, 9.1.1-9.1.3, 9.2
HLR9.2	Users are provided with customized summaries about the knowledge objects available within the shared environment (e.g. users might request an overview of the tasks completed within the last 2 weeks or the interactions of people within a shared workspace)	<ul style="list-style-type: none"> <li>• Knowledge evolution analysis (M48)</li> <li>• Data export tool and History &amp; Participation awareness (M36)</li> <li>• SSp Tools: Community view (M44)</li> </ul>	8.9, 8.11
HLR9.3	Users can retrieve and consult information about discussions that addressed a particular artefact at stake.	<ul style="list-style-type: none"> <li>• M2T</li> </ul>	

## DO 10: Provide users with possibilities for group formation and sustained networking with external stakeholders and other communities

**Rationale:** The possibility to form groups and to be in contact with different stakeholders provides an important prerequisite for collaboration, especially when users are not co-located both physically and/or organizationally. Furthermore, allowing users to decide with whom they want to collaborate and under which conditions provides an opportunity to create ownership and collective responsibility. Furthermore, users should be supported to create and maintain contacts with different stakeholder or other parties of interest for the user, in order to find collaborators or experts, to exchange ideas and get feedback,

### Expected Benefits:

- Allows users to create groups in an ad hoc and decentralized manner.
- Enables different stakeholder groups to be present and keep contact in the same space.
- Provides users with quick and easy meeting possibilities, which enable to keep work flowing.
- Enables users with flexible means to keep track, build and develop their networks using previous contacts with connection to the context of the contacts.
- Helps users to avoid double information by providing one place to modify / update information about their networking contacts.

### Related Design Principles:

- DP5 - Emphasizing development through transformation and reflection between various forms of knowledge and practices

**Table 11: High-level Requirements related to DO10.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR10.1	Users have means to define and change their roles or have multiple roles (e.g. students can have different social and professional positions; be in the role of a learner, teacher or researcher).	<ul style="list-style-type: none"> <li>• Shared Space and User Management (M24)</li> <li>• SSp Tools: Community view (M 44)</li> </ul>	8.9
HLR10.2	User can form groups.	<ul style="list-style-type: none"> <li>• Shared Space and User Management (M24)</li> <li>• SSp Tools: Community view (M44)</li> <li>• SMAT (M36)</li> </ul>	8.9, 8.10, 8.11, 8.13, 8.14, 8.16 - 8.17, 10.5
HLR10.3	Users can grant access rights to external stakeholders and partners if needed.	<ul style="list-style-type: none"> <li>• Shared Space and User Management (M24)</li> <li>• SSp Tools: Community view (M 44) Partially</li> </ul>	8.1, 8.2, 8.9, 8.11, 8.14
HLR10.4	Users are provided with tools and means to keep up their networking contacts.	<ul style="list-style-type: none"> <li>• Map-It (M12-v1.0)</li> <li>• SSp Tools: Community view (M44)</li> </ul>	8.1, 8.9
HLR10.5	Users are provided with information about other users relevant to a particular task, or artefact.	<ul style="list-style-type: none"> <li>• SSp Tools: Community view (M44)</li> </ul>	8.1
HLR10.6	Users are provided with tools to track back interactions with the contacts.	<ul style="list-style-type: none"> <li>• Map-It (M12-v1.0)</li> <li>• SSp Tools: Community view (M44)</li> </ul>	8.1, 8.2, 8.9
HLR10.7	Users can link to and import external community information.	<ul style="list-style-type: none"> <li>• SSp Tools: Community view (M44)</li> </ul>	8.1, 8.2

## DO 11: Provide users with virtual meeting facilities

**Rationale:** Meetings play an important role both for the coordination of work processes as well as the orchestration of collaborative work on shared objects, whether groups are physically or organizationally dispersed. To support these quite demanding activities users should be provided with scaffolds that guide the preparation and conduction of such meetings as well as assistance for the documentation of the meeting and its outcomes.

### Expected Benefits:

- Users can initiate, organize and carry out meetings on demand
- Users are provided with scaffolds for argumentation and negotiation activities as well as means to ground conversation during meetings.
- Allows users to consult the various used resources and outcomes of the meeting: audio recordings, generated minutes, discussion maps representation, chat transcripts, shared external links and documents, tasks (to-dos), decisions...

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP4 - Fostering long-term processes of knowledge advancement

**Table 12: High-level Requirements related to DO11.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR11.1	Users can organize and carry out synchronous and asynchronous virtual/in presence communication	<ul style="list-style-type: none"> <li>• Map-It (M12-co-located, M24 distant)</li> <li>• M2T (M32)</li> <li>• Chat (M36)</li> </ul>	8.1, 8.2, 8.6, 8.9, 8.14, 9.3, 9.6
HLR11.2	Users are provided with support for structuring and moderating the meetings.	<ul style="list-style-type: none"> <li>• Map-It (M12)</li> </ul>	8.6, 9.3, 9.4, 9.6
HLR11.3	Users can synchronously or asynchronously share ideas, and use/choose various discussion and argumentation representations.	<ul style="list-style-type: none"> <li>• Map-It (M24)</li> <li>• M2T (M36)</li> <li>• Chat tool (M33)</li> <li>• Commenting (M24)</li> </ul>	8.17, 9.4, 9.6
HLR11.4	Users can prepare meetings in advance	<ul style="list-style-type: none"> <li>• Map-It (M12)</li> </ul>	8.13, 9.4, 9.6
HLR11.5	Users are provided with automatic recording and documentation of participants contributions during meetings, incl. both verbal as well as written contributions.	<ul style="list-style-type: none"> <li>• Map-It (M12 for written, M22 for audio in co-located settings, M36 for distributed Internet settings)</li> <li>• Chat?</li> </ul>	8.6, 8.13, 9.4, 9.6
HLR11.6	Users can use ontologies and metadata to annotate and present their contributions (also online/during the meeting/integrated with the meeting activities?).	<ul style="list-style-type: none"> <li>• Map-It (M24)</li> </ul>	9.3, 9.4, 9.6
HLR11.7	Users can refer to and share external resources during the meeting as well as use external tools (such as calendars, to-dos etc.)	<ul style="list-style-type: none"> <li>• Map-It and M2T (M32)</li> </ul>	8.6, 8.9, 9.4, 9.6



## DO 12: Provide users with means to capture, reflect, discuss and model their activities and to develop new models of working

**Rationale:** In order to support participatory analysis and development of working practices, users should be provided with means to capture, reflect, discuss, and model existing as well as innovative activities and ways of working. Towards that end users should be provided with tools and technologies that guide the overall development process but also scaffold the explication and analysis of the working practices at stake.

### Expected Benefits:

- Allow users to explicate contradictions as incentives for transformation
- Systematic approach and conceptual tools allow users to develop their own collaborative work and to come up with innovative new knowledge practices.
- Enables users to practice self-reflection of community’s knowledge practices.
- Can act as supervision tool for teachers and as research tools for researchers.

### Related Design Principles:

- DP1 - Organizing activities around shared objects
- DP3 - Eliciting individual and collective agency
- DP4 - Fostering long-term processes of knowledge advancement
- DP6 - Cross fertilization of various knowledge practices across communities and institutions

**Table 13: High-level Requirements related to DO12.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR12.1	Users can work around a shared “virtual whiteboard” view where collaborative modelling and discussion takes place.	• ASDT (M24)	9.1.1-9.1.3, 10.5, 10.6
HLR12.2	Users can create tables, four-fields or free text (or mark key time-stamps and highlights, to multimedia material) and link it to a theme and documents.	• ASDT (M24) • SMAT (M32)	10.5, 10.6
HLR12.3	Users are provided with a dynamic model of activity system that can be annotated and linked to created material.	• ASDT (M24)	10.5, 10.6
HLR12.4	Users are provided with the model of expansive learning to structure the development process.	• ASDT (M36)	10.5, 10.6

## DO 13: Provide users with a possibility to collect data about activities and interactions systematically and over longer periods of time

**Rationale:** In order to investigate longitudinal transformation of knowledge practices and to analyze and reflect on interactions within working groups as well as between users and the technical environment, users (incl. researchers and teachers) have to be able to collect respective data systematically according to their particular information needs. Providing users with the possibility to specify the data they are interested in and to support the collection and export of this data for further analysis serves researchers as well as the users themselves as it allows them to evaluate and revise their learning and working activities.

### Expected Benefits:

- Allows users to investigate knowledge practices in the context they occur over prolonged periods of time.
- Allows users to investigate within-person changes over time as well as between person differences.
- Helps users to avoid shortcomings of the conventional survey research: retrospective memory biases etc. and gives a possibility to choose sampling strategy depending on the occurrence of the event of interest.
- Provides summative information on users interactions
- Allows users to export qualitative and quantitative information on user's interactions as well as the outcomes of their work.

### Related Design Principles:

- DP3 - Eliciting individual and collective agency
- DP5 - Emphasizing development through transformation and reflection between various forms of knowledge and practices

**Table 14: High-level Requirements related to DO13.**

ID	Description	Tools (Release Date)	Related Research Studies
HLR13.1	Users can create queries, manage participant information, and choose the sampling strategy to fit each research subject	<ul style="list-style-type: none"> <li>• CASS Query (M24)</li> <li>• CASS Query admin (M36)</li> </ul>	8.8., 8.12
HLR13.2	Users can monitor the accumulation of data in real-time and search as well as browse the data available	<ul style="list-style-type: none"> <li>• CASS Query (M24)</li> <li>• CASS Query admin (M36)</li> </ul>	8.8, 8.12
HLR13.3	Users can answer by open text, predefined questionnaires, pictures, audio recordings using mobile phones.	<ul style="list-style-type: none"> <li>• CASS Query (M24)</li> <li>• CASS Query admin (M36)</li> </ul>	8.8, 8.12
HLR13.4	Users can export logged data to other applications (e.g. Excel, SPSS, Social network analysis tools) for further analysis.	<ul style="list-style-type: none"> <li>• CASS Query (M24)</li> <li>• CASS Query admin (M36)</li> </ul>	8.8, 8.12
HLR13.5	Users can customise the way they want to retrieve wanted data for analysis.	<ul style="list-style-type: none"> <li>• CASS Query (M24)</li> <li>• CASS Query admin (M36)</li> <li>• Data export M24, M32</li> </ul>	8.8, 8.12
HLR13.6	Users are provided with summative information on performed actions (e.g. added comments, created tasks, modifications in metadata, background materials for decisions, etc.).	<ul style="list-style-type: none"> <li>• Knowledge evolution analysis (M48)</li> <li>• Data export M24, M32</li> </ul>	
HLR13.7	Possibility to export all database content in a shared space (and its child spaces) in readable and easy to use format (textual listing of objects, comments, tags etc. with links to files saved in a same place)	<ul style="list-style-type: none"> <li>• Data export M24, M32 in some form or other – under discussion</li> </ul>	

## 4. Added Value of Semantic Services from an User's Point of View

In order to achieve the driving objectives and fulfil the high-level requirements described in section 3, the tools of KP-Lab System draw on a variety of semantic services provided by the so-called Semantic Web Knowledge Middleware (SWKM).

The semantic nature of all KP-Lab services and tools provides one of the important technological pillars of the whole project, as this provides a necessary enabler of the real (semantic) integration of the various KP-Lab tools. The following subsection 4.1 elaborates a bit more on this fundamental principle.

Moreover, after some attempts to find a suitable common language to establish more coherence between technological and pedagogical models as well as across research studies, it has been decided that a generic reference model expressed as an ontology will be the most suitable approach. In this ways it is possible now to find a suitable match between both, pedagogical research studies and technological tools being developed to support them. More about all activities related to construction of pedagogical models based on the reference model will be reported in Deliverable 8.4, KP-Lab Pedagogical Models and their Semantic Descriptions.

As users do not interact with these services directly but 'through' the different end-user tools, the added value of the semantic services heavily depends on the proper exploitation of the semantic services and their potentialities by these end-user tools. Furthermore, the rationale for the utilization of the SWKM services also differs across user tasks and the different forms of mediation associated with this task. Therefore, the utilization and expected benefits of the SWKM services are discussed separately in this section from the user tasks' perspective in subsections 4.2 to 4.5 briefly summarize the most important implications of semantic services from the end users' point of view.

Moreover, advanced SWKM services (like text mining, notification, analytical and knowledge mining services, or knowledge synthesizer) are built only because of the underlying semantic nature of the internal KP-Lab data. These would be hardly (if at all) possible to implement in case the underlying semantic data representation would be missing. Some brief implications for the end-user tools are also elaborated in subsections 4.4 and 4.5 below.

### 4.1 Semantic Integration of Tools

Semantic integration of the KP-Lab tools serves first and foremost the interoperability, which is being implemented on three different levels: the user interface, the service and the data levels. In many cases interoperability of two tools requires collaboration on more than one level. For example, smooth user interface level interoperability might require also data-level interoperability.

The data-level interoperability means that one KP-Lab tool is able to use the data created or stored by another application. It is based on a common semantic data model (an ontology), which allows for the exchange and integrated use of artefacts across tools within the environment. As the different tools are not just "co-located" in a single environment but also share the same semantics, all tools "know" e.g. what a task or content item is, users' can access and modify the information created by all the other tools without the need for manual update and synchronization. For example, users might create a shared document in Google Docs or the integrated wiki, which is then annotated and stored as a content item in the KP-Lab knowledge repository (SWKM). Annotations as well as other information about the item such as its authors or version history, can then be retrieved from other tools such as for example Process view of the Shared Space tool, To-Do-List or M2T. Similarly a group might decide on new tasks during a virtual meeting, create a task item with Map-It

tool and have their project plan updated accordingly in group's shared space (the group would see the new task e.g. in the Gantt chart of the SSp tool's Process view).

The service-level interoperability ensures that one tool is able to call a service provided by another tool or by the KP-Lab platform, which is achieved by using Web Services standards. Web Services, however, is not a solution to service interoperability problems related to semantic heterogeneity among software applications. The presence of a common ontology enables KP-Lab tools and services to communicate and exchange knowledge.

The user interfaces of many KP-Lab tools will be integrated so that user-interface of one application can be invoked from the user-interface of the other. The user interface level integration can be loose with tools exchanging only some minimal data in order to interoperate. Or it can be tight, such as that of Shared Space Tool and the ASDT. To enable the use of Shared Space Tool's GUI as the basic user interface for the ASDT environment, the ASDT ontology models the collaboration spaces used in ASDT as a subclass of Shared Space class. When a user loads the Shared Space network to the GUI, also the ASDT instances will be loaded (based on transitional subclass relationship). When a user wants to enter a ASDT space, the system detects that the a special kind of Shared Space is in question and loads to the user-interface ASDT specific features in addition to the normal Shared Space features.

Furthermore, by storing metadata and content separately users can easily integrate different content repositories within a single environment making it possible to search and update the information about all content items simultaneously.

For a detailed overview of semantic services used by the different tools currently under development in KP-Lab project, see Table 15. This table provides an updated version of table 6 in the DoW3.1 (KP-Lab, 2008b).

**Table 15: KP-Lab tools and their underlying SWKM services.**

Functionality grouping	Tools	SWKM services used														
		Query	Update	Import	Export	Registry	AKMS	Clustering	Classification	Comprehension	Information Extraction	Recommendation	Versioning	Change Impact	Diff	Synthesizer
1. Shared Space and Common Tools	Shared Space and User Management	X	X	X		X										
	Shared Space Network View	X	X			X										
	Re-use Library	X	X			X										
	Awareness						X									
	Search	X	X					X	X	X						
	Help						X			X	X					
	Data Export	X														
	Import/export service for SCORM/IMS packages	X	X													
2. Management and Analysis of Complex Knowledge Structures	Commenting	X	X													
	Semantic Tagging	X	X			X		X	X							
	Visual Model editor	X	X		X	X		X				X	X	X	X	X
	Visual Modelling Language editor	X	X	X	X	X		X				X	X	X	X	X
	Tag Vocabulary Editor	X	X			X							X	X		
	Content View	X	X	X	X	X										
	Tailored View	X	X	X	X	X	X									
3. Process Management and Analysis	Knowledge Process	X	X				X									
	To-Do	X	X													
	Calendar	X	X													
	Knowledge Evolution Analysis	X	X	X	X											
4. Networking and Community Building	Chat	X	X													
	Community View	X	X	X	X		X									
5. Document Centred Collaboration	Note Editor	X	X													
	Drawing tool	X	X													
	Semantic Wiki	X	X													
	Real-Time Collaborative Document Editing	X	X													
6. Activity Systems Design Tool (ASDT)	ASDT Service	X	X									X				
	ASDT Analysis Service	X	X				X	X	X	X						
	ASDT Analysis GUI						X									
7. Semantic Multimedia Annotation Tool (SMAT)	Semantic Multimedia Annotation Scenario Management	X	X													
	Semantic Multimedia Annotation Awareness Management	X	X													
	Semantic Multimedia Annotation Analysis	X	X					X	X	X	X					
	Semantic Multimedia Annotation Search	X	X													
	Semantic Multimedia Annotation Ontology Mining And Management	X	X				X									
8. Meeting and Conferencing Support	Map-It	X	X													
	M2T - Meetings Management Tool	X	X					X	X							
9. Mobile Tools	CASS Memo	X	X													

In the following the added value of semantic services is discussed along the requirements for these services and the users tasks they support. For each requirement a description and rationale is provided and related high-level requirements are listed. Table 15 maps the requirements for semantic services against the user tasks defined in section 3.1.

**Table 16: Requirements for semantic services in relation to user tasks.**

User Tasks	Requirements for Semantic Services
User Task 1: Organizing shared artefacts and collaborative tools	Basic Knowledge Management
User Task 2: Modifying the content of the shared artefacts individually and collaboratively	Annotation and Categorization of Knowledge Artefacts
	Creation, Selection, Use and Modification of Conceptual Models
	Evolution of Conceptual Models (change, difference and versioning)
User Task 3: Management and organization of collaborative work processes	Notification on Changes of Artefacts and other Events
	Tracing, Monitoring and Analysis of the History of Contents and Work Processes
User Task 5: Investigation and development of knowledge practices	Users' Participation and Activity Analysis
	Evolution of Knowledge in Work Processes

## ***4.2 Semantic Services in Support of Organizing Shared Artefacts and Collaborative Tools [User Task 1]***

Semantic services and technologies support the organization of shared artefacts and collaborative tools in two basic ways. On the one hand side the use of a common semantic data model ensures that knowledge objects can be exchanged and re-used across tools (see subsection 4.1 for more details). On the other hand semantic description of all artefacts and services provide basic facilities for knowledge management such as the storage, retrieval, and organization of documents or content items.

### **Basic Knowledge Management**

For the efficient organization, management and working with knowledge objects, users should be able to store, retrieve, and modify content items as well as metadata of these items. Metadata thereby includes both automatically as well as user-generated information about an item, its structure, context or meaning and provides a central means for the organization and retrieval of shared artefacts. While basic metadata about the lifecycle, format or context of an artefact should be generated automatically, users should also be able to annotate artefacts themselves either by drawing on existing conceptual models or by defining their own descriptors.

From a user's perspective the use of metadata supports search and filtering and allows users to adapt the description and organization of artefacts based on local requirements, resulting not only in traditional free-term search, but also to semantic search (in form of faceted search, which may be used stand-alone or in combination with free term search). The search results can be organized in many different ways to form a comprehensive view of the relevant content. For example, the text mining services can be used to cluster artefacts in the result according to their semantic tags. Also, additional artefacts can be identified based on the identification of their semantic proximity with the result set of the search operation.

**Table 17: Basic Knowledge Management and Semantic Services.**

Related High Level Requirements	Related Semantic Services
HLR1.1: Users can create structure and share various artefacts.	Query, Update, Import, Export, Clustering
HLR1.3: Users can select and invoke the tools they want to work with from one place.	Query, Import
HLR1.4: Users can search artefacts within and outside the shared environment using full text, metadata or domain ontologies.	Query, Information Extraction, Comprehension, Clustering
HLR1.5: Users can create and work with selected subsets of artefacts (e.g. a user might select all content items relevant for a certain task at hand).	Query, Update, Clustering, Classification, Information Extraction
HLR2.2: The tools are generic enough to allow users to use them in various ways of working, e.g., personalization of the tools and adaptation to different domain knowledge	Query, Update
HLR2.5: User can import and export artefacts and access data across the tools integrated or connected to the KP-Environment.	Import, Export, Query, Update
HLR8.6: Users can search the content and metadata using full text or semantic metadata search for planning and reflecting on activities.	Query, Update, Clustering, Classification, Comprehension

### **4.3 Semantic Services in Support of the Work on Conceptual Artefacts [User Task 2]**

Besides their support for the organisation and management of shared artefacts and tools, semantic services and technologies are also used to support the collaborative work on conceptual artefacts such as vocabularies, concept maps or ontologies, which can in turn be considered also as shared artefacts with the notable difference that they are used to structure a certain domain or knowledge space and thus any kind of changes or interactions on them might have more widespread effects. On the other hand, conceptual models carry their own metadata so that they can also be searched semantically and associated through semantic relationships by other artefacts used in a learning environment. Towards this end, semantic services, which are used by the search tool, the tag-vocabulary editor, the visual model editor as well as SMAT and the semantic wiki, shall enable users to explicate, develop and apply conceptual models<sup>2</sup> as well as to analyze complex sets of data or information collaboratively. The aim is to provide the user with intuitive and flexible but yet powerful tools that allow the user to easily move between different levels of abstraction and formalization.

### **Annotation and Categorization of Knowledge Artefacts**

The structuring, organization and analysis of complex documents or data sets is a characteristic element of many knowledge creation processes, ranging from text analysis over collaborative analysis of empirical data (e.g. the coding of an interview transcripts or video-fragments) to the identification of high-level patterns such as social network structures. In order to support such kind of processes, users should be able to systematically annotate and categorize knowledge artefacts as well as their contents, building on pre-defined as well as user-created conceptual models (e.g. in the form of vocabularies, schemas or templates). These models should be allowed to change or evolve as users extend, update or combine them. In addition semi-automatic<sup>3</sup> support for annotation based on text-mining services becomes important when data sets become overly large and complex. Similarly clustering services allow users to explore data sets systematically

<sup>2</sup> The term 'conceptual model' is used here in a very broad sense, including various kinds of abstract descriptions of a certain phenomenon or domain of interest, such as vocabularies or ontologies.

<sup>3</sup> Semi-automatic refers to the fact that the system, by means of classification services, provides suggestions only which have to be accepted or rejected by the user.

without the necessity to build a model in advance (as it is the case for classification) as well as create e.g. draft concept maps automatically from a given set of textual artefacts.

**Table 18: Annotation and Categorization of Knowledge Artefacts and Semantic Services.**

Related High Level Requirements	Related Semantic Services
HLR4.1: User can categorize, classify and cluster artefacts in different manners	Import, Update, Clustering, Classification
HLR4.2: Users can use semantic descriptions to collaboratively work on the structure and meaning of artefacts as well as their relations (including using sound and schemata for adding semantic descriptions)	Import, Update, Query, Information Extraction, Comprehension
HLR4.6: Users can annotate contents of documents (text, audio and video files as well as wiki-pages) using tags, vocabularies and ontologies and link contents via specific anchors	Import, Update
HLR4.7: Users are provided with functionality for suggestions of semantic descriptions for content items and suggestions for amendments to the vocabularies based on text-mining analysis	Clustering
HLR7.5: Users are able to create links between text-based artefacts and/or sections contained within them with a possibility to add semantic descriptions into these	Update
HLR7.6: Users are able to semantically describe and analyze text-based artefacts (or document sections) according to the structure and content of the document	Update, Export, Clustering, Classification

### **Creation, Selection, Use and Modification of Conceptual Models**

The users should be able to create or import, select and use different conceptual models (ontologies and vocabularies) in order to describe the underlying domain and annotate respective content items. While predefined conceptual models can be useful to support routine tasks, knowledge creation activities often require novel conceptual models, which either extend existing models or are genuinely new. This means that users need to have a way to retrieve and refine existing models or modelling languages (stored in the Knowledge Repository) or the ability to create and store (in the Knowledge Repository) new ones. In some pedagogical scenarios predefined conceptual models, selected or created by the teacher, are used as scaffolds to support students' activities. Furthermore, users should be able to work with multiple conceptual models in parallel in order to describe the domain from different viewpoint and under different perspectives. Since users cannot be aware of the existence or not of every model or modelling language in the Knowledge Repository, they should be allowed to search their metadata information in the Registry and subsequently export or query them. The actual representation and handling of the conceptual models depends on the particular tool used. Currently the following formats are foreseen: Semantic tagging and the Tag-vocabulary Editor provide the user with hierarchically organized sets of terms that can be used for the annotation and search of documents. The Visual Model Editor and the Visual Modelling Language Editor allow users to create conceptual models in a visual format. The semantic wiki finally employs conceptual models as templates for text production and analysis. All these tools rely on the underlying support of the semantic services in order to properly store new or extended models, retrieve and combine them or search for them.



**Table 19: Creation, Selection, Use and Modification of Conceptual Models and Semantic Services.**

Related High-Level Requirements	Related Semantic Service
HLR1.2: Users are able to view artefacts and their relations from different perspectives	Query, Export, Update, Import, Registry
HLR4.4: Users are able to save and share conceptual model (e.g. vocabularies and visual models)	Import, Update, Registry
HLR6.1: Users can modify existing or create new visual modelling languages, ontologies and vocabularies.	Import, Update, Change Impact, Registry
HLR7.6: Users are able to semantically describe and analyze text-based artefacts (or document sections) according to the structure and content of the document.	Import, Update, Export, Query
HLR7.7: Users can create and use templates to scaffold the production of text-based documents (e.g. to create reports or document experiences systematically).	Import, Update

### Evolution of Conceptual Models (change, difference and versioning)

The users should be able to continuously update and revise the conceptual models they are working with (both ontologies and their instances) in order to account for new ideas as well as evolving practices. As conceptual models are interconnected and rely one upon another changes in one conceptual model might have unforeseen side effects to this or other models or the data annotated with it. Thus users need ways to be notified by the possible side effects and react or decide accordingly. Moreover these side effects can make the update process rather costly so it is also the user who needs to decide whether he wants to go through with the proposed changes or wants to postpone them for a later stage or even cancel them. Additionally users might need just to inspect and not necessarily implement a change. On the other hand users can be constantly provided with new (already made) models which they need to compare with their own or other already existing models, thus they need a mechanism to identify and report the differences among them. Finally, versioning mechanisms are needed since conceptual models involve both in time as they are used by different users in different occasions and also in space since many users can use and change the same model simultaneously in different contexts.

**Table 20: Evolution of Conceptual Models and Semantic Services.**

Related High-Level Requirements	Related Semantic Services
HLR4.3: Users can work with multiple conceptual models (vocabularies or visual modelling languages) in parallel.	Query, Update, Import, Export, Change Impact, Versioning
HLR4.5: Users are able to compare and integrate different knowledge representations/visual models.	Query, Update, Import, Export, Diff, Change Impact, Versioning
HLR6.1: Users can modify existing or create new visual modelling languages, ontologies and vocabularies	Import, Update, Export, Query, Change Impact, Versioning
HLR6.2: Users can refine, make proposals and give objections on modelling languages, ontologies and vocabularies while working on the respective knowledge representations and visual models	Import, Update, Export, Query, Change Impact, Versioning
HLR6.3: Users can share and integrate different visual modelling languages, ontologies and vocabularies	Import, Update, Export, Query, Change Impact, Versioning

## 4.4 Semantic Services in Support of Management and Organization of Collaborative Work Processes [User Task 3]

Since all content items (i.e. also tasks) are described in a semantic fashion, this provides excellent support for the organisation and coordination of collaborative work processes, e.g. by allowing the user to define types of

events s/he wants to be informed about. Furthermore, the semantic services support tracing and monitoring the history and evolution of contents and work processes.

### **Notification on Changes of Artefacts and other Events**

In order to allow for smooth collaboration, users must be able to follow and react on events and changes relevant to their own tasks and obligations. Especially when cooperation takes place asynchronously, over longer periods of time and tasks are complex, it becomes more and more difficult to keep track of what is going on and to decide which occurrences are relevant to one's own activities. Consequently users should have the possibility to decide on a personalized notification scheme, which allows them to specify the events they want to be informed about and when, via user defined subscription criteria. Users' subscriptions are not only based on traditional criteria such as type or initiator of an event, or ID of an artefact, but also based on semantics of the event (e.g. regarding annotation of the artefact in question, or change in the conceptual model used).

**Table 21: Notification on Changes and other Events and Semantic Services.**

Related High-Level Requirements	Related Semantic Services
HLR8.4: Users are provided with advanced awareness affordances and can request notifications of users' interactions (e.g. users can manage various awareness levels and collaboration rules).	Notification, Recommendation
HLR5.5: User are able to tailor and select what notifications to receive and in what frequency to their mobile device.	Notification, Recommendation

### **Tracing, Monitoring and Analysis of the History of Contents and Work Processes**

When documents are revised over and over again or when new people (such as clients, experts but also collaborators) enter an already existing group it is often important to understand not only the contents of the artefacts currently in use, but also to understand how these documents have been created and the decisions that already have been made. For this purpose the sequences of preceding actions need to be analysed. Semantic description of particular events makes it much easier to trace not only timely but also conceptually related actions and define interesting patterns (sequences of actions, or generalized actions) that mirror interesting knowledge practices (either good or bad practices). Such kind of patterns may be used at least in two different ways: 1) for analysis of similar past processes and identification of similar patterns there, or 2) for running processes e.g. to alert in advance when the process tends to follow some of the "bad practice" patterns. This functionality can manifest for the user like the notification scheme described above, but it is conceptually different. In this case, a series of events (some pre-defined pattern) will trigger a notification of the user, not just one event, matching user's subscription.

**Table 22: History of Contents and Work Processes and Semantic Services.**

Related High-Level Requirements	Related Semantic Services
HLR8.6: Users can search the content and metadata using full text or semantic metadata search for planning and reflecting on activities.	Query, Update, Clustering, Classification, Comprehension
HLR8.7: Users are provided with a customized analysis of groups' working processes (e.g. identification of typical sequences of actions or interesting rules)	Analytical and Knowledge Mining Services

## 4.5 Semantic Services in Support of Investigation and Development of Knowledge Practices [User Task 5]

Finally semantic services are also used to support users' investigation and development of knowledge practices. Towards that end the main purpose of the semantic services (esp. the analytical and knowledge mining services) is to provide users (incl. researchers, teachers, students and knowledge workers) with synthesized information about the activities going on in a particular workspace, as well as support discovery of interesting working patterns indicating interesting knowledge practices.

### Users' Participation and Activity Analysis

Users should be able to retrieve synthesized information about their own (or others') behaviour in order to monitor and reflect on their own (or others') working practices. Content and format might vary depending on users' needs. Possible formats might include comparisons of planned and actualized activities, social networks or the distribution of workload and participation over time. Three categories of data to be exported for analytical purposes are envisaged:

1. Quantitative data export (e.g. number of drafts, number of revisions, who revised how many times etc.)
2. More qualitative and descriptive summaries (e.g. types of textual data, chronology of them, links between different types of data, etc.)
3. Comprehensive exports of everything that was going on in a knowledge creation process (covered e.g. by a shared space) – here the semantic nature of content items from the KP-Lab can also very well be exploited in order to organize the way all data is exported for later analysis.

**Table 23: Users' Participation and Activity Analysis and Semantic Services.**

Related High-Level Requirements	Related Semantic Services
HLR9.2: Users are provided with customized summaries about the knowledge objects available within the shared environment (e.g. users might request an overview of the tasks completed within the last 2 weeks)	Query, Export, Clustering, Comprehension, Analytical and Knowledge Mining Services
HLR14.6: User are provided with summative information on performed actions (e.g. added comments, created tasks, modifications in metadata, background materials for decisions)	Analytical and Knowledge Mining Services

### Evolution of Knowledge in Work Processes

Users' collaborative interactions and networks can be analyzed based on traditional interaction types (such as the number of chat messages or comments on a shared artefact) as well as based on the common use of semantic objects (like tags or metadata). This kind of information can be visualised directly within various KP-Lab tools (e.g. community view of the shared space, or whiteboard of the Activity system Design Tool), or it can be exported and re-used by external tools for more advanced visualisation and specialised analyses, that do not need to be reproduced directly within the KP-Lab system.

Furthermore, information about the evolution of contents and work processes also provides a means to directly monitor what is going on within the working environment and to reflect on the community's practices for developing them. Towards that end, it is important to identify relevant actions that led to the advancement or evolution of a particular knowledge artefact (discussion contributions, comments, linked artefacts, or changed conceptual models etc.). Analytical and Knowledge Mining Services will provide means to support this kind of knowledge evolution analysis.

**Table 24: Evolution of Knowledge in Work Processes and Semantic Services.**

Related High-Level Requirements	Related Semantic Services
HLR9.1: Users can track the evolution and changes of knowledge objects and find out their authors (sequences of performed steps in time, incl. versioning).	Analytical and Knowledge Mining Services
HLR1.2: Users are able to view the artefacts and their relations from different perspectives	Query, Analytical and Knowledge Mining Services

## 5. Conclusions and Future Work

Even though the set of user tasks, driving objectives and high-level requirements discussed in this deliverable turned out to be quite robust (i.e. changes from the previous version are rather incremental) several modifications and trends seem noteworthy.

The process of reviewing and updating the driving objective revealed an increased interest among pedagogical partners for those high-level requirements related to data export and data analysis, such as for the example Data Export and the Knowledge Evolution Analyzer. To better account for respective needs, which are also reflected in the use of semantic models as part of the KP-Lab research strategy, a new Driving Objective (DO14) has been added, which feeds into User Task 5 “Investigation and development of knowledge practices”.

Besides this, the collaborative discussion led to an improved wording, the identification of redundant or at least overlapping requirements as well as the disambiguation of high-level requirements, which is reflected in the rephrasing and re-organisation of the high-level requirements.

Furthermore, the distinction between “expected benefits” in the sense of direct added value for a user and the elaboration of the underlying “rationale” for a driving objective made it possible to become more precise about the intended effects.

The future work on user tasks, driving objectives and high-level requirements will follow the tasks specified in the DoW3.1 (KP-Lab, 2008b) as well as the KP-Lab research strategy and will include the following:

1. Evaluation of driving objectives and high-level requirements by the KP-Lab scientific board (T2.3.2) in conjunction with the evaluation of KP-Lab tools. This evaluation is scheduled for fall 2008 and aims to ensure the coherence of technology development and the overall research strategy.
2. Specification and update of user and software requirements for KP-Lab tools based on the Driving Objectives and High-Level Requirements specified in this document. This task will be carried out by the working knots in close collaboration with the technical work packages.
3. Regular usability testing of all KP-Lab tools prior to their official release. These tests are carried out by pedagogical partners in collaboration with the respective working knots. Their aim is to ensure the fulfilment of the high-level requirements.
4. Empirical evaluation of the role and benefit of KP-Lab technology with regard to knowledge creation and practice transformation. These evaluations will be carried out as part of the KP-Lab research cases by the pedagogical work packages.

The outcomes of these tasks will then be used for another update and refinement of the user tasks and driving objectives.

## 6. References

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