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APOSDLE: Advanced Process Oriented Self-Directed Learning Environment
Integrated Project
IST – Technology enhanced Learning

APOSDLE Scope and Boundaries

Deliverable D6.1

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Executive Summary

This document provides a baseline for the APOSDLE project's scope and boundaries. Since the APOSDLE prototypes within year 1 will be focused on the domain of requirements engineering, this deliverable explains and illustrates the APOSDLE vision, the context model and the key concepts using this domain.

Within the first part of this deliverable the **APOSDLE vision** is presented in the form of three scenarios. The support APOSDLE aims to provide for learners, experts and workers is illustrated using the example of a requirements engineer. Based on the APOSDLE description of work this vision was developed by the Know-Center. During the APOSDLE kick-off meeting it was presented, discussed and agreed by all partners.

The second part of this deliverable identifies actors (both human and technical) whose work may be designed or re-designed through work carried out in the APOSDLE project in an **APOSDLE context model**. It is designed to give an overview of the scope of the project's influence. This model was developed through work in work package VI on establishing user requirements. As part of this work, staff from City University met with staff from each of the application partners (CCI, CNM, EADS and ISN). During these meetings, four separate partner-specific context models were constructed and discussed. Following the meetings, actor roles and relationships from each of the application partners were generalised to create a generic context model reflecting common patterns of interaction across all partners.

Within the final part of this deliverable key project concepts and terms are defined in a glossary. Definitions were provided by the relevant work package leaders, and have been validated by all project partners. Illustrative examples are provided from the domain of requirements engineering, which is to be the focus of the project's first prototypes. Finally, for key concepts their influence on the APOSDLE goals (specifically for year 1) is discussed.

The boundaries and definitions set out in this document are seen as first cut definitions. The project vision, context model and glossary will evolve during the course of the project. However, the versions provided here have been agreed upon by all partners, and as such, provide an important starting point for the development of a common orientation and cross-project consensus regarding the aims of the project.

Table of Contents

1 Introduction

1.1 Purpose of this Document

This document provides a baseline for the APOSDLE project's scope and boundaries. Since the APOSDLE prototypes within year 1 will be focused on the domain of requirements engineering, this deliverable explains and illustrates the APOSDLE vision, the context model and the key concepts using this domain.

The APOSDLE vision is presented in the form of three scenarios. Actors (both human and technical) whose work may be designed or re-designed through work carried out in the APOSDLE project are identified. Key terms are defined and their role within the APOSDLE goals is discussed.

1.2 Scope of this Document

The boundaries and definitions set out in this document are seen as first cut definitions. The project vision, context model and glossary will evolve during the course of the project. However, the versions provided here have been agreed upon by all partners, and as such, provide an important starting point for the development of a common orientation and cross-project consensus regarding the aims of the project.

1.3 Related Documents

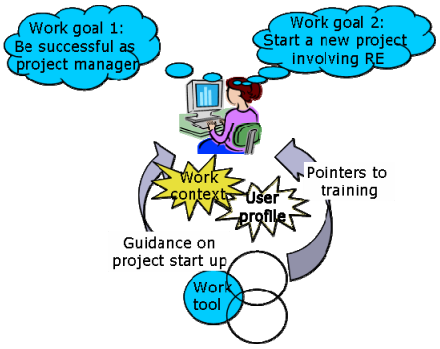
Other models and materials developed as part of the work in WP VI are available to project partners on the internal project document store. These include:

- Human activity descriptions - descriptions of typical work currently carried out by knowledge workers in each of the application partners;
- Partner-specific context models showing the relationships between knowledge workers and other key actors for each of the application partners, as well as a table showing the relationships between these models and the generic context model shown later in this document (see section 3);
- A use case diagram, and associated use case précis, developed by the application partners, and outlining proposed functionality of the first project prototypes in the requirements engineering domain;
- Some partner-specific use case diagrams, also developed by the application partners, and outlining ideas for additional features to be added in later, domain-specific prototypes;
- A document which provides a snapshot of the current state of requirements for the first prototypes.

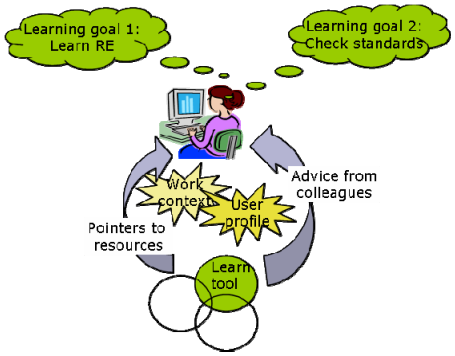
2 APOSDLE Vision

This following usage scenario[1] provides a first vision of how the APOSDLE system will be working. The scenario shows how the different roles of a knowledge worker (see 4.1.1) – Learner, Expert and Worker – will be supported at her workplace within *one integrated* APOSDLE environment. Since with the first prototype we will be focussing on the domain of Requirements Engineering, the scenario shows how Sandra, a requirements engineer, will be working with the system.

Background. Sandra is a technical expert at HighTech. She has recently been promoted to project manager. In this new role she has now also the responsibility of directly working with the customer to elicit the user requirements of the software application to be developed. In addition, she is responsible for ensuring that the requirements are updated, linked to the design documents, and finally used for testing. In the past she was involved with requirements management (RM) but never in the elicitation process (RE). Also, she feels a little uncomfortable since she is not sure that her team handles requirements according to the company standard.



Worker Support. A new project is about to start and so Sandra instantiates a new project folder in the common file system, sets up a common e-mail repository, etc. By analyzing these actions (which Sandra is executing within her work environment) an APOSDLE Work Tool automatically identifies that Sandra currently is in the project management phase "ProjectStart". Another APOSDLE Work Tool unobtrusively offers all information relevant to the ProjectStart phase. This helps Sandra to remember all the steps which need to be done. In addition, the APOSDLE Platform keeps a user profile of Sandra. In this profile Sandra's expertise in RE has been recorded as low. One of the important first tasks associated with the ProjectStart phase is that the user requirements for the system to be developed need to be elicited. Due to Sandra's profile the APOSDLE Work Tool makes Sandra aware that more detailed and more introductory information about RE is available. Since Sandra is happy about all the help she can get she selects the offered APOSDLE Self-Directed Learning (SDL) Tool.

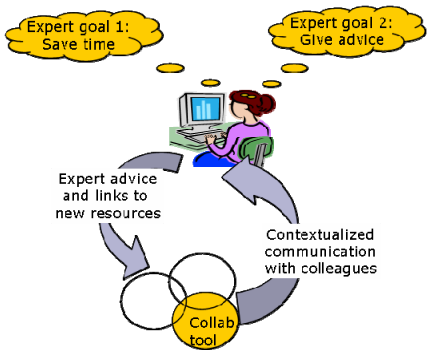


Learner Support. By glancing at the window offered by the APOSDLE SDL Tool Sandra notices a number of very different available resources associated with RE, structured neatly into categories: *templates* to document user scenarios, a *frequently asked questions* list, *questionnaires* for structured interviews, *example* documents from other projects, a *tutorial* about scenario-based RE, a *link* to a community of practice (COP) platform within HighTech related to the topic, and even an announcement for a RE *class* to be held in a few weeks. The APOSDLE SDL Tool explains which resources can be used for which purpose and how it all fits into the RE process. In addition, the tool provides Sandra with guidance about how best to approach to learn RE.

Right now Sandra is in a bit of a hurry since the first customer meeting will be held tomorrow. So the first thing she does is look at the COP platform. This platform is an APOSDLE Teaching Tool which knows about Sandra's work and competency context and helps her identify people with the right know-how to help her learn. She immediately asks some urgent questions and is pointed to a little pre-recorded tour through the available methods. Based on this information and the advice given Sandra

[1] This scenario was published in Lindstaedt & Mayer (2006).

decides that she will use the scenario-based RE approach. She switches back to her APOSDLE SDL Tool and selects this approach. She accesses the user scenario templates, skims through the tutorial, and looks at some examples from projects she was involved in. (At that time she was not interested in RE, so she did not learn too much about it. Now the time is right, her motivation high, and the familiar context helps her to understand the new aspects better.) But since Sandra is not only interested short-term in RE but also wants to establish a better RE practice in her team she also signs up for the course offered.



Expert Support. Some weeks later Sandra reviews the use case descriptions of one of her newer team members. By now she has learned quite a bit about RE and especially is knowledgeable about the RE standards employed within HighTech. She immediately notices that her colleague started to document design options instead of focusing on the user requirements. Since this is a typical mistake most beginners make and which she has made herself, she already has compiled a number of reference materials, examples, and guidelines within the review environment (an APOSDLE Collaboration Tool). She now marks the suboptimal parts in the use case, links the relevant material to it and writes a short explanation in the chat window about how the material applies here and how the team member can best learn from it. She also points him to other such use case examples done before. In addition, by using another APOSDLE Collaboration Tool she records a short tour of the available use case modeling resources in the APOSDLE environment and makes this guided tour (including her voice annotations) available to all her team members by associating it to the project management phase ProjectStart. From now on inexperienced use case designers will be offered this tour automatically by the APOSDLE system.

3 APOSDLE Context Model

Here we present the APOSDLE context model, designed to give an overview of the relationships between different actors of relevance to the APOSDLE project, and the scope of the project's influence.

This type of model was developed for use in the RESCUE process (Jones and Maiden, 2004), which is being used within WP VI to provide a framework for establishing user requirements. It is normally produced within the first stage of the RESCUE process as a precursor to more detailed modelling of the relationships between a system's actors and their goals.

Within the central ellipse, we show the technical, or computer-based component of the system to be designed, or re-designed. This component forms the main focus of software development activity within the project. It is also known as the 'target system' for the project.

Within the next layer of the model, we show actors who interact directly with the target system, and whose work may be designed or re-designed as part of the development of the new socio-technical system.

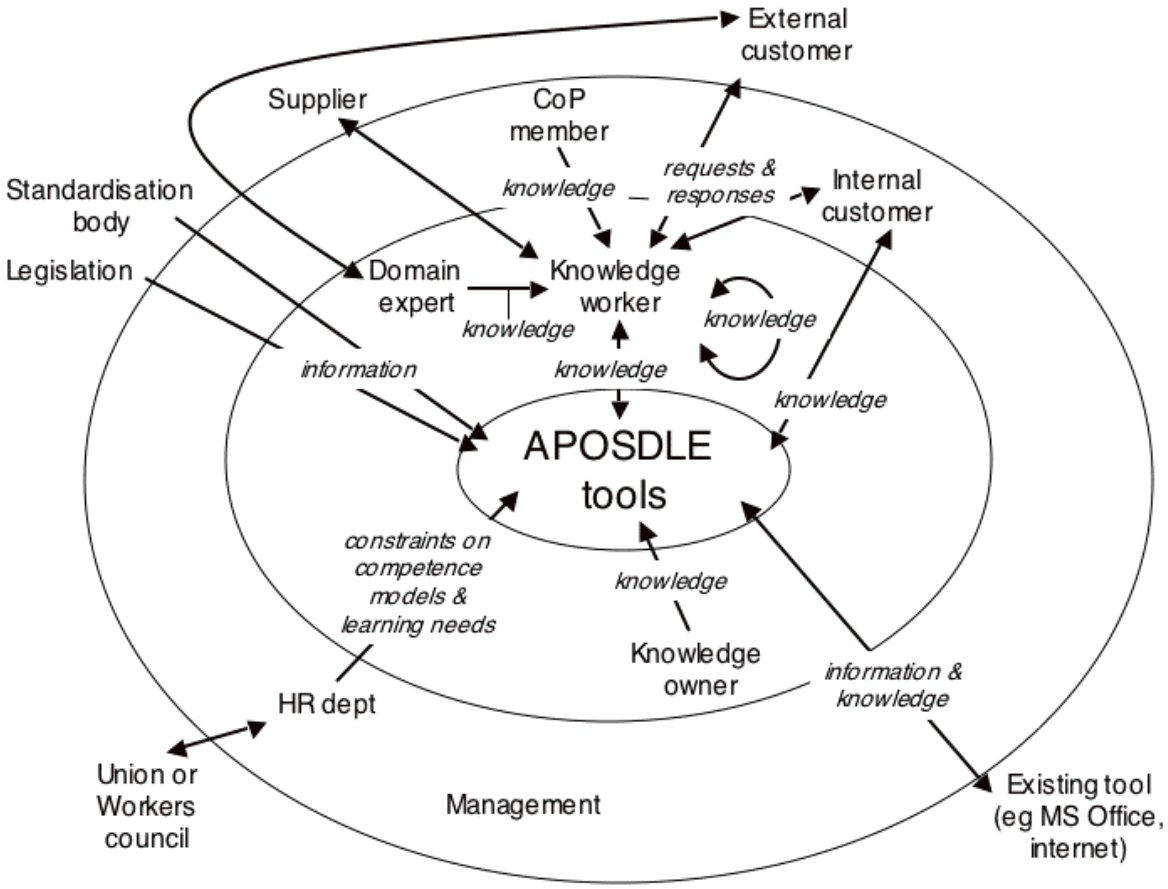


Figure 3-1: APOSDLE Generic Context Model

Existing systems or people who will be influenced by the system, and systems which may change to accommodate the new system and its users, but which are not dependent on it, or amenable to mandatory change, are shown in the third layer.

Finally, on the outside of the third ellipse, we show external actors and systems which interact with actors in other layers of the model, but which will not change as a result of the project, and are completely beyond the scope of the project's influence.

Note that actors shown in the model denote roles, rather than individual people or systems, so that one person may fill a number of different roles at different times. Where the meaning of any of the actor names is unclear, please refer to the project glossary in the following section.

The model shown in Figure 3-1 was developed through work in WP VI on establishing user requirements. As part of this work, staff from City University met with staff from each of the application partners (CCI, CNM, EADS and ISN). During these meetings, 4 separate partner-specific context models were constructed and discussed. Following the meetings, actor roles and relationships from each of the application partners were generalised to create a generic context model reflecting common patterns of interaction across all partners. This generic context model was then validated with all application partners during a one day workshop.

The content of the model shown in Figure 3-1 may be explained as follows.

Knowledge workers (see 4.1.1) - corresponding to staff in the Darmstadt CCI, CNM consultants and developers, EADS researchers and requirements engineers, and ISN partners - interact with the APOSDLE Tools (4.5.5). They extract Knowledge (4.1.4), in their role as Learner (4.3.3), and enter knowledge, in their role as Expert (4.4.7) or Knowledge Owner (4.6.5). They may wish to interact with the system when in their normal office environment, or from home or when off-site with a client (see 4.1.2).

Knowledge workers also exchange knowledge with each other. This may happen in informal settings (e.g. while drinking coffee), or more structured meetings, or via tools provided by APOSDLE, such as an electronic whiteboard.

A knowledge worker may obtain knowledge from a Domain Expert (4.6.3), or from an external Community of Practice (4.6.4). Once again, communication with domain experts or the community of practice may happen in informal settings, or more structured meetings, or via tools provided by APOSDLE, such as an electronic whiteboard. Knowledge workers may sometimes ask domain experts to communicate directly with a Customer (4.6.6).

Knowledge workers respond to requests or requirements from internal or external customers on an on-going basis. Once again, communication with customers may happen in informal settings, or more structured meetings, or via tools provided by APOSDLE. Internal customers may be given direct access to APOSDLE as a more efficient means of exchanging knowledge, for example knowledge about a new project.

Knowledge workers also need to interact with suppliers.

Knowledge workers sometimes need access to information from a Standardisation Body (4.6.7) or Legislation (4.6.8). This information may be stored or sign-posted in APOSDLE for ease of access.

The Human Resources department of a knowledge worker's organisation may impose some constraints on the use of competence models and user profiles, as some knowledge workers may be uncomfortable with their performance being too closely monitored. A Union or Workers Council (4.6.9) may play a similar role, but would not interact directly with the APOSDLE system.

The Human Resources department may use information from the APOSDLE system to help identify a knowledge worker's learning needs.

A Knowledge Owner (4.6.5) is an individual who has access to knowledge which she may make available to APOSDLE. Knowledge workers may act as knowledge owners. So may project managers, domain experts or customers.

Finally, the APOSDLE system must be able to interact with existing tools within the knowledge worker's organisation in order to extract useful knowledge, or possibly also to enter information into the tools.

Many of these concepts are explained further in the following section (see, in particular, section 4.6).

4 APOSDLE Glossary

The following definitions of key terms for the project were provided in the first instance by the relevant work package leaders, and have been validated by all project partners.

Examples are provided from the domain of requirements engineering, which is to be the focus of the project's first prototypes, and in particular, from the RESCUE process for requirements engineering (Jones and Maiden, 2004).

4.1 Overall Definitions

4.1.1 Knowledge Worker and Knowledge-intensive Work

With the term knowledge worker we refer to an employee of an organisation whose essential operational and value creating tasks consists in the production and distribution of knowledge (Machlup, 1962). Rudolph et al. (1987) distinguish between routine knowledge work and knowledge work with a dominant creative part. Studies have revealed that truly creative activities only account for about 20% of knowledge workers' tasks. Other models of knowledge-intensive work (Schreiber et al., 1999) distinguish between synthetic tasks (design, modelling, planning, scheduling, assignment) and analytic tasks (classification, assessment, diagnosis, monitoring, prediction).

Knowledge Workers are predominantly controlled by overall goals and expected results instead of defined procedures. Thus, they have significant autonomy in structuring their activities (such as timing and procedures) (Pyöriä, 2003; Davenport, 2005). This means they may dynamically switch to different tasks or domains in the process of their work. This is also reflected by dynamic changes in their *user context* (see 4.2.6). Knowledge Workers may dynamically switch to different roles in the context of their work, e.g. to that of the *learner* (4.3.3) or the *expert* (4.4.7). *Learning goals* (4.3.5), as well as *learning strategies* (4.3.6), are usually set by knowledge workers themselves.

Example: Requirements Engineering is a very complex activity. In order to enable people to handle this complexity, RESCUE defines a task structure which determines when and where which activity has to take place. Within the single activities however are parts which require experience and substantial creative powers in order to execute them well. APOSDLE here can introduce the structure, provide guidance for the individual activities and help experts to communicate their experiences etc. In order to support the creative parts APOSDLE might be able to point the user to relevant information.

A first goal of APOSDLE is to research learning aspects of knowledge-intensive work. Within the workplace learning study (Deliverable II.1, Month 9) we will analyze relevant aspects and distinctions of knowledge-intensive work in respect to learning and arrive at a better understanding of work-integrated/workplace learning itself. Based on this study APOSDLE will then choose a focus for the support tools.

4.1.2 Workplace and Work Environment

Workplace is the physical location where a knowledge worker performs her work. This may be on-site (e.g. in an office) or off-site (e.g. at a customer or at home). The work environment is the set of all tools, artefacts, people, communication channels, etc. which are available to the knowledge worker in her workplace. In the context of APOSDLE it is important to differentiate between computational (i.e. computer tools are available) and non-computational work environments. Computer support may be provided through a desktop computer or through a mobile device. Thus, a knowledge worker using a desktop computer on the one hand works within her computational work environment in order to e.g. write a report but at the same time might use aspects of her non-computational work environment (e.g. read a book from her bookcase) as well.

Example: In the context of the first APOSDLE prototypes within the domain Requirements Engineering the workplace will be the office of the requirements engineer. Her desktop computer and all the available (and possibly specialized) software tools (such as MS Word, or RequisitePro) constitute her computational work environment. Her non-computational work environment includes the books in her office, the telephone, the people around her, etc.

It is the goal of APOSDLE to design methods and tools which can be integrated into the computational work environment and allow for virtual informal learning and knowledge transfer. This is why, within APOSDLE we focus exclusively on the possibilities of enhancing the computational work environment. Activities taking place in a non-computational work environment will be considered as far as they can be related to or reflected in the computational environment. For example, it might be the case that minutes of a meeting are made available in the IT environment, or a reference to a book or an event may be stored in the IT environment. However, if the IT environment does not reflect an event or activity in any way APOSDLE will not be able to process it.

Considering that what is a non-computational work environment today maybe a computational work environment in the future (e.g. through the use of mobile devices), the analysis of requirements for the APOSDLE system and the analysis of the status quo of workplace learning activities takes into account aspects of non-computational work environments as well. However, this is always done with the goal of enhancing the computational work environment in order to arrive at a rich environment which allows people to transfer knowledge and learn from each other *virtually*.

The underlying assumption is that in distributed organizations it is essential to provide knowledge transfer and learning support virtually so that all people can benefit from it.

4.1.3 Information

Information is data to which meaning is attached through the interpretation of the recipient of the data.

4.1.4 Knowledge

Knowledge describes the capability of an agent to carry out a task. It is a result of mental processing of information. Knowledge can be applied for different purposes. Knowledge can be partially explicated in a knowledge artefact (4.1.5).

4.1.5 Knowledge Artefact

A knowledge artefact is a digital entity which has been created in a knowledge-based activity. Examples for knowledge artefacts are a drawing of a software architecture, a (part of a) requirements engineering document, a link to a person or a community of practice, etc. Every knowledge artefact in APSODLE is addressable via a unique identifier. Knowledge artefacts can be described by a set of concepts from a formal model and related to other knowledge artefacts. They can be parts of documents, as long as they are addressable via a unique identifier.

Example: a human activity model, a requirements document, an UML diagram, etc.

4.1.6 Communication Artefact

A communication artefact is any kind of electronic communication piece, such as an e-mail, an entry in a news-forum, a conversation about a knowledge artefact in a synchronous chat etc. A communication artefact is a knowledge artefact created by means of communication. Communication artefacts can be connected to knowledge artefacts via relations (as can be knowledge artefacts to knowledge artefacts) and are addressable via a unique identifier.

Example: a chat discussion between the requirements engineer and a potential user about the activity model

4.1.7 Work integrated Learning, Workplace Learning

Learning refers to an advancement of knowledge and skills of the knowledge worker. Our understanding of workplace learning is such that it is truly integrated in current work processes and practices and makes use of existing resources. It is relatively short unstructured (in terms of learning objectives, learning time or learning support) learning at the workplace where the main aim of the activities is to enhance task performance. From the learner's perspective, workplace learning is spontaneous and/or unintentional. Learning in this case is a by-product of the time spent at the workplace (Colley, Hodkinson & Malcolm, 2002).

While traditional eLearning might also happen at the workplace in terms of time and place, our understanding of workplace learning would additionally require that

- Learning needs and goals are derived directly from the tasks the knowledge worker currently performs
- Learning activities happen in close interaction with available *knowledge artefacts* (*4.1.5*) which are stored in the *3spaces*. Either learning activities make use of available knowledge artefacts, or they result in creation of new artefacts (e.g. communication artefacts).
- Results of the learning activities, i.e. acquired knowledge and skills, can be more or less directly transferred to the worker's working situation (see *4.3.8 Learning Transfer*).

Example: A requirements engineer needs to design a use case model about the system to be built (learning goal). Using existing use case models (available knowledge artefacts) from previous projects she gets a good understanding about the activities to be modelled. After studying the diagrams she is able to create her own use case model (learning transfer).

4.1.8 3spaces

The concept of *3spaces* serves as an abstraction of the different environments a knowledge worker typically interacts with: learning space, knowledge space, and work space. The *3spaces* are one component of the knowledge worker's work environment (*4.1.2*), namely the one concerned with the search and use of information and acquisition and use of knowledge. Although the *3spaces* could be understood to encompass the non-computational elements of the work environment, the focus of APOSDLE is to enhance the computational work environment (see *4.1.2*).

The *3spaces* reflect the structure of the knowledge sources that knowledge workers interact with when working and learning. However, we suggest that the spaces also mirror the mental models of the people using them and shape the decisions about information and knowledge sources they seek. Accordingly these sources are structured in a specific way and accessed accordingly.

The motivation of APOSDLE arises from a disconnection between the three spaces, a cognitive/structural as well as technical disconnection, which can usually be observed in organizations. One goal of APOSDLE is to transcend this disconnection and allow the knowledge worker to interact with the 3spaces as a unity.

The following sections give details on the three different spaces, and the way they are currently structured.

Learning Space: The learning space stands for conscious learning situations, e.g. attending seminars and taking courses. In the learning space, activities are usually structured according to very clear and explicit learning goals and their dependencies. Also the learning space usually addresses different levels of expertise: different learning situations are planned for beginners than are for intermediates or experts. The learning space is either completely outside any technical system or represented by an e-learning platform. The structure of the learning space mirrors the structure of the learning topics as it is seen by course providers. It follows the didactical abstraction of the topic, and very often, it does not provide information about the relationship of work tasks to courses. In addition, the available course material is fairly general and has to be adapted to the worker's work context.

Example: RESCUE tutorial documents and face-to-face seminars

Knowledge space: The knowledge space encompasses the expertise that has been developed by the organisation. It represents unconscious learning, application of past experiences (own and from others) to new situations, spontaneous search for information, and use of examples in order to better understand how to apply knowledge. Also groups of experts or communities of practice often operate in the knowledge space to exchange relevant knowledge and learn from each other. In technical terms, the knowledge space corresponds to the organisational memory. It is often distributed over different systems such as the Intranet, the Internet, a common file server, etc. The structure again is different: organisational knowledge often does not have one clear structure, but mirrors the internal cognitive map of each person providing the knowledge. Often a mix of the topics or a domain structure and the organisational department structures is found here.

Example: RESCUE experts available over chat connections, lessons learned documents describing how RESCUE was employed in other projects, example RESCUE documents from other projects

Work space: Work Spaces are used in the process of work. Accordingly, they are structured in terms of the work processes, i.e. in terms of the tasks and their dependencies. The work space represents the user's desktop PC and shared document storage devices such as a common file structure or a document management system. It contains the work documents which are needed by a knowledge worker on a day-to-day basis, such as project related documents. The work space is typically structured according to a company's organization and task structures (e.g. project structures).

Example: a chat discussion between the requirements engineer and a potential user about the activity model

4.2 WP 01: Work Processes

4.2.1 Worker

Worker refers to the "default" role of a knowledge worker, besides *Learner (4.3.3)* and *Expert (4.4.7)*. Within this role she applies her knowledge, creates documents, designs artefacts, and communicates to others with the intention to perform the tasks at hand. Today much of this knowledge work is conducted within and mediated through computational environments (see *4.1.2 Workplace and Work Environment*).

Example: a requirements engineer

4.2.2 Task and Sub-Task

A task is a definition of an action which arises from a concrete situation and is to be assigned to a specific actor. With the acceptance of the task by an actor the task becomes an action. A task can be structured in a number of sub-tasks that are to be executed as part of the respective action.

A sub-task is a part of a task. The process (*4.2.3*) coordinates the sub-tasks forming a task.

(See also *4.1.1 Knowledge Worker and Knowledge-intensive Work*)

Example: task: "human activity modelling", sub-task: "plan and prepare acquisition sessions"

4.2.3 Work Process

A process describes the entire hierarchy of sub-tasks that originates from a given task. Due to the decoupling of task, the latter only describes the upper level of execution whereas the execution of subtask is out of its scope. In contrast to that the process encompasses all tasks that originate via

subtasking from a given task. Thus a process describes its entire execution structure of the respective task.

The dependencies between subtasks of a given task can only be considered as recommendations in order to keep the flexibility of knowledge workers.

4.2.4 Domain Model

A domain model is a formal model of one domain of knowledge which is relevant to the knowledge worker. “One” domain of knowledge stresses the fact that the knowledge worker might move from one domain of knowledge to another. “Formal model” refers to the fact that the model is machine-readable. Human-readable definitions of model entities may be provided for convenience.

The domain model consists of definitions of basic domain concepts, relations between them and restrictions on both concepts and relations (axioms).

Example: a domain model of requirements engineering

4.2.5 Concept

A concept is an abstract idea generalized from a set of particular ideas or objects. A concept may be expressed by different lexical representations (e.g. synonyms: table, desk; different languages: table, Tisch).

A concept in the context of a formal model such as the domain model is defined by a URI, its relations to other concepts and restrictions placed upon it.

Example: a domain model of requirements engineering contains concepts such as requirements engineer, requirement definition, system, scope, etc.

4.2.6 User Context

In our understanding context is the substrate in which events occur and which allows a meaningful interpretation of data. Context is characterized by a relevant subset of all surrounding potentially dynamic (e.g. temporal, environmental) information and external and internal conditions. To assess the relevance of information a goal must be considered, which is bound to a knowledge worker. The context is characterized by a potentially dynamic subset of all environmental features.

For the APOSDLE User Context the three parts of the *3spaces* need to be considered (see *4.1.8*). Accordingly, the User Context is an abstraction of three context spaces. The work-related context space is defined by a knowledge worker’s tasks and the resources necessary to execute tasks. The learning-related context space is defined by a knowledge worker’s competencies. The knowledge–related context space is defined by a knowledge worker’s knowledge with regard to a certain knowledge domain.

For the APOSDLE User Context also three different activities need to be considered: Working, learning and contextualized collaboration. The relevance of information from the User Context differs depending on the type of activity a knowledge worker is currently involved in. During working, aspects relevant to the task the knowledge worker is currently operating in are considered relevant. During learning, aspects that are directly related to the knowledge worker’s learning needs are considered relevant. During contextualized collaboration, aspects directly related to the act of communication and collaboration with other agents are considered relevant.

Within APOSDLE, we restrict the information considered for the User Context to those aspects where the acquisition of this information in an IT-based model is feasible. In the following an exemplary list of aspects of the User Context is given:

- The current task the knowledge worker is currently working in.

- Her short- to medium-term goals with regard to executing the job at hand.
- Her long-term goals with regard to corporate and personal advancement.
- The set of knowledge artefacts a knowledge worker has read or produced as a consequence of executing her jobs and tasks.
- The knowledge worker's progress in education and learning, which is expressed as acquired competencies (see definition of competencies).
- The current learning need is the gap between a knowledge worker's acquired competencies and the competencies needed at a given point in time. The current learning need is expressed as a concept or set of concepts (see definition of concept).
- The current task, which makes contextualized collaborative effort necessary.
- The other agents who are currently involved in acts of contextualized collaborating.
- Those topics (expressed as concepts), which are relevant to the communication act.

The context acquisition relies on a model, which relates worker activities to the work situation. Thus, also worker activities that are not embedded in specific work processes can be considered, e.g., if a user reads an interesting document that is not directly related to her work.

The user context is implemented in the *user profile* (*4.5.3*).

4.2.7 Competency

A competency refers to a combination of human characteristics, e.g. knowledge and skills, together with the ability to apply them in different contexts. Competencies can be developed in a learning activity, either while working or within a formal training. Competencies are needed for effective performance in the workplace. Competencies are theoretical constructs and can not be directly observed. They can only be inferred from actual *performance* (*4.2.8*). Missing competencies can be used to derive *learning goals* (*4.3.5*) and thereby provide the connection between workplace performance and learning.

Example: competencies relevant to requirements engineering include "knowledge of creativity techniques", "ability of thinking in processes and analyzing processes", "knowledge about the Strategic Dependency Model"

4.2.8 Performance

Performance refers to the successful or unsuccessful execution of tasks in the workplace in a concrete situation. Task performance is a result of the utilisation of competencies. Performance can be observed and judged according to some defined or implicit standard. The performance of a knowledge worker is used to infer her *competencies* (*4.2.7*).

Example: successful execution of the task "build a first cut Context Model to identify system boundaries" in a specific requirements gathering project

4.3 WP 02: Self-directed Learning

4.3.1 Learning

(see *4.1.7 Work integrated Learning, Workplace Learning*)

4.3.2 Self-directed Learning

Self-directed learning (SDL) refers to a conscious or unconscious self-directed exploration of knowledge sources and the application of knowledge by learners with the purpose of advancement in a learning domain. SDL largely relies on the learners' own initiatives and creativity. SDL often appears in working contexts where learners need to pursue their *learning goals* (*4.3.5*) within time and resource restrictions of their work. Necessary pre-requisites for SDL are: learner's having been empowered to take responsibility for their own learning attempts, means that allow them to carry out various learning activities (self-directed literature research, collaboration in groups etc.), and access to various learning resources.

Example: a requirements engineer searching for example use case models to help her design her own model

4.3.3 Learner

Learner refers to one role of the knowledge worker which she may spontaneously take at various times in the context of her work. In this role, her primary goal is to advance her knowledge in a certain domain in order to more successfully meet current or future requirements of her work. At times, this goal may not be fully explicit. Especially, the learning goals may not be clearly defined. We refer to the activities in this role as learning activities (e.g. looking for information, seeking help) and the situation as a learning situation.

Example: the requirements engineer above learning about use case models

4.3.4 Learning Need

A learning need arises when the knowledge worker is in doubt about her knowledge that is needed to give meaning to an event. She acknowledges that there is a gap between the needed and possessed knowledge. These feelings of uncertainty are converted into concrete subjects or questions that lead to searching information or knowledge (Choo, 1998). From a learning need, more concrete *learning goals* (*4.3.5*) can be derived.

Example: The need of the requirements engineer to understand requirements acquisition better.

4.3.5 Learning Goal

The goal of learning is to close the gap between the needed and possessed knowledge that is needed for a certain task or for the acquisition of a new competency. The goal of searching for information is to end feelings of uncertainty and to change competencies as a result of the acquisition of new knowledge.

Example: to learn about available requirements acquisition techniques and their applicability in a certain context

4.3.6 Learning Strategy

The learning strategy refers to the approach the learner uses in her attempt to acquire new knowledge that results in changed competencies. A learning strategy can differ from person to person and even may differ for one person. It entails the steps that are taken to acquire new knowledge.

Example: Reading an example use case from a prior project, deriving general principles of use cases, applying the principles to a new situation

4.3.7 Learning Resource

A learning resource is utilized by the learner for acquiring knowledge in the act of learning, i.e. when building up knowledge, needed for a certain competency. A learning resource can be made up of one or more (existing) knowledge artefacts. A learning resource usually has been (manually or automatically) designed or structured in a way to enhance the learning process.

New knowledge may be acquired from different types of learning resources, like documents on the computer or on paper, or from a person. Within APOSDLE the main emphasis is on computational learning resources (which can refer to personal or paper learning resources) but also on help by experts using computer-mediated communication.

Example: Tutorial documents for RESCUE, typical problems when learning about RE together with help on how to do it right.

4.3.8 Learning Transfer

Knowledge and competencies that have been acquired during prior experiences of formal education, *self-directed learning* (*4.3.2*), and informal *knowledge transfer* (*4.4.5*) are effectively and continuously applied in new and sometimes unexpected contexts. Learning transfer comprises several levels of transfer from non-specific transfer over near transfer to far transfer and creative transfer. Whether or not transfer of learning is successful strongly depends on successfully bringing learning in line with applying knowledge. This can be achieved by situating learning within *user's work contexts* (*4.2.6*) and work environments (*4.1.2*).

Example: If the requirements engineer can apply the newly gained knowledge about use case models directly to her task of creating such a model herself, then the learning transfer was strong.

4.4 WP 03: Contextualized Collaboration

4.4.1 Interaction

Within APOSDLE interaction refers to mutual influence on the behavior of individuals and groups. In a broader sense interaction refers also to mutual influence on the behavior of humans and machines such as a computer.

4.4.2 Collaboration

Collaboration refers to a process where individuals and groups interact with each other in order to reach a common goal. Collaboration might include communication, coordination and work on shared knowledge artefacts.

Example: the joint creation of a requirements engineering document.

4.4.3 Communication

Within APOSDLE communication refers to a process of interaction between individuals and groups in order to exchange information. In a broader sense communication refers also to information exchange between humans and machines or between machines.

Example: Chat communication between experts about a use case model.

4.4.4 Coordination

Within APOSDLE coordination refers to the process of interaction between knowledge workers in order to negotiate resources and sequence activities in order to reach a common goal. Coordination is achieved via communication and work on shared artefacts (e.g. a calendar).

4.4.5 Knowledge Transfer

Knowledge transfer refers to the process as well as a result of collaboration as far as new knowledge is gained by at least one of the involved individuals. The individual who gains knowledge is referred to as knowledge recipient, the individual who made knowledge explicit is referred to as knowledge creator. (Note the difference to *4.3.8 Learning Transfer*)

Example: An expert in use case modelling coaches an inexperienced requirements engineer.

4.4.6 Contextualized Collaboration

Contextualized collaboration in the case of APOSDLE refers to collaboration, which is supported by the computerized system based on its information about the user context (including current goals, user profiles etc. see *4.2.6*). Within APOSDLE we focus on knowledge transfer via knowledge artefacts (including communication artefacts). Specifically we distinguish between intentional and non-intentional knowledge transfer: In an intentional knowledge transfer situation the expert is aware of his role as an expert (e.g. because he has been asked explicitly for advice). In a non-intentional knowledge transfer situation the experts are not aware of the fact that they transfer knowledge e.g. by collaboratively creating a document. Both types of knowledge transfer will be supported within APOSDLE. Depending on a knowledge worker's expertise, she will be able to act as a knowledge creator and as a knowledge recipient. Knowledge workers roles can dynamically change during a collaboration situation.

4.4.7 Expert

Expert refers to another role of the knowledge worker. In this role, she performs activities with the primary goal to help others advance their knowledge in a certain domain. This may be through collaborating with others or through producing or changing knowledge artefacts which later on are shared with others. In the role of expert, the knowledge worker is considered by others to be a valuable source of knowledge in a certain domain; they feel that his view is less likely to be incorrect.

4.5 WP 04: Integrated Knowledge Structure

4.5.1 Integrated Semantic Knowledge Structure

The knowledge from the *3spaces* (defined in *4.1.8*) is typically treated independently and structured differently. The Integrated Semantic Knowledge Structure will ensure the interoperability of the individual semantic structures (e.g. ontologies) of the *3spaces*. Based on the multiple semantic structures describing the *3spaces* an associative network will be created. Knowledge artefacts in the *3spaces* will be represented through nodes in the network. Edges in the network will be created and weighted by means of structure and classification information contained in the *3spaces*.

4.5.2 Associative Network

An associative network is a generic network of information items represented by nodes. Relations between information items are expressed by edges interconnecting the nodes. Weights on the edges can be used to represent the strength of the relation between the information items. In the context of APOSDLE the associative network will consist of concepts from the domain model and knowledge

artefacts. Associations will be made by similarity of content of knowledge artefacts and semantic similarity of concepts from the domain model.

While the Integrated Semantic Knowledge Structure deals with the integration of various models on a conceptual and technical basis, the associative network is a data structure optimized for the contextualized retrieval of knowledge artefacts.

4.5.3 User Profile

The User Profile represents users in their personal work and learning context (see 4.2.6). The constituting elements of the context and their mutual relationships stem from the APOSDLE *3spaces*. The User Profile serves as integrative entity with respect to these relationships. While the user context (*4.2.6*) is a formal model, the user profile is the data structure that implements part of the user context. There are elements in the user profile which are not part of the context (e.g. access rights).

4.5.4 APOSDLE Platform

The APOSDLE Platform provides context-sensitive and integrated access to the underlying information spaces for the APSODLE Tools. Semantic technologies will be applied and developed further to fulfill this task.

4.5.5 APOSDLE Tools

The APSODLE Tools are a variety of learning-domain and work-environment (application partner) specific tools for self-directed learning (*4.3.2*), contextualized collaboration (*4.4.6*), and work related context identification (*4.2.6*). They operate on top of the APOSDLE Platform and are connected via standardised interfaces. We distinguish between 4 sets of APOSDLE Tools: work tools, learning tools, communication tools, and modelling tools.

Example: An example for a work tool could be a context-sensitive information delivery tool which offers information about RESCUE. A learning tool could be a reflection-in-action tool which helps the user to stop and reflect about the requirements written at specific synchronization points within the RESCUE process. A communication tool could be a chat tool which allows for the discussion of the underlying assumptions behind a use case specification. A modelling tool could be a tool to document the essential competencies needed for human activity modelling.

4.6 WP 06: Requirements, Application & Evaluation

4.6.1 Formative Evaluation

A formative evaluation is an evaluation which is done during the design of a system to check whether the finished system is likely to meet the users' requirements. The results of a formative evaluation are used to inform further design and development of the system. The formative evaluation techniques used in APOSDLE will deliver an evaluation of both utility - fitness for purpose in terms of satisfying user requirements - and usability of prototypes developed during the project.

4.6.2 Summative Evaluation

A summative evaluation is an evaluation which is done to assess the success of a finished system. A summative evaluation is used to check that a system meets its users' requirements, or that relevant standards have been correctly applied and implemented. In the context of APOSDLE, the summative evaluation will be performed to examine whether users of the APOSDLE Tools (*4.5.5*) have actually been supported in their learning activities.

4.6.3 Domain Expert

The term 'domain expert' defines a role, which a person may fill if s/he is an expert (see *4.4.7*) in a particular domain (see *4.2.4*). A knowledge worker is likely to be a domain expert for a number of different domains. A Customer (*4.6.6*) may also be an expert in specific domains related to his/her own business. A person who is a domain expert may also have the role of Knowledge Owner (*4.6.5*).

Example: A practitioner, or academic, who is an expert in the domain of requirements engineering.

4.6.4 Community of Practice

A group of knowledge workers with the same or similar experience, as a result of working in related domains. A community of practice may form for a particular domain, such as requirements engineering or quality management. It may be a national or international community and include organisations such as professional groups or special interest groups, such as INCOSE (the International Council on Systems Engineering). It may also be a smaller group within a particular organisation, for example all those working on quality management in a large organisation may share organisation-wide standards and best practice. A community of practice will typically include many domain experts and other knowledge workers, working in the same domain.

Users of APOSDLE may, over time, form new communities of practice as a result of sharing domain expertise and common learning experiences.

Example: In the UK, the British Computer Society Requirements Engineering Specialist Group forms a focus for a community of practice in the domain of requirements engineering.

4.6.5 Knowledge Owner

The term 'knowledge owner' defines a role, which a person may fill if s/he has information or knowledge which s/he makes available through APOSDLE. A knowledge worker may act as a knowledge owner. Other individuals may also act as knowledge owners, for example, a project manager may make information about a particular project available through APOSDLE in the form of knowledge artefacts which can be used to support learning by other APOSDLE users.

Example: A project manager makes context and use case models developed as part of a requirements project available through APOSDLE. These can then serve as examples for knowledge workers wanting to learn about developing such models in future.

4.6.6 Customer

In the context of the APOSDLE project, a customer is defined as a client of the knowledge workers using APOSDLE. An external customer is a customer in a different organisation from the users of APOSDLE, on which the APOSDLE system will have no impact. An internal customer is a customer from within the same organisation as the knowledge workers, for example from a different department or business unit within the organisation.

Internal customers may have direct access to the APOSDLE system.

Example: A client for whom a requirements engineer is writing a requirements specification.

4.6.7 Standardisation Body

An organisation, such as ISO or W3C, which sets national or international standards relevant to the work of the knowledge worker.

4.6.8 Legislation

National, European or international laws affecting the work of the knowledge worker, such as European law on data encryption.

4.6.9 Union or Workers Council

An organisation of employees formed to bargain with employers. Referred to by different terms in different countries within the EU. For example a UK union has a similar function to a German workers council.

4.6.10 Beginner

A knowledge worker who is new to a particular domain. A beginner will need to learn about the new domain.

4.6.11 Newcomer

A knowledge worker who is new to an organisation. A newcomer will need to learn about the organisation, and may or may not also need to learn about a new domain.

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