Project Number **027023**

**APOSDLE:** Advanced Process Oriented Self-Directed Learning Environment

Integrated Project

IST – Technology enhanced Learning

# Publishable Executive Summary

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Organisation name of lead contractor for this deliverable

**JRS – JOANNEUM RESEARCH**

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### Dissemination Level

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| ☒ | PU | Public |
| ☐ | PP | Restricted to other programme participants (including the Commission Services) |
| ☐ | RE | Restricted to a group specified by the consortium (including the Commission Services) |
| ☐ | CO | Confidential, only for members of the consortium (including the Commission Services) |

## Disclaimer



## Imprint

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# Publishable Executive Summary


# Advanced Process-Oriented Self-Directed Learning Environment

## Project Objectives

In a world of rapid change and continuous technological innovation the economy of the European Union relies on the ability of their knowledge workers to learn efficiently and especially to apply new knowledge effectively within their work processes.

The goal of the APOSDLE project is to enhance knowledge worker productivity by supporting informal learning activities in the context of knowledge workers' everyday work processes and within their work environments.

The key distinction of the APOSDLE approach as compared to more traditional (e)Learning approaches is that APOSDLE will provide integrated ICT support for the three roles a knowledge worker fills at the professional workplace: the role of Learner, the role of Expert, and the role of Worker. Chiefly, this support will be provided within the work environment, and not in a separate learning environment. It exploits synergies between learning and knowledge management by reusing content not originally intended for learning. It will utilize contextualized communication for knowledge transfer, and ease the burden on experts for these tasks. Finally, it will be based on knowledge sources available within an organization – specifically business space, (e)Learning systems, and knowledge management – and not require a switch to a new system.

The outcome of APOSDLE will be in-depth understanding of workplace learning (within the APOSDLE scope). Based on this understanding a methodology and reference architecture for the support of workplace learning within computational environments will be created. In order to ensure the general applicability of this outcome we will use an application-driven approach to cover the needs of three different organizations: a network of SMEs, a public organization, and a large corporation. Their needs and constraints provide APOSDLE with the necessary guidance to develop informal learning processes, contextualized collaboration methods, and work support.

The prime deliverables of the APOSDLE project will be the domain-specific APOSDLE Environments embedded into the application partner organizations. Using these environments, we aim to demonstrate and evaluate the benefits of seamless integration of learning and working in the professional workplace.

## Work Performed and Results Achieved

### Work-Integrated Learning: Insights and a Conceptualization

The APOSDLE project has continued to work on the concept of work-integrated learning. Results of two empirical studies offer deep insights into how knowledge workers work, learn and collaborate at their workplaces. After the first set of studies carried looked at the learning episodes and bottlenecks encountered, the second study more directly addressed the access to information spaces and the use of media in the learning and collaboration process. Media Richness Theory provided one of the backbones of this study that was carried out as a large scale scenario driven survey that was answered by over 100 knowledge workers in knowledge intensive businesses across Europe.

These studies together with an extensive literature and state-of-the-art review are the basis for the definition of work-integrated learning in relationship to theories of knowledge work and workplace learning. Specifically, the APOSDLE approach to self-directed learning support has been described in detail taking into account learning from material as well as human resources.

Based on these insights and on the broad expertise in the APOSDLE consortium, a conceptual architecture for the APOSDLE approach of work-integrated learning was delivered. This architecture for brings together all diverse conceptual elements and theoretical underpinnings relevant for the APOSDLE approach. The document spans areas from user context determination, competency-based systems, semantic technologies, knowledge management, performance support systems, associative retrieval, user profile services, and contextualized collaboration. Taken together, this conceptual basis addresses the major challenges of learning *real-time*, with *real content*, and in the *real computational environment*.

**The Third APOSDLE Prototype: Integrating Working, Learning and Collaborating**

The conceptual architecture was transformed into an integrated software system in a large-scale, distributed and innovation-driven software design and development process. Integrating these diverse ideas and heterogeneous software systems has been a major challenge for the project consortium. Nevertheless, an integrated prototype again was delivered at the end of year 3 which contains all major aspects of work-integrated learning and presents a considerable improvement over the previous prototypes. Improvements are specifically pronounced in the areas of seamless integration of working and learning and in the systems usability. It was designed to be evaluated in real workplace settings in the last project year.

The third APOSDLE prototype presents itself as desktop application which is designed to allow for high degrees of flexibility and work-integrated support. The APOSDLE Main application includes a number of tabs: “APOSDLE Suggests” suggest document snippets, topics, tasks and persons based on the current context the user is in (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). The current task or topic the user is working on can be detected automatically by a context monitoring daemon that runs in the background and picks up low level system interactions. APOSDLE Main also includes a global search and browsing facility for documents and models in the APOSDLE knowledge base. .

When a resource is selected, a resource viewer displays documents and multimedia content, and highlights all parts of the document which were found to be relevant. This resource viewer also includes annotation functionality, which lets users annotate parts of documents with concepts from a domain ontology and a description of the instructional role they play (such as being an example or a definition) (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). Learning hints can be selected for each document snippet that allow the user to learn more about the topic the snippet is about. The user can also collect different snippets into collections, structure learning paths using these snippets or share collections and learning paths with others.

Cooperation processes in APOSDLE are supported by a cooperation wizard which guides cooperation partners through a cooperation process, from a request, to the actual cooperation, to a reflection of the cooperation (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). Different standard cooperation tools (such as skype, telephone, email, text messaging, audio/video messaging and cooperative authoring) are available and are integrated in APOSDLE via a cooperation framework. The cooperation event is contextualized by allowing all cooperation partners to share their context information (such as current tasks, learning goals and resources viewed). Completed cooperation events can be stored in a cooperative authoring space and used for reflecting on these events.

Finally, APOSDLE keeps track of the experiences a user has made by storing a usage history. This history lists all topics the user has dealt with in her interactions with the APOSDLE system (Figure 4). This can be used to reflect about the current state of knowledge and possible further learning goals, and is also used for the intelligent suggestions APOSDLE makes.

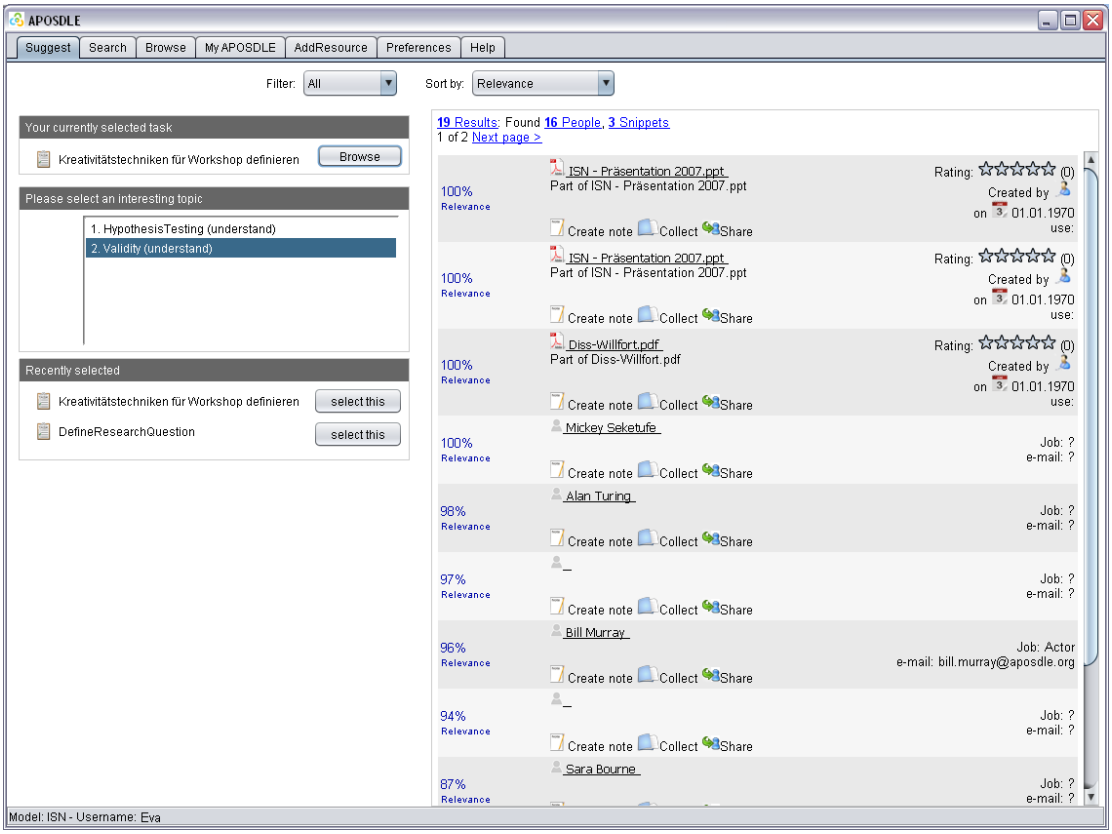


**Figure 0-1: APOSDLE Main Application**

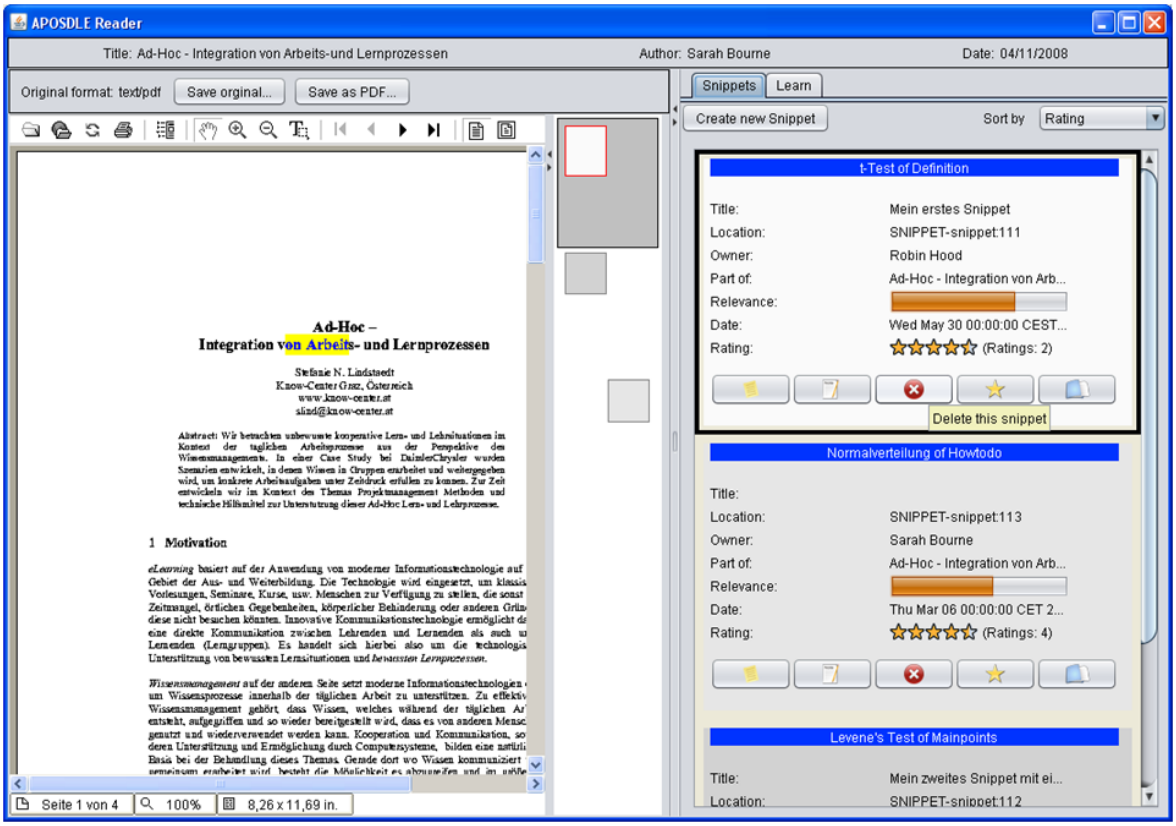


**Figure 0-2: APOSDLE Reader, Annotation Tool and Learn more**

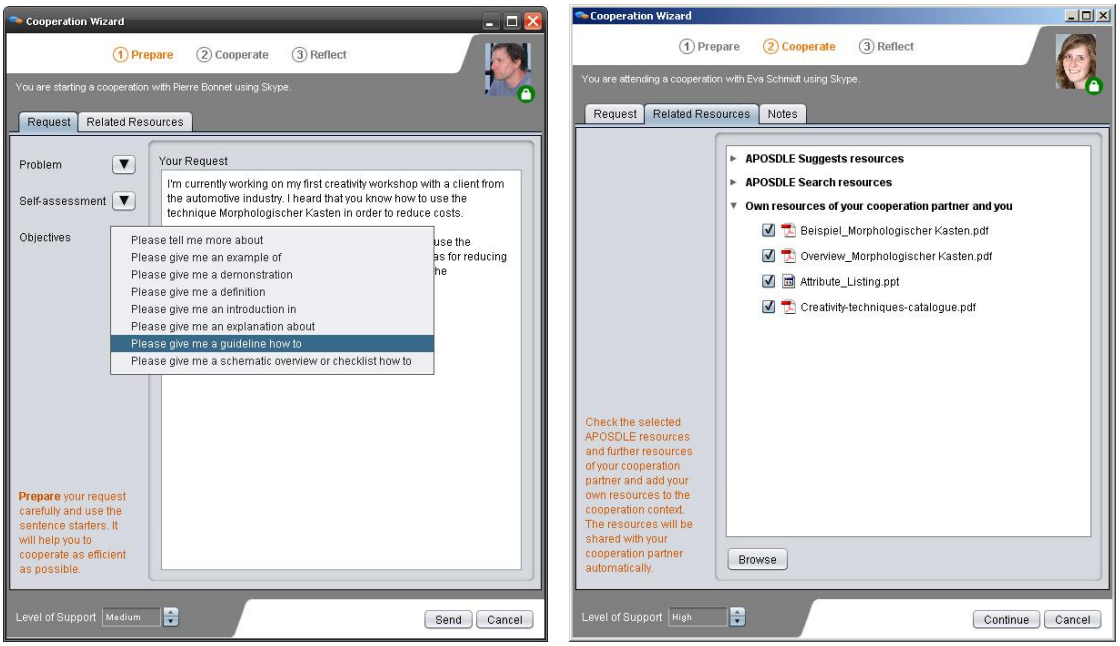


**Figure 0-3: APOSDLE Cooperation Wizard**

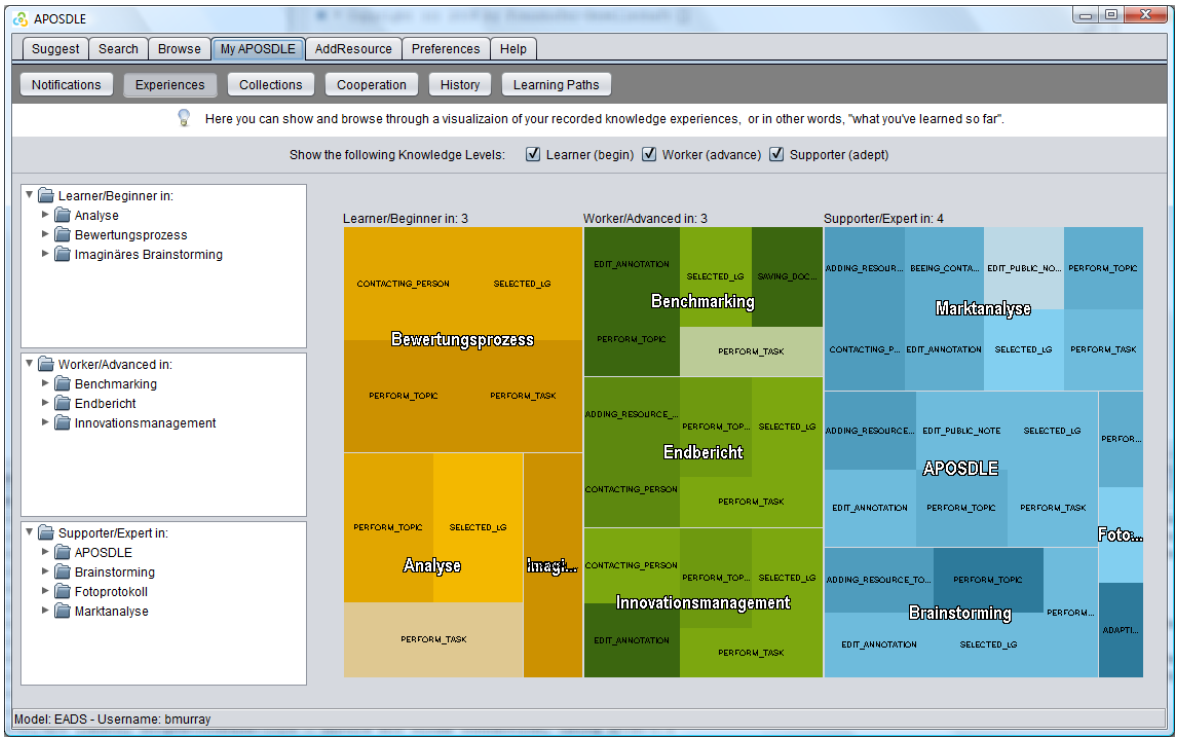


**Figure 0-4: APOSDLE Cooperation Wizard**

### Technological Infrastructure: A set of Innovative Semantic Services

To realize many of the functionalities described above, the APOSDLE tools make use of a number of innovative services. Knowledge Discovery and Extraction algorithms provide similarity measures for textual documents, discover important domain concepts and instructional roles of certain material, and extract textual information from multi-media sources. These services support retrieval of documents and also manual annotation.

An associative retrieval service performs context-based retrieval based both on textual content of documents as well as semantic metadata attached. This service can both perform exact queries (such as for material of the type “example”) as well as fuzzy associative queries (such as expanding a query for a concept to include similar concepts).

The User Profile Services realize a set of functionalities for maintaining and analysing user-related information. It also provides inferences based on the usage history, such as ranking topic or snippet suggestions according to the user’s learning history and ranking cooperation partners based on history of past cooperations. This data is also provided in a history view part of the APOSDLE Main application, which allows users to access, change and delete any of the collected information. Security and Privacy Enhancement Services ensure that users are authenticated, organizational and personal privacy policies applied, and access rights strictly obeyed.

### Semantic Models: An Integrated Modelling Methodology

Much of the intelligent services rely on semantic models which have to be provided for an application in a specific domain. This has the advantage that the software as such is generic and can be tailored to any suitable domain by exchanging the models. The APOSDLE system operates on three types of models which are tightly interconnected, a *domain model*, describing the learning domain, a *task model*, describing the tasks that need to be executed, and the *learning goal model* which provides the link between the two in order to realize work-integrated learning.

An integrated modelling methodology was created that describes the process of creating the three models in an interactive manner involving domain experts and knowledge engineers. The methodology is supported by a set of modelling tools, such as the Modelling Wiki (MoKi, a semantic media wiki extension), MoKi plug-ins for term extraction and clustering supporting content driven modelling, and a number of automatic checks enabling iterative evaluation during modelling.

On a technical level, services give access to the models as if they were one single knowledge structure, even though they were written using very different conceptual and formal representations. This is achieved through a unifying schema specifically developed for the purpose of supporting work-integrated learning.

### Application Driven Approach and Evaluation

To establish the requirements for APOSDLE we have used advanced requirements techniques including creativity workshops, scenario walkthroughs and measurable requirements techniques. These have been integrated together into a requirements process called RESCUE already applied to specify complex socio-technical systems.

An extensive evaluation of Prototype 2 within the application partner organizations helped us to identify important usability and conceptual issues. The lessons learned contributed significantly to an even tighter integration between working and learning support (fine granular activity support) and to the redesign of the whole APOSDLE environment in Prototype 3.

The third APOSDLE prototype has been prepared for five knowledge intensive domains, including simulation for aircraft engineers, innovation management, intellectual property rights consulting, the RESCUE requirements engineering process and statistical data analysis. The prototype is currently being deployed in workplace settings to undergo an extensive summative evaluation. For this purpose, we have combined usability evaluation techniques with data capture techniques including on-line diaries and ethnographic observations using technology uptake frameworks to triangulate evidence for problems and successes during knowledge transfer when using APOSDLE.

### Dissemination and Exploitation of Project Results

By conducting several market and competitor analyses, industry focus groups and several industry tutorials, the project is exploring the market potential and external requirements on solutions like APOSDLE. In addition, several approaches have been made to help identify key characteristics which help determine the applicability of APOSDLE. On the one hand a SWOT analysis sheds light on the usefulness of APOSDLE for the individual application partners. A questionnaire concerning the involved knowledge work types provides potential user organizations with a tool to identify suitable application scenarios. This will inform subsequent developments and help the consortium decide on a suitable business model for further exploiting project results.

In terms of dissemination to the external world, the project continues to be successful in creating visibility in the technology enhanced learning and knowledge management communities, especially by broad participation in the EC-TEL conference, and organization of the I-Know conference. Links to other EU projects and activities were established by founding the EATEL Special Interest Group on Professional TEL (SIG ProTEL, based on the Professional Learning Cluster), being involved in STELLAR, and being invited by other EU projects for presentation (e.g. MATURE, ACTIVE). A project website is maintained at http://www.aposdle.org.

## APOSDLE Consortium

The APOSDLE consortium consists of 12 organisations from 7 different European countries, ensuring that the demands of the ambitious vision of the project can be met both in terms of complementary competences and in terms of broad access to different technologies and domains of application.

JOANNEUM RESEARCH, Austria

Know-Center, Austria

SAP, Germany

Technical University Graz, Austria

Fraunhofer Gesellschaft, Germany

University of Twente, Netherlands

City University London, United Kingdom

Fondazione Bruno Kessler, Italy

EADS France, France

isn - Innovation Service Network, Slovenia

ComNetMedia, Germany

Chamber of Industry and Commerce – Darmstadt, Germany

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