AD-HOC – WORK-INTEGRATED TECHNOLOGY-SUPPORTED TEACHING AND LEARNING

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Abstract

Carrying out today's knowledge work without information and communication technology (ICT) is unimaginable. ICT makes it possible to process and exchange information quickly and efficiently. However, accomplishing tasks with ICT is often tedious: Colleagues have to be asked, how best to proceed. Necessary resources have to be searched for in the intranet and internet. And one has to get familiar with applying the various systems and tools. This way, solving a simple task can become a time consuming process for inexperienced employees and also for those who are asked for their expertise.

Therefore, at the Know-Center Graz, Austria , the AD-HOC methodology has been developed to support knowledge workers in task-oriented learning and teaching situations. This methodology is used to analyse the work processes, to identify the needed resources, tools, and systems, and finally to design an AD-HOC Environment. In this environment, systems and tools are arranged for specific work processes. Users are then guided at their work tasks and are provided with the necessary resources instantly.

This article presents the AD-HOC methodology. It analyses the obstacles that hamper efficient knowledge work and how AD-HOC overcomes them. Finally, the support of users at their specific work tasks by deployed AD-HOC Environments is shown in two field studies.

Keywords: Knowledge Work Productivity, AD-HOC, Work-integrated Learning, Technology-supported Learning, Unconscious Learning.

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Suggested track: L Practitioner's Track

1 Motivation

Peter Drucker (Drucker 1999) states, "the most important, …, contribution of management in the 20th century was the fifty-fold increase in the productivity of the manual worker in manufacturing." For the 21st century he forecasts, "the most important contribution management needs to make … is similarly to increase the productivity of knowledge work

and knowledge workers." Knowledge workers and their productivity, Peter Drucker predicts, are the most valuable asset of a 21st-century institution.

Information and communication technology (ICT) provides the tools for the knowledge workers. It has made it possible to process and exchange boundless amounts of data and information within seconds.. However, this is a first step. But more steps are needed to really take advantage of ICT's full potential.

Peter Drucker furthermore identifies six major factors in his article that determine the knowledge-workers' productivity. One of those factors addresses teaching and learning:

> *"knowledge work requires continuous learning on the part of the knowledge worker, but equally continuous teaching on the part of the knowledge worker".*

Today's organisations' ICT infrastructures are designed functional-driven. They are used for communication (e. g. e-mails), for storing and retrieving knowledge (e. g. document management, intranet), etc. So far, at their design and deployment, not much attention has been paid on the requirements for teaching and learning between knowledge workers.
This article focuses on the requirements for teaching and learning at knowledge work. On the basis of two deployments, it shows how ICT can be designed and the various tools can be integrated in order to let teaching and learning happen ad hoc.

This article (a) analyses the problems that have to be addressed, when work-integrated teaching and learning should be supported by ICT tools, (b) suggests how organisations' ICT infrastructures can be arranged and the various tools integrated to approach teaching and learning requirements, and (c) presents two deployments.

2 Obstacles to overcome

AD-HOC focuses on knowledge-intensive organisations, which can be law firms, research and development institutes, consulting companies, etc. In such organisations ICT is applied for creating value.
Organisations (Schanz 1992) are social systems with a structure to distribute and coordinate tasks in order to achieve goals. Thus, work is solving tasks, and, particularly in knowledge-intensive organisations, this implies continuous learning. Inexperienced persons learn from their experienced colleagues, and they acquire the knowledge necessary to solve their work tasks. However, learning is a process that takes place mainly unconsciously. Solving the particular work tasks is a priority - learning is just a means.

In the context of knowledge work, important obstacles that hamper efficient unconscious learning are:

1. Time pressure
2. Inadequate learning support in the work context
3. Cognitive and structural disconnection between work, knowledge, and learning

These obstacles, AD-HOC helps to overcome, are discussed in detail below.

2.1 Time Pressure

Lave und Wenger (Lave and Wenger 1991) have analysed novice-expert relationships in situated learning settings. Their field studies show, that legitimate peripheral participation in a community of practice works, when sufficient time is available for the learning process but is likely to fail in situations with time pressure. In today's organisations, time pressure is omnipresent. Experts do not have time to provide their know-how in a structured and advisory form. And novices just want to get information that is necessary to accomplish work tasks fast and efficiently.

To overcome the obstacle "time pressure", AD-HOC aims at the following: during work, experts leave their tracks in the organisation's ICT-infrastructure. In the case the same tasks have to be accomplished by inexperienced colleagues, and the expert's tracks can give guidance and help, AD-HOC will communicate these tracks to those inexperienced colleagues. As the means of communication, the work context itself is used. The work context is either directly or indirectly represented in an AD-HOC Environment.

If the work process is visualised, it can be applied as a "navigation metaphor" to communicate task specific information and knowledge between experienced and inexperienced employees. For instance, an expert works on a special kind of report, and during this task she accesses knowledge resources in the intra- and internet. When finished, she stores the final report together with the resources' references, and she sets a link from the visualised work process to the report. In the case an inexperienced colleague has to write a similar report, the visualised work process leads him instantly to the already written one and the applied resources. He sees what the report must look like and is provided with the knowledge resources, necessary for composing it.

2.2 Inadequate learning support in the work context

Formal trainings like seminars and e-learning courses are part of organisations' human resource development programs. They are an adequate instrument to teach employees new and complex topics. However, there is often a gap between the training and the employees' actual work context. And this gap can be characterised by a disconnection in place, time, and context:

A disconnection in place exists at formal trainings, when they are conducted by third parties, and when they take place in settings separated from the work place.

The disconnection in time can be described by the following: when employees arrive back at work from e. g. a week long seminar, their accumulated workload can be overwhelming. Stacks of papers on desks, hundreds of unanswered e-mails in mailboxes, minor emergencies in projects, and so on are waiting for them. And before new methods or acquired knowledge can be applied, weeks and months have gone by.

The third disconnection is a disconnection in context. Formal courses convey the subject material in a general way to be applicable in a wide range of situations. Thus, an employee has to adapt the acquired knowledge to his specific work tasks.

Furthermore, today's knowledge work includes continuous search for relevant information; understanding how to apply the found information by the means of examples. Unconsciously much of the work we do every day is learning. This unconscious learning is of a different

nature and has many different properties and goals than the conscious learning experienced in formal trainings.

However, for many work situations, the continuous search for the right information is, on the one hand, very tedious, and on the other hand, formal trainings would be overkill. What would be needed here is "a bridge" that closes this gap. We call this bridge the AD-HOC Spectrum, which is shown in Figure 1.
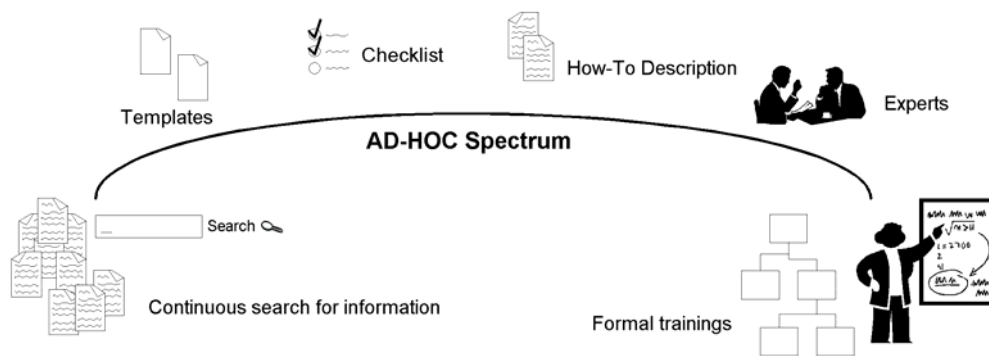
Figure 1: The AD-HOC Spectrum

Many short task-oriented unconscious learning experiences and few long general conscious learning episodes represent the two extremes of the AD-HOC Spectrum. Between those extremes, AD-HOC offers the workers (learners) a variety of different resources relevant for their specific work tasks. These resources range from example documents and templates, checklists, how-to descriptions, guidelines, contacts to dedicated experts and so on.

2.3 Cognitive and structural disconnection between work, knowledge, and learning

Figure 2 shows the typical workplace of a knowledge worker and its structure consisting of three separate spaces: a workspace, a knowledge space, and a learning space.

The workspace represents the user's desktop PC and the shared document storage devices such as a common network file structure or a document management system. It contains the work documents which are needed by an employee on a day-to-day basis, such as project related documents. The workspace is typically structured according to the user's tasks and work processes.

The learning space stands for conscious learning situations, e.g. attending seminars and taking e-learning courses. 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 in general, it does not provide information about the relationship of work tasks to courses.

The knowledge space 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. 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 organisations processes, topics and department structures is found here.
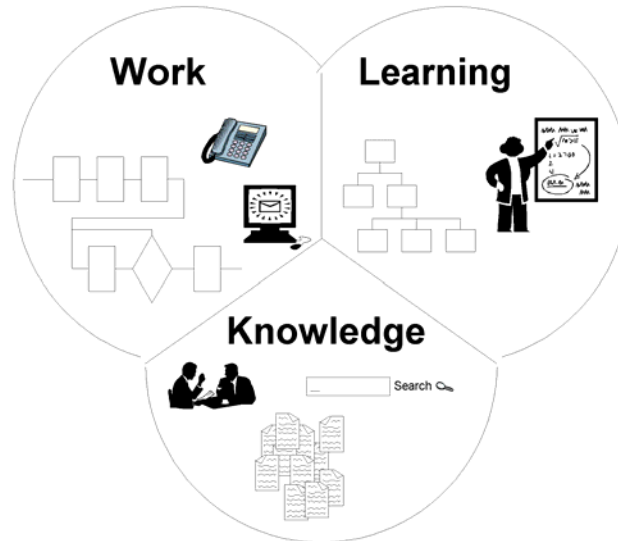
Figure 2: The three spaces, a typical workplace consists of

Based on the description of these three spaces, two main problems can be identified when linking the spaces together and integrating teaching and learning support and everyday work:

a. Cognitive disconnection between the three spaces: each of the spaces has an inherent structure which mirrors to some extent the mental model of the people who are using it.
b. Structural separation of the three spaces: each of the spaces is implemented on a different technical system. And here the contents' structure is predetermined by the system's design.

Both have to be bridged. The cognitive disconnection is removed by applying the work process as the link to work, knowledge, and learning resources. The structural disconnection is removed, when work, knowledge, and learning activities are supported by one single system. And this is the reason why AD-HOC Environments are implemented on knowledge management systems (KMS). A KMS generally consists of a repository for the organisation's explicit knowledge. Around this repository, various communication and exchange tools support the knowledge management (KM) life cycle - the collective development, distribution, and application of knowledge.

3 Method and Objective

Teaching and learning situations, which are part of knowledge work in an organisation, have been analysed in respect of the three obstacles: time pressure, inadequate learning support in the work context, and disconnection between work, knowledge, and learning. This has been done by employing the AD-HOC methodology, which has been developed at the Know-Center Graz, Austria. A concept has then been developed to overcome the obstacles. The concept suggests selected tools appropriate for support at particular work tasks and arranges them to a so called AD-HOC Environment.

In the following, two field studies are described. For both studies, the design, the use, and the lessons-learned of the deployed AD-HOC Environments are discussed.

4 Field Studies

4.1 Field Study 1: Project Close-Out at the Know-Center, Graz

This field study was conducted at the Know-Center Graz. The Know-Center is Austria's competence center for knowledge-based applications and systems. It carries out problem-driven and application-oriented projects in the field of knowledge management.

4.1.1 Challenge

The Know-Center has documented its project management processes in the past. Over time they were updated and adapted to emerging needs. However, they were not sufficiently applied and it was difficult to communicate the process changes to all affected employees. Processes were conducted improperly, and people forgot things and skipped steps.

On this account, the Know-Center decided to deploy an AD-HOC Environment and support its employees at the Project Close-Out process.
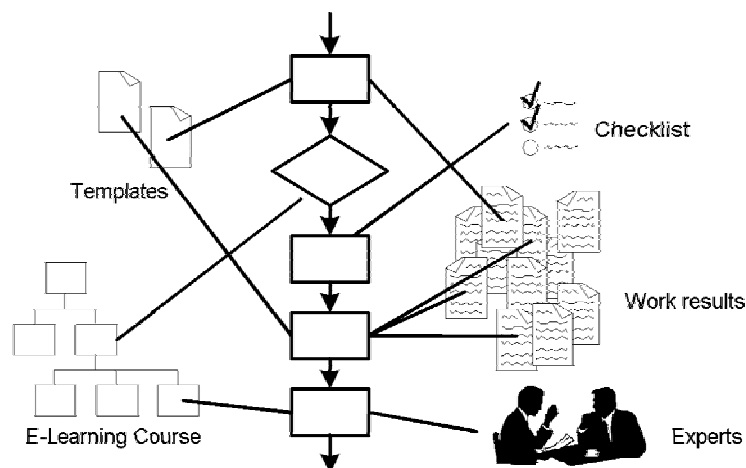

Figure 3: Aligning work, knowledge, and learning resources according to the Project Close-Out process

4.1.2 ICT Design

The Project Close-Out process has been examined from the AD-HOC viewpoint. For each work step, relevant work resources (e. g. document and e-mail templates), knowledge

resources (e. g. checklists, how-to descriptions, exemplary work results), and learning resources (e. g. proper sections in e-learning courses) have been identified. These resources have then been aligned according to the work process, as it is shown in Figure 3.

The AD-HOC Environment has then been deployed on the Hyperwave Knowledge Management System which is already used by the Know-Center for managing its documents and project work. Figure 4 shows the web-interface of the Hyperwave KMS.
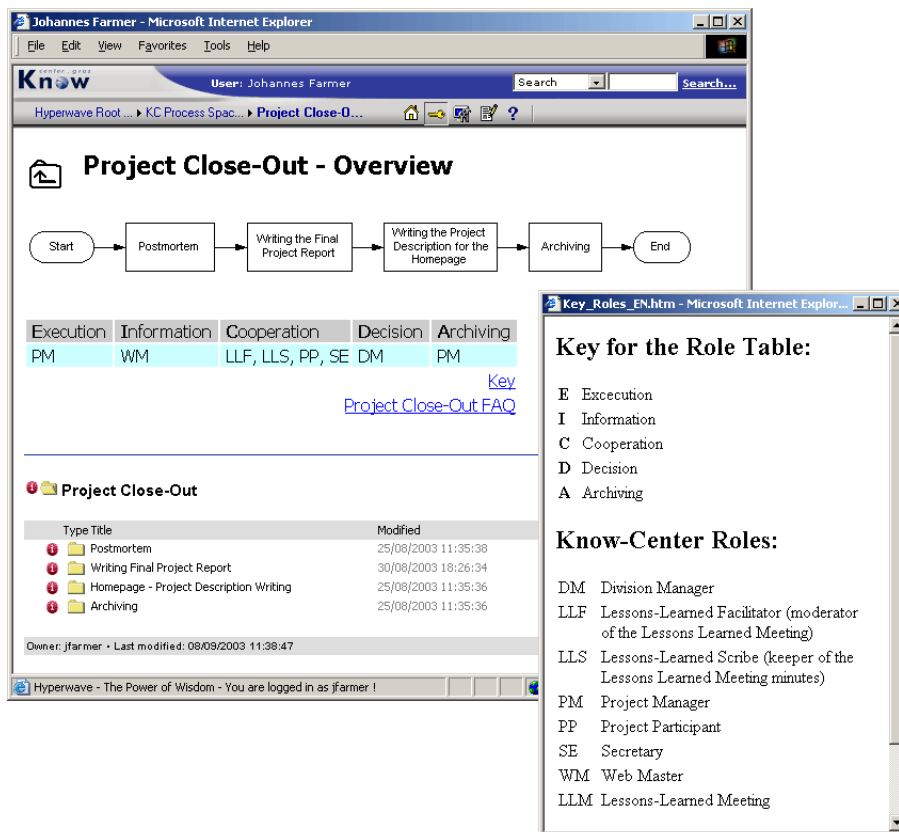
Figure 4: The Hyperwave web interface with AD-HOC integrated that guides users through the work process

The lower part of the browser window shows Hyperwave's typical collection and document structure. The browser window's upper part is the AD-HOC Environment: the flow-chart presents the work process in a simplified way. The work process is here the navigation metaphor. Simply, clicking on one of the work-process' steps, moves the user ahead to a more detailed view. A table below the work process diagram shows the roles that are involved. It tells the user which role is responsible for executing the entire process, who has to be informed about the process' status, who participates, who has to make a major decision, and, finally, who is responsible to archive the results. The pop-up window is the legend of the roles in the table.

4.1.3   Use

Figure 5 shows the AD-HOC Environment that supports users at writing a final project report. It appears when the task "Writing the final project report" is clicked in Figure 4. The user is

provided with the document template. Depending on her expertise, she can choose between a checklist that specifies the important topics to address, a detailed how-to description, and references to reports from former projects. A review cycle involving the division manager is part of the process "Writing the Final Project Report". At the review the division manager rates and attaches a comment to the report. The comment and rating gives the composer feedback and allows to identify good reports from colleagues.
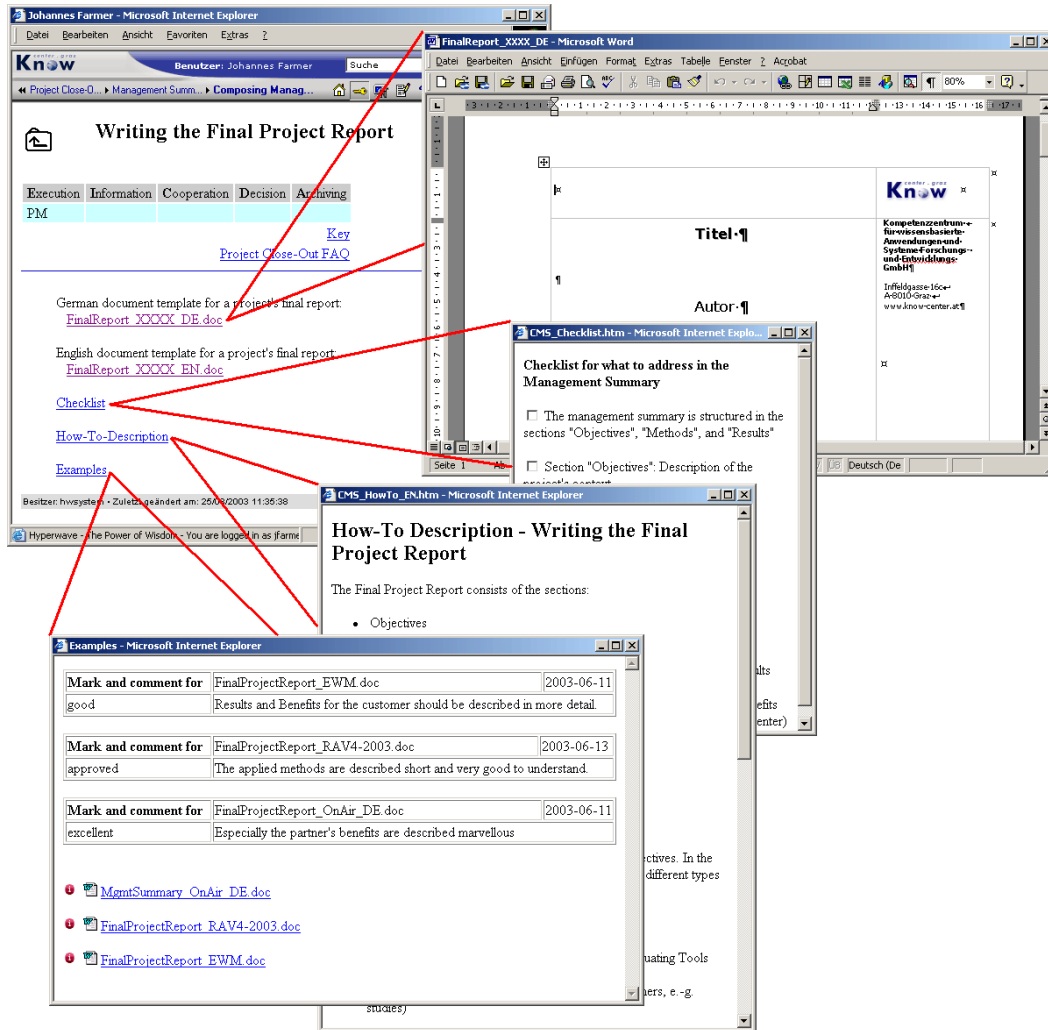

Figure 5: AD-HOC Environment: Support at writing a final project report

The various work, knowledge, and learning resources are provided to the user integrated for the specific work context of writing the final project report. The resources form an AD-HOC Spectrum. And the user does not have to spend time for searching them.

4.1.4   Lessons-Learned

This field study shows that AD-HOC achieves the following two objectives: It informs the users what has to be done and guides them at the tasks, so that they are efficiently accomplished. Furthermore, as soon as processes change, they are instantly communicated to the users. Users are provided with task-specific information. Depending on their experience,

they utilise checklists, to make sure nothing is left out, or they access detailed how-to descriptions.

However, the first case study has also shown the following: setting the static links to the various resources at deployment and maintaining them after something has changed is too costly.

A relief would be here to apply dynamic links – preconfigured search agents that utilize meta-data or full-text analysis.

4.2 Field Study 2: Requirements Engineering for Complex Socio-technical Systems

The second field study is currently deployed together with the Centre for Human Computer Interaction Design (CHCID) at City University London. The objective was to provide a requirements engineering framework, called RESCUE, as an AD-HOC Environment.

4.2.1 Challenge

RESCUE (**R**equirements **E**ngineering with **SC**enarios for a **U**ser-Centered **E**nvironment) (Maiden et al. 2003) is a multi-disciplinary process for specifying requirements of complex socio-technical systems (e. g. air traffic management systems).
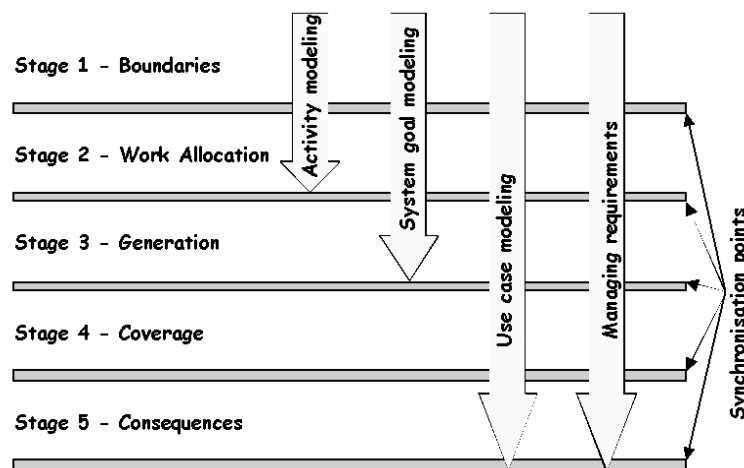

**Figure 6: Stages and Streams of the RESCUE process (c) (Maiden et al. 2003)**

As it is shown in Figure 6, RESCUE supports four concurrent process streams – human activity modeling, system goal modeling, use case modeling, and managing requirements. Orthogonally to them, five synchronization processes (stages) are applied that cross check models from the streams.

The challenge in this field study is the complexity of the RESCUE framework – the amount of material, and the high number of interdependencies between the processes.

4.2.2 ICT Design

To handle the amount of material, a role concept has been applied. Use case modelers only get provided with the resources necessary for their tasks, and persons responsible for

synchronising system goal models with use case models just have access to resources relevant for their work context. However, providing the RESCUE processes tailored and visualized for the various roles would have been to costly. Instead, the project work space, containing the project's documents and working objects, has been used as the "navigation metaphor".
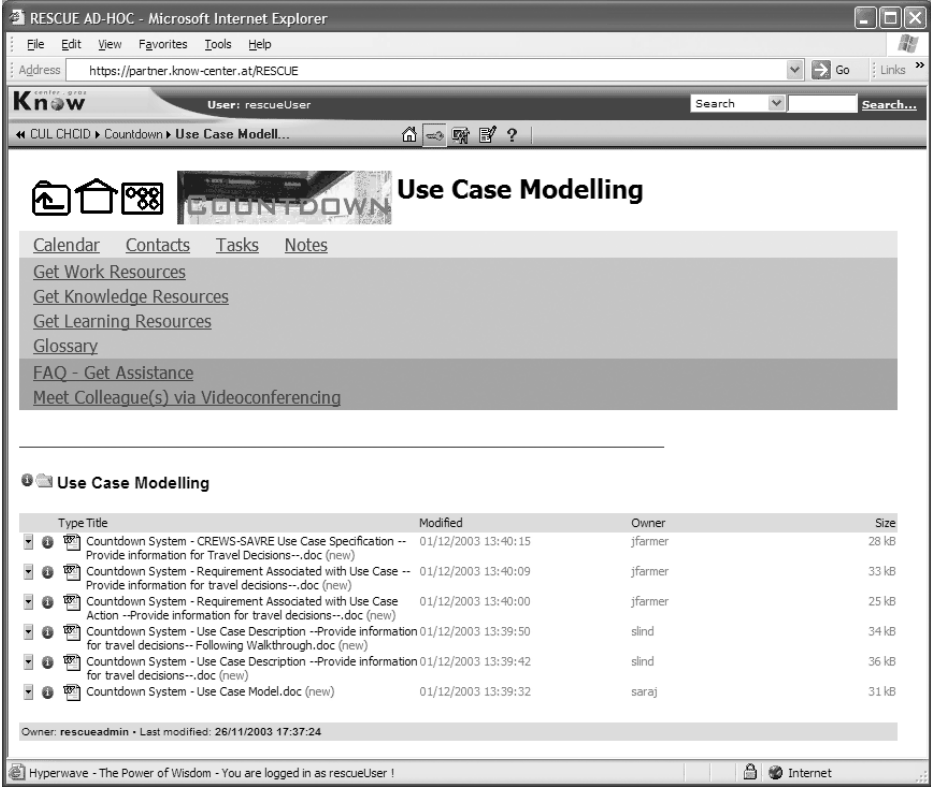
Figure 7: RESCUE AD-HOC – Workspace for Use Case Modelling

Figure 7 shows the workspace for use case modeling of a project named "Countdown". The bottom of the browser window contains the documents, use case modelers work on. At the top, the AD-HOC Environment integrating work, knowledge, and learning is presented. The AD-HOC Environment is structured in "Administration", "Resources", and "Collaboration" (each shaded in different colouring). The "Administration" area ("Calendar", "Contacts", "Tasks", and "Notes") points to project administration information like the timetable, project partner's contact information, etc. In the "Resources" area, "Get Work Resources" for instance is a preconfigured search agent which provides document templates and software tools for use case modeling.

Collaboration between project participants is supported in the following way: "FAQ – Get Assistance" is an intelligent frequently-asked-question-tool. If a user has a specific question, she enters it. If no answer can be found, the question is immediately forwarded to a dedicated expert. The expert's answer is then added to the FAQs. "Meet Colleague(s) via Videoconferencing" initiates a videoconference. A whiteboard, desktop sharing, and application sharing support real-time collaboration between users at different locations.

4.2.3 Use and Lessons-Learned

In the RESCUE AD-HOC Environment, the references from the project workspace to the resources are dynamic. With the help of meta-data and full-text analysis, preconfigured search agents provide the resources. This simplifies the maintenance: no references have to be set, when content is updated and added.

The RESCUE AD-HOC Environment was demonstrated at the requirements training workshop which was held by the British Computer Society's Requirements Engineering Specialist Group (RESG) on December 3, 2003. The feedback was very positive. The RESCUE AD-HOC Environment ensures that users apply the latest templates and tools. The role concept prevents information overflow. The frequently-asked-question-tool does not only help, when questions arise; its question and answer pairs point out what has to be improved concerning the contents and the AD-HOC Environment itself.

The RESCUE AD-HOC Environment has not been applied for specific projects yet. The plan is to apply it for requirements engineering exercises held at City University London. After this field test, it will be applied in upcoming projects.

5 Conclusion

In this article, AD-HOC, the first methodology for designing technology-supported teaching and learning as part of knowledge work, is presented.

Information and communication technology (ICT) is the means of today's knowledge work. But, as it has been argued, the way it is applied does insufficiently follow the needs of teaching and learning as part of the work processes.

The AD-HOC methodology analyses work situations in respect of the obstacles that hamper efficient teaching and learning. On the basis of the analysis, a concept is developed. This concept selects the appropriate ICT tools to support at the particular work tasks. The tools can range from information retrieval agents, e-learning systems, to asynchronous and synchronous communication and collaboration programs etc. The tools arranged for the work process form the AD-HOC Environment.

On the basis of two field studies, two AD-HOC Environments are described. Both AD-HOC Environments support users in very different work settings - at closing a project and at requirements engineering. For the first time, ICT is provided by integrating work, knowledge, and learning. The AD-HOC Environments show a new way, how knowledge workers are guided and supported and how experts can communicate their experience at particular work tasks.

6 Acknowledgements

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