Project no. 027087

TENCompetence

Building the European Network for Lifelong Competence Development

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**D4.1 Pilot evaluation plan**

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### Project Deliverable Report

#### D4.1: Pilot evaluation plan

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<tr>
<td>Contributors</td>
<td>David Griffiths (UPF), Ayman Moghnieh (UPF), Josep Blat (UPF), Marco Romeo (UPF), Santi Fort (UPF), Jose Luis Santos (UPF), Toni Navarrete (UPF), Guillermo Patiño (UPF), Krassen Stefanov (University of Sofia), Petko Ruskov (University of Sofia), Miguel Artacho (ALTRAN), Javier Arenales (ALTRAN), Ruud Lemmers (LogicaCMG), Sanna Postelmans (LogicaCMG), Ronald Cornelissen (LogicaCMG), Luk Vervenne (Synergetics), Davor Meersmand (Synergetics), Carel Keuls (UNESCO-IHE).</td>
</tr>
<tr>
<td>Contact Person</td>
<td>Ayman Moghnieh</td>
</tr>
<tr>
<td>WP/Task responsible</td>
<td>Josep Blat</td>
</tr>
<tr>
<td>EC Project Officer</td>
<td>Hans-Juergen Westhoff</td>
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**Abstract (for dissemination)**

This report describes the validation plans for the TENCompetence project. The validation strategy is described and the significance of the pilots programme described in the context of the project work plan. The opportunities provided by the four pilot areas are analysed. More detailed plans are provided for the Digital Cinema pilot scheduled for cycle 1 of the project. Plans are also provided for the testing and technical validation of the integrated system.

**Keywords List**

Testing and Validation, Pilots, Proof of Concept Validation, Competence Development Programmes
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|                  | Additional information: | Cycle 1 – ICT pilot  
|                  | - Cycle 2 – City of Antwerp Pilot |                                                                         |
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Version 2 of D4.1 differs of version 1 essentially in providing more detail with respect to pilots, which were analysed with less detail in version 1. This means a much more extended Appendix 1 where the pilots for cycle 2 are described, and a detailed description of the additional pilot for cycle 1, the ICT pilot, in section 5. Additionally, the pilot description of the water management pilot has been fully replaced in order to fit with the region, the Nile, selected.
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Executive summary

This deliverable provides a structure for the validation of the TENCompetence project as a whole, and more detailed plans for work to be carried out in Cycle 1. The body of the report contains a discussion of the issues and a description of the plans put in place, while much of the detail is included in appendices, which make up half of this report.

The validation strategy for TENCompetence focuses on pilots of the system in authentic environments, working in partnership with other institutions to address challenging Life Long Learning needs. To this end four main areas were identified in the Description of Work (DOW) in which the project would be active, with the institutions that would be involved were indicated. Since starting work the project has established active links with these institutions, and the particular challenges to be addressed in the pilots have been identified, and may be summarised as follows.

1. **Digital Cinema**: in collaboration with the IP-RACINE project the changes in the film industry following the move to digital technology have been analysed. The challenge presented is to provide a paradigm and demonstrator for providing Life Long Learning (LLL), which can support a major shift in competences for an entire industry, with a large body of independent professionals. Workflows and job descriptions have been identified for Digital Cinema, and the detailed competences required for the profession of Virtual Set Technician identified, and this will be the focus for the first pilot.

2. **Water management.** This pilot will be organised through UNESCO-IHE in Delft. UNESCO-IHE-Delft organises training in water management in many parts of the world, and the best fit with the TENCompetence project is the support of Water Management Support Systems in the Nile basin in Africa. The pilot presents three types of challenge. Firstly the project will be supportive to working with and within a non-European environment where the effectiveness of the infrastructure in a non-Western cultural context can be validated. Secondly the pilot meets a real need, as water management support systems knowledge needs to be transferred and exchanged within the Nile basin region. And there is a need to extend the group of professionals with new competences in the field of flood management and decision support systems. Thirdly the pilot involves making the link between higher education and CDPs.

3. **Life Long Learning for medical professionals.** This pilot will work with the Hospital Clinic of Barcelona to provide a Competence Development Programme (CDP) in colorectal cancer. This offers challenges in three respects. Firstly, this medical practice is a domain with a highly structured set of competences, which will enable the project to test its support for competence management. Secondly there is an urgent need to develop effective LLL to provide training in the diagnosis and treatment of colorectal cancer, because regulations are to be introduced across Europe, which will make the provision of colorectal screening compulsory. This will create unsustainable demands on health care systems unless effective CDPs can be
provided. Thirdly, of course, medicine is an area where life and death decisions depend on the competences of the professionals involved.

The CDPs will be innovative in that they will be structured around clinical guides, which will provide both the pedagogic structure and the basis for the interface provided to users.

4. Managing competences in Antwerp. The project will work with the ALLCITY project to provide improved matching of the competence development needs and services of local industry, professionals and education. This will be done through the Regional Technological Centre of the Antwerp Chambers of Commerce. The pilot will bring together employers, professionals and education providers in a single network using competences as the means of unifying their needs and processes. It will offer the project the opportunity to validate the way in which users can use the infrastructure to match their competences to competence development paths, identify opportunities, and find the best solutions to their learning needs.

5. Additional Pilots. WP4 will be constantly on the lookout for opportunities to develop additional pilots to help in validating the TENCompetence framework in accordance to a diversified set of domains and learning challenges. The additional pilots are planned with the participation of external partners that will alleviate the extra work required by these pilots in order to not overload WP4’s resources. Redundancy will be avoided by carefully considering the value of each additional pilot and compare the context it offers for validating the TENCompetence framework with the ones already addressed by the four main pilots. Currently, two additional pilots are being planed as part of WP4 ongoing activities, being the ICT Training pilot and Digital Cinema Game pilot.

As regards the validation actions to be carried out in Cycle 1, plans are described for the implementation of a pilot to be run from March 2007. This will provide a CDP for cinema professionals who want to obtain competences required for work as Virtual Set Technicians. A schedule has been established which identifies target dates for the implementation of the various aspects course, content and infrastructure development. One innovative aspect of the CDP is the integration of remote practical work into the course activities. The TENCompetence system will be extended to provide this solution, which as well as constituting a valuable and generalisable functionality also validates the extensibility of the framework. This kind of adaptation will no doubt be necessary in many applications of the TENCompetence infrastructure, and is one of the strengths of an Open Source solution.

In the final six months of Cycle 1 work will be carried out to firm up the plans for pilots to be carried out in the other pilot areas in Cycle 2.

Validation in Cycle 1 of the project provides proof of concept. The TENCompetence concept is constituted by the seven solutions to the problems identified in the DOW, which are the basis for the research and development carried out in the project. The questions to be addressed by the validation actions are consequently closely tied
to these problems and solutions. For each of these a detailed list of questions is provided, and related to methodologies and respondents. A schedule is established for the development of instruments and reporting.

In addition to validation of proof of concept in the pilots, this plan also covers the testing and technical evaluation of the integrated system (System Test), to ensure that the system provided to pilot users is of high quality and to guide them as to its capabilities and requirements. Detailed plans have been prepared for both these aspects and are included in appendices to the deliverable. The testing and evaluation of the technical aspects will be led by WP3 under close cooperation with WP4 as agreed. The role of WP4 is to set the usability and functional guidelines by which the integrated system can provide the necessary infrastructure to run the pilots conceived for each Cycle.
Introduction

The aim of the TENCompetence project is to meet the needs of users (individuals, groups and organisations in Europe) for lifelong competence development by establishing the best infrastructure, which is possible today, using open-source, standards-based, sustainable and extensible technology.

This plan addresses the need to validate this infrastructure by planning pilots in authentic and challenging settings which will ensure that the project is effective in providing solutions for meeting the Lifelong Learning in the Europe of tomorrow. It also contains plans for the testing and evaluation of the integrated system. The plans established in this document address only the integrated TENCompetence system. They are the “integrated validation plans”. The development work being carried out by the various workpackages are not within scope for this plan. The specific workpackage development will be evaluated within each workpackage, with its own specific plan. The outcomes of this work will fall within the scope of this present plan as and when they are incorporated into releases of the integrated system.

The document consists of four principal sections

Section 1 focuses on the context for TENCompetence validation work. The role of the pilots within the project is outlined, and relevant aspects of the plan of work described and discussed. The key factors identified are the division into aspect and integration activity, the three cycles of development, and three corresponding cycles of pilots, which correspond to them. Finally the roles of the pilots in each specific cycle are analysed.

In section two the validation strategy for the project as a whole is examined. The role of intensive pilots in the project is described and the four pilot areas are identified: Digital Cinema, Life Long Learning for medical professionals, UNESCO training in water management in the Nile region, and competence management and development in Antwerp. The specific opportunities of these pilot areas are outlined.

In section three the plans for validation in cycle 1 are provided with a substantial amount of detail. The schedule for the actions to be taken, the methodologies to be used and the actions to be carried out are identified. The nature of “proof of concept” in the context of the project is specified, and way in which the planned Digital Cinema pilot addresses this is analysed. Together they form the Test Plan (which governs the performance and integration of the components of the integrated system) and the Technical Evaluation Plan (which explores the performance of the system in various contexts of hardware, software, connectivity and use, and also issues of security, and performance under stress). Section four completes section three with a description of the domain of the Digital Cinema pilot.

Finally Appendices are provided, with further details of the pilot areas, the full Technical Evaluation Plan and the Test Plan.
1. The context for TENCompetence validation work

In this document we address three principal issues, which were defined in the deliverable description in the Description of Work (DOW). These are firstly the user requirements and validation criteria for the project; secondly the definition of scenarios and pilots; and thirdly the development of evaluation strategies and the initial evaluation implementation plan.

In this introductory section we examine how the validation work to be carried out is related to the DOW and the ongoing TENCompetence development work.

1.1 Validation and the TENCompetence Description of Work

The context for the validation actions described in this plan is provided by the strategy for the development of the TENCompetence system defined in the project DOW.

The areas of TENCompetence evaluation are set out in the DOW as follows:

The evaluation efforts in TENCompetence are divided into three principal areas:

- **Evaluation of the effectiveness of project outcomes.** This will be carried out as part of activity cluster ‘Pilots with & Validation of the Integrated System’, with the development of an evaluation plan, and extensive but highly focused pilots in a challenging and authentic environment; this is closely related to the integration strategy described above.

- **Validation of the technical performance of project outcomes.** This consists of ensuring that the technical systems produced by the project conform to their requirements set out in verifiable form in the specifications documents, and that the component parts of the system interoperate as planned.

- **Self-assessment of project processes and documentation.** This consists of ensuring that optimum processes are in place for the development of project documentation and deliverables, and that all project deliverables and services are evaluated and optimised.

In planning to carry out this work there are two key aspects of the plan of work which must be born in mind when planning validation: the structure of the RTD work carried out and the cycles of project activity.

**Relevant aspects of the work plan: 1) Two types of RTD activities**

In order to manage the complexity of the development process project RTD activities the Plan of Work divides them into two categories:

**Aspect RTD activities**

Aspect RTD activities are focused on the further elaboration of one of the four core aspects of competence development:

1) Knowledge Resource Sharing & Management (WP5).
2) The development and use of Learning Activities and Units of Learning (WP6).
3) The development and use of Competence Development Programmes (WP7).
4) The connection of these programmes into interoperable Networks that can serve individuals, groups and organisations to build competence (WP8).

The core outcomes of these projects are: Models, methods and tools with a scope restricted to the focus area (e.g. a design tool for units of learning).
Integration RTD activities
Integration RTD activities integrate the research outcomes of the four aspects by developing and validating an integrated model and infrastructure for competence development. This is done in three tightly related activities:

1) Requirements & Analysis of the Integrated System (WP2).
2) Technical design & Implementation of the Integrated System (WP3).
3) Validation of and Pilots with the Integrated System (WP4).

This Integrated Project design balances the needs of researchers to focus on the problems they are experts in, without too much additional constraints coming from other bodies of knowledge, with support for the development and validation of a strongly integrated model and infrastructure for competence development.

Relevant aspects of the workplan: 2) The cycles of project activity.
The work will be done in three cycles, each of 18 months.

Cycle 1.
In the first cycle (inception/elaboration) the current state-of-the-art and the technologies the partners bring into the project are the input for the integration process. All of the current tools of the partners comply to open standards, but are not integrated and combined into a common framework for competence development. That will be accomplished in the first cycle. The outcome is an open source, interoperable framework using open standards. During the first cycle, the Aspect RTD activities will concentrate on the research and development of new models and technologies that will be integrated in the second cycle. The role of the pilots in Cycle 1 is to take this common framework and use it in initial pilots which focus on 'proof of concept', and the principal pilot will be in the area of moving from analogue to digital cinema techniques. The work carried out in the Aspect RTD activities in this cycle will not be validated by the Cycle 1 pilots, and will be evaluated within each workpackage.

Cycle 2.
In the second cycle (construction) the evaluation results of the pilots and the output of the first cycle of Aspect RTD activities will be taken as the input for the integration activities and the infrastructure will be redesigned and extended to accommodate these new results. In this second cycle the main integrated technology development activities will take place to construct the infrastructure. The pilots’ programme will be greatly expanded in this cycle, with major planned pilots in professional development in medicine, water management related to the Nile region, and integrated competence management in the city of Antwerp, as well as in digital cinema. This second cycle of pilots has the character of 'usability pilots', and they will validate that the solutions developed to make the TENCompetence concept a reality are usable, that is to say that they provide effective solutions to real problems in an authentic context.

Cycle 3.
In the third cycle (transition) the evaluation results of the pilots and the output of the Aspect RTD activities in Cycle 2 are again taken into account as input for this last
cycle. The pilots are now 'business models demonstrators', mainly involving external parties to increase the sustainability.
In this cycle the project pilots will demonstrate to the wider Life Long Learning community the advantages of adopting the TENCompetence concept and the infrastructure, which will have been developed to support it. Consequently it is intended to leverage and extend the successful pilots, which have been established in Cycle 2. The role of associate partners is also expected to be a key factor in organising pilots in Cycle 3.

**Addressing Informal Learning**
Informal learning unquestionably forms an essential part of life long learning. People constantly learn to develop their skills and knowledge through paradigms that do not conform with classic learning methodologies, leading us to consider basing pilot development and evaluation both on formal and informal aspects of life long learning. The topic of informal learning is also addressed in several aspect work packages in order to provide the required tools, basis, and environment for such process to thrive. During Cycle 2, aspect components integrated in the TENCompetence client are expected to provide such functionalities and requirements, whereas their absence from Cycle 1 client limits our ability to validate informal learning approaches.

In the prospect of according the required attention to informal learning methodologies, WP4 is planning the Digital Cinema Game pilot (see section on Digital Cinema Game pilot) that is entirely devoted to validating and evaluating informal learning approaches in TENCompetence. As informal learning is an increasingly important issue, the project will go on monitoring additional pilots with a strong focus on it, through the partners’ possibilities.

**1.2 The scope of this report**
In the light of the structure established for TENCompetence evaluation and validation in the TENCompetence Description of Work briefly summarised above we make some observations.

1) The scope of this report regarding the three areas of TENCompetence evaluation activity mentioned above may be defined as follows:
   a) **Validation of the effectiveness of project outcomes.** The TENCompetence project is carrying out research into the best way to address the real life solutions to the challenges presented by Life Long Learning. Consequently the only way of validating the effectiveness outcomes of the project is to use them in authentic and challenging Life Long Learning tasks. This means, firstly, identifying scenarios in which users can use the system while they are carrying out their normal job and training activities, rather than setting up trials, which are attended by users out of their work context. Secondly the pilots must be challenging, in the sense that they should resolve the Life Long Learning need which is at present not adequately addressed. This deliverable set out the framework for this validation process, and describes the four focused scenarios in which have been selected for TENCompetence pilots. These are Digital Cinema, the treatment and prevention of cancer, UNESCO training in water management, and the management of competences and training in
Antwerp. A framework and an outline for the “pilots based” validation are provided, as well as the details for the first cycle validation in this document.

b) Evaluation and testing of the technical performance of project outcomes. Technical evaluation and testing of the integrated system is carried out in separate actions from the project pilots for two reasons. Firstly, it is essential that the system perform satisfactorily from a technical point of view before it is piloted with users in order to establish its effectiveness for the purposes for which it was designed. This aspect is addressed by the Unit and Integration Test plan, which is described in this deliverable and included as an appendix. Secondly, it is important to establish the performance of the system in the widest possible range of technical environments through a systematic programme of tests. This information is important for setting up pilots with associate partners, as well as for wider dissemination purposes. This need is covered by the technical evaluation plan, which is described below and included as an annex to this deliverable.

c) Self-assessment of project processes and documentation. This aspect of evaluation is addressed in a separate Integrated Quality Assurance plan which is included in the Project Handbook. This sets out the procedures for measurable assessment of performance, which is divided into two categories: scientific publications and technologies. TENCompetence applies the regular scientific output norm, i.e. every scientific full time equivalent (FTE) produces three scientific publications a year, or the equivalent in technologies. The quality assurance strategy is closely linked to the Unified Process, which has been adopted to structure the project as a whole. In line with this approach each cycle covers the full workflows of requirements definition, analysis, design, implementation and testing. The process for internal review of milestones and deliverables is specified and scheduled.

2) Those aspects, which relate to the evaluation of the work carried out in the Aspect RTD. Activities are carried out within the individual Aspect RTD workpackage (WP5, WP6, WP7, WP8). Note that in the second cycle of the project the outcomes of these workpackages will be incorporated into the TENCompetence system, and will then fall within the scope of the pilot programme. The planning process for each individual workpackage covers fulfilment of the evaluation needs of Aspect RTD work, and the articulation of this process is part of the Quality Assurance responsibilities of the coordinator.

3) The detailed plans reported here relate to Cycle 1 of project activity (Months 1 - 20). The outline plans for Cycle 2 pilots are also addressed, to ensure that there is a coherent strategy for the validation of the project as a whole.

4) We note that the focus of Cycle 1 is a proof on concept of the first version. Thus the key tasks in this report are to
   a) examine what proof on concept means in the context of TENCompetence;
   b) define what this implies for the validation activities to be carried out;
   c) plan for meeting these requirements.
2. Validation strategy

2.1 Pilot Validation strategy

The use of intensive pilots

Life Long Learning is an extremely wide field, and the pilots carried out by the project cannot aspire to addressing a significant proportion of the potential applications of the TENCompetence system. Consequently the strategy adopted has been to identify pilot applications with high impact, and a relevant and challenging industrial or social scenario. The key justification for running the pilots within the project is not their impact or the scenarios being relevant: they should be able to provide the test bed for the validation of TENCompetence solutions (the seven which make up the project concept, recalled in chapter 3.1 of this document). In chapter 3.5, a very detailed table discussing the validation of the seven TENCompetence proposed solutions for the cycle 1 pilot is provided. This table is the model that will be followed by the cycle 2 pilots for providing in detail the extent to which each of the pilots will be able to validate the solutions proposed by the project. However the validation of the solutions will be more significant if the pilots fulfil the high impact, real and challenging traits indicated. An associated partner strategy has been developed which has an important role in extending pilot use of the project outcomes to a wider range of real work applications. These pilots are combined with testing of the integrated system (which will ensure that the technical systems produced by the project conform to their requirements) and technical evaluation of the integrated system (which will explore the capabilities of the system in a more open ended way).

As set out in the Plan of Work, the pilots are introduced gradually through the three cycles. Additional pilots run by Associate Partners may be organised at any point, but it is anticipated that this activity will increase as the project progresses.

Cycle 1 pilots

The initial Digital Cinema pilot will be commenced in the first 18-month cycle to provide proof of concept, and the opportunity to develop a specific application of the infrastructure in collaboration with a particular user group. At the time of writing of this report plans are already well advanced for this pilot, with the competences, learners, and course content all defined, developed, and pending finalization. The pilot will be in the area of Virtual Sets, an aspect of Digital Cinema where there is substantial demand for training. This provides an authentic environment for trialling the TENCompetence infrastructure, as described in detail below. On the other hand, Cycle 1 also will encompass the ICT training pilot which will help widens the base upon which the proof of concept is tackled. The difference between the two pilots of the user-base, deployment environment, and pedagogical approaches highly justifies running both pilots during this cycle. The ICT training pilot does not require the functionalities provided by Cycle 2 components, but expanding it to run in Cycle 2 will be later considered based upon the results of the first evaluation and the subsequent needs for validation if encountered.

Technical testing and evaluation will also be carried out, according to the plans described in later sections and included in the appendices to this report.
Cycle 2 pilots
In the second 18-month cycle the solutions developed will be extended to four additional scenarios, as well as continuing with the Digital Cinema area.
- Pilot 2 will address another key industrial sector, health workers. This offers a domain with highly specified and well-established competences. The pilot will focus on the use of clinical guides as the basis of training in up-to-date techniques for the diagnosis and treatment of cancer.
- Pilot 3 will explore the potential of TENCompetence in a different cultural context with very different organisational requirements: the programme led by UNESCO-IHE – Institute for Water Education will strengthen the capacity of both professionals and institutions active in the management of water resources in the Nile region.
- Pilot 4 will explore the use of TENCompetence in a citywide context by integrating project outcomes with the Antwerp Lifelong Learning City plan. This will enable the project to analyse the systemic implications of the systems that have been implemented.
- An additional pilot presenting a Digital Cinema game targeting informal learning pedagogies whose objectives in this case are to provide a social environment where groups can cooperate to organize a cinema production process and learn about the challenges and mishaps that may arise during such practice.

Cycle 3 pilots
In the third cycle full pilots will be conducted in all four scenarios with the complete TENCompetence system. In this stage the pilots are focused on 'business models demonstrators'. This means that the role of associate partners becomes increasingly important. The aim is to develop sustainable implementations, with a focus on supporting uses of the system, which meet an agenda established by the pilot hosts. Consequently the pilots for this cycle are not specified here. It is anticipated that associated partners will play an expanded role in this stage of the process.

2.2 The four planned main pilots
In this section we describe how the four focus areas for TENCompetence pilots provide authentic and challenging environments for carrying out validation.

Digital Cinema

The context
The move from analogue production to an integrated Digital Cinema chain will involve significant changes in the production workflow, with specific impact in at least two major aspects. The first aspect is that professionals may have to change their tools and position in the workflow. Digital techniques require new skills, for camera operators, directors, and special effects. This is true even for less obvious areas, such as make-up, where visual effects are replacing traditional methods, and as they have in many other areas, are bringing about an increased focus on postproduction. The second aspect is that the traditional, almost craft-based way of producing movies will be under pressure to change to a more conventional industrial type of production with a strengthened integrated workflow.
All these changes require professionals to acquire new competences and adapt to a radically changed professional environment. Each of the many different roles played in film production has its own detailed set of competences, and so the management of competences is highly challenging.

**Specific challenges to be addressed**

Thus the Digital Cinema domain is challenging in a number of ways, which provide rich opportunities for validating the TENCompetence infrastructure, both in the Cycle 1 pilot and in later phases of the project.

1) **Digital Cinema has real and urgent need for development of competences.** After more than one hundred years of film cinema production, a new way to make, distribute and project motion pictures is rapidly becoming a reality, and before long digital production, post production and display will be the accepted paradigm for cinema. For this to happen, however, the industry requires a new wave of artists, operators and technicians conscious of the strengths and weaknesses of this new medium.

2) **Digital Cinema involves the definition, development and management of an extensive and complex set of competences.** Traditional film (analogue) based production procedures are being gradually replaced by digital techniques. This is particularly true in that part of the production chain known as Digital Intermediate. This digital phase starts with scanning film into digital format, integrating visual effects or fully synthetic aspects, implementing some post-processing aspects for finalisation (such as colour grading), and, currently, printing to film again, for release, distribution and exhibition. This process involves a large number of professionals, each with their own set of competences, which are radically different from those required in the analogue past. The competences are also highly inter-related and dependent on each other.

3) **The competences required by the digital cinema industry are rapidly developing** A fully digital workflow is now a practicable possibility, which can bring considerable advantages in cost savings and flexibility. It is therefore likely that in the medium term the cinema industry will move to an entirely digital production chain. The move to Digital Cinema is, however, happening in a piece-by-piece process, as described by the IP Racine project.

The chain currently consists of at least three separate businesses: (1) digital cinematography and content creation; (2) digital postproduction of the movie; and (3) digital distribution and display. While different parts are developing at different speeds, and the transition from analogue to digital is expected to continue for at least a decade, the introduction of digital cameras and projectors has begun and there is a rapidly growing reliance on digital data processing. Nevertheless, the Digital Cinema process is still fragmented, rudimentary and highly skills-based, operating at or beyond the limits of technology.

Whilst the US ‘majors’ dominates film production, specialist European companies (mainly SMEs) lead in digital cinema technology and services. European manufacturers, studios and postproduction companies have a reputation for quality, technical sophistication, creativity and cost-effectiveness. Only by continuing to research and develop world-leading technology can Europe maintain its position in the global market for digital film equipment and services.

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1 IP Racine project website, http://www.ipracine.org/objectives/objectives.html
Consequently, while digital intermediate is a valuable and well-established technology, it seems unlikely that the procedure will be a long-term solution. Digital capture is becoming a more viable and aesthetically accepted option, and digital projection at cinemas is becoming more common (although by no means dominant as yet). Similarly the tendency to shoot in the studio using a virtual set is becoming ever more marked. As these changes become introduced to the production chain the competences definitions for the domain also need to be changed, providing a challenging environment for testing the TENCompetence infrastructure for managing competences.

4) The actors involved in the Digital Cinema industry are geographically distributed. Cinema production and post-production is often a highly distributed industry. The teams who come together to work on a production may be drawn from many different areas and countries, and post-production may be carried out by specialised companies in different countries. This makes Digital Cinema a good domain for testing distance education infrastructure.

5) Digital Cinema professionals require highly flexible training opportunities. Cinema professionals have valuable skills, which are in high demand. Many also have to structure their working life according to the demands of production schedules, and cannot guarantee that they will be available for long periods of time in the same location. At the same time training in Digital Cinema in many cases requires access to specialised equipment, and so there is often a need to provide face-to-face training. These factors mean that highly flexible course structures will be required to meet the training needs of the domain.

The opportunity

The domain of digital cinema has been chosen for the first project pilot because it provides rich opportunities for testing the TENCompetence system. In this section we describe only some relevant aspects of the domain of Digital Cinema, and provide details of the pilot itself in the pilot plan below.

The project has established a strategic partnership with the project IP-Racine, funded by the IST programme of the European Union. IP-Racine is carrying out RTD Activities in five groups covering workflow and data handling; improved digital cameras; the virtual film studio; film object description and processing; and digital playout and display of sound and image. As part of this process they have generated information about the workflows and job functions in the digital cinema area, and these will provide the basis for defining competences and planning pilot LLL initiatives.

The articulation of Digital Cinema into professional areas is described in the section on the Digital Cinema pilot below. Of these areas the one that has been selected for the pilot is that of Virtual Set Technician.
UNESCO-IHE Water Management Support Systems pilot

As described in the DOW, contact has been established with UNESCO-IHE Delft Institute for Water Education with a view to running a pilot in cycle 2 and 3. Following discussion with the Institute it appears that the best opportunity for running a pilot is to address on-line competence development in the field of water management support systems and to focus on participation of water professionals within the Nile basin region.

Besides face-to-face academic education UNESCO-IHE is also involved in capacity building and competence development activities in a broader sense. Their involvement in and focus on network development of professionals needs further development in terms of ways to support knowledge sharing and competence development within these networks. A digital, supportive competence development infrastructure is an important mean for communication and knowledge exchange between geographically disperged professionals. This EU project supports UNESCO-IHE in exploring and testing the TENCompetence virtual environment to nurture capacity and knowledge enhancement and to evaluate its contribution to educational innovation and knowledge network support.

UNESCO-IHE has already quite some history in educational and capacity building activities in the Nile region. The Hydraulics Research Institute (HRI) in Cairo (Egypt) is partner in our PoWer network. Currently UNESCO-IHE is involved in the Nile Basin Capacity Building Network on River Engineering (NBCBN-RE) in which knowledge sharing and generation is supported by doing collaborative research. Within 6 Research Clusters, each hosted by a different country, collaborative research on Nile related issues is carried out. One of the research clusters is involved in GIS and Modeling and one in Flood management. GIS and modeling are two data and knowledge intensive toolsets that are related to the broader domain of water management support systems. In this project there is close cooperation with HRI.

With the support of fellowships by the Nile Basin Initiative (NBI) currently eight participants from the Nile basin region are involved in a Masters programme at UNESCO-IHE. Part of their education will be dedicated to decision support systems for water management. It will be a challenge within this pilot project to support competence development, knowledge sharing and knowledge transfer when they have gone back to their countries in 2008.

The general objective for this pilot is to explore the TENCompetence infrastructure and pedagogical model(s) in its ability to support competence development and life long learning of professionals in the water sector. The focus will be on e-learning and knowledge sharing activities around Flood Modeling for Management and on a module on Decision Support Systems, both examples of water management support systems.

This objective will be elaborated with selected groups of water professionals from the Nile basin region to participate in the pilots.

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2 The Partnership for Water Education and Research" (PoWER) represents an open network of 17 founding partners in Africa, Asia, Latin America and the Middle East. Through the use of Internet, satellite and other advanced ICT in distance learning and joint education delivery, UNESCO-IHE is consolidating collaboration efforts in response to the needs of the water and environment sectors worldwide.

3 The Nile Basin Initiative (NBI) in which all 10 riparian countries are represented, is founded in 1999, and represents a solid foundation for a successful regional partnership to facilitate a sustainable development and management of Nile waters.
The validation of the TENCompetence infrastructure for the on-line course on Flood Modeling for Management will focus on different pedagogical models. The validation of the Decision Support Systems module and knowledge sharing environment will be tested in its ability to support the community of practice of professionals that have returned to their home countries and organisation. In this way the project enhances the support for the Nile basin countries in their development of competences in the field of water management support and decision systems.

The following competence development related goals can be distinguished for the Pilot:

1. To develop, run and evaluate the Flood Modeling for Management Course within the framework of the TENCompetence Infrastructure;
2. To develop, run and evaluate the Decision Support Systems module and knowledge sharing environment within the framework of the TENCompetence Infrastructure;
3. To assess the impact of the TENCompetence Infrastructure and pedagogical models for knowledge network support in the Nile Basin region

In relation to 1 and 2 attention will be given to the concept of Communities of Practice and the abilities of the infrastructure to support the organic life cycle of geographically dispersed people networks.

The use of the Open Source TENCompetence infrastructure offers clear potential advantages regarding the sustainability of this effort, and the opportunity to establish TENCompetence as a sustainable solution.

There are three principal areas where this pilot will provide challenges, which offer opportunities to validate the TENCompetence infrastructure:

- **Training of Nile basin participants.** This involves the training of a cohort of professionals, providing them with new skills, which enable them to bring in flood modeling knowledge in decision making contexts. Among other aspects, this will enable us to validate the capacity of the TENCompetence infrastructure to support empowerment and collaboration.

- **Knowledge sharing between trained participants.** A key aspect of TENCompetence is the integration of learning activities, competence development programmes and networks for Life Long Learning in a single infrastructure. This aspect of the pilot will enable the effectiveness of the solutions developed, to be validated in a context where there is an authentic need for various learning providers to collaborate in providing a range of learning solutions to address the various needs of the professionals working in the water sector in Indonesia. From the perspective of the learners we will validate the way in which the infrastructure represents these learning solutions, and enables learners to identify and participate in those which best meet their needs.

- **Nurturing a community of Decision Support Systems for Water Management**

  The learners in the courses established will be a distributed group with authentic and urgent learning needs. This provides an ideal environment to validate the effectiveness of TENCompetence in providing Life Long Learning. A particular challenge is the fact that many of the learners will be highly knowledgeable in certain aspects of the field, and this provides the opportunity to validate the capability of the system to support innovative pedagogical approaches, which
involve the learners in sharing and building knowledge using the TENCompetence infrastructure, as well as receiving it.

At UNESCO-IHE an existing eLearning infrastructure exists, but it has been developed in the context of traditional University teaching, rather than development of professional competences. Within the Nile basin HRI is developing its Internet based support for the knowledge network incrementally and successfully. Competence development infrastructure could become part of that. It is not expected that the TENCompetence infrastructure will entirely replace this existing infrastructure in the pilots. Rather it is anticipated that e-learning and knowledge exchange challenges presented by the project will be identified, which are likely to improve our understanding of a professional and competence based approach and the need to support collaboration and integration of training.

On a practical level, the language of the courses will ultimately be in English. Internet connectivity within involved African countries is adequate, but links with the rest of the world can problematic. Consequently it might be valuable to have an African installation of the TENCompetence server.

It has been agreed that TENCompetence and IHE-Delft will maintain contact in the second half of 2006 to refine the ideas for collaboration. When the Cycle 1 infrastructure is released in March 2007 and the Digital Cinema pilot is underway this will offer IHE Delft the opportunity to get a clearer view of what TENCompetence can offer. At this point the planning process will commence in earnest and pilot proposals developed for the end of Cycle 1 of the project.
Medical pilot with Hospital Clinic Barcelona

The context
Progress in the development of medical practices depends on the speed at which new therapeutic knowledge and technologies can be acquired and disseminated. On the frontline where medical science is battling newly diagnosed diseases, heavily funded research activities are formulating new therapeutic strategies based on novel insights into how these diseases form, propagate, and are treated. In many cases this flux of medical knowledge is not sufficiently supported by dissemination infrastructure, especially in certain areas of specialization such as cancer. Here for example, new competences for early diagnosis and prevention of cancer have recently been formulated but are only slowly being acquired by medical practitioners, resulting in loss of lives that might otherwise be saved. To address such gap of knowledge, a system for transmitting and sharing knowledge and information is needed to help medical practitioners acquire state of the art diagnostic and therapeutic competences as the latter are being developed rapidly.

The needs of medical professionals
Keeping in touch with advances in scientific areas of medical specialization is a practical challenge in lifelong learning, since medical personnel have a moral commitment to seek the best available cures or treatments. Finding the best therapy or cure available, however, requires continuous monitoring of advances in medical technology and therapeutic strategies. This process usually demands extensive study, starting with a familiarization with newly published literature, workshops, seminars, and empirical work, and extending to many other accessible resources.

TENCompetence partnership
The Medical Pilot is built on an ongoing partnership for over five years between TENCompetence partner UPF and the Hospital Clínic of Barcelona. The two institutions have a record of collaboration, which includes the SCOPE project⁴, which established an in service training service for specialists in gastroenterology, which has become highly successful⁵.

The planned TENCompetence pilot will build on this earlier work by extending the GHContinuada approach, which is built around documentation of emerging research, and establishing one, which is built around competences. The infrastructure will support the search for newly formulated medical competences and provide an effective learning environment where they can be acquired. It is planned to differentiate between medical personnel according to their specialties, interests, and needs, and provide a personalized learning environment and competence development program. Each learner will be able to evaluate his/her progress through an assessment procedure embedded in each competence development program. The learners can also use the social tools incorporated within their learning environment to connect with each other and discuss learning concerns, exchange advices, recommendations, and personal experiences.

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⁴ http://www.tecn.upf.es/scope/showcase/
⁵ http://www.ghcontinuada.com/
The infrastructure that is provided for medical professionals can also provide access to patients who want to learn more about the disease or condition, which they are facing.

**The challenge to be addressed**

The medical professionals who will be addressed in these pilots work in areas with highly specified and measurable competences. The area is very authentic, in the sense that the learners will be using the knowledge acquired to take life and death decisions in their professional practice. This environment provides TENCompetence with the opportunity to validate the capability of the infrastructure to manage a set of well-defined competences and to deliver effective competence development programmes which are tightly integrated with those competences.

It will focus on the area of colorectal cancer diagnosis and prevention. This area is of particular importance, as compulsory provision of colorectal cancer screening will be introduced across Europe within the lifetime of the project. The pilot is planned to comprise development programs associated with the development of competences related to the diagnosis and treatment colorectal cancer. This involves relating the competences and associated development programmes with several specialised groups of people involved in this process.

**The approach to be taken**

A key intervention in the pilot will be to use clinical guides as the basis for both competence definition and as a means of structuring the learning offered to participants in competence development programmes.
The competence development programs will be based on the clinical guides who represent the decision flow and information related to the roles involved in learning about colorectal cancer diagnosis. Each of these programs will encompass all of the available information related to a diagnosis and prevention strategy regardless of the group of people it intends to address. In other words, a player’s competence development program might as well be the fusion of the aggregation of a number of clinical guides each designed for a specific group. The TENCompetence infrastructure will format the data present in a competence development program by using information abstraction based upon the data provided in the learner’s e-portfolio reflecting his professional background and interests.

The format of these guides will be familiar to learners from their existing practice, but their use as a basis for Life Long Learning will be highly innovative. The full range of functionality offered by the TENCompetence infrastructure will be integrated with this approach, to provide an implementation, which can support and manage the full range of participants’ Life Long Learning needs.
Antwerp ALLCITY project

Overview of the project
The ALLCITY project aims at matching the local industry and education needs better and to provide substantial support for the further development of the Antwerp Regional Technological Centre (RTC) that is being founded by Voka (Chambers of Commerce of Antwerp – Waasland) with funds of the Flemish Government.

This pilot project will build a joint competence driven learning and knowledge platform in which both education and industry invest. The infrastructural collaboration projects between industry and education within the framework of the Antwerp RTC will be anchored to this joint knowledge platform. As such, the development of the joint infrastructure will be able to keep up with development of (also internationally determined) new educational and pedagogical contents.

Key points for this pilot project are the mandatory use of international open standards, exchangeability and free reusability of learning means from a repository in function of the increase of the competences of the learners, irrespective of the location of the learners (school, company…).

As can be seen, there is an excellent fit between the needs of the ALLCITY project and the validation needs of TENCompetence. This is particularly true in the areas of competence assessment and matching in a cross-institutional context, and in networks of Life Long Learning, which more difficult to address in other pilot scenarios.

The Antwerp RTC will take initiatives in following areas:

1) The mutual harmonisation between educational institutions and companies in the supply and demand of infrastructure, appliances and technical equipment for technical- and professional schools which can fulfil a pedagogical role, especially by the development or support of infrastructural embedment.

2) The mutual harmonisation between educational institutions and companies in the supply and demand of internships and/or apprenticeships.

3) Facilitating or coordinating continuing education in the field of new technologies.

4) The creation of a platform where educational institutions and companies can exchange knowledge and experience.

These will be supported and facilitated by the TENCompetence infrastructure.

The Antwerp educational context
The city of Antwerp has built up a tradition of facilitating cross-sector collaboration between the different educational institutions on its territory and of common consultation and cooperation between educational and industrial partners.

More than ten years ago the City of Antwerp founded the Antwerp Education Council who gives neutral educational advice to the City Council on educational issues. All main actors are part of the Council.
The city administration for education was renamed “Learning City” three years ago and now also has a separate administration for general educational policy, so that LLL objectives can be met in a better way.

Antwerp has also decided to allocate its educational means in a global policy structure, called Baobab. Its mission is to allocate the means in specific projects with measurable results, to be executed by third parties.

**New forms of learning** (competence driven and blended learning) need a new form of educational platform for education and industry.

- **Knowledge is increasingly becoming a skill**: it is not about the accessibility of information but rather the manner in which it is handled.
- The **development and dissemination of knowledge** is also in technical professions becoming increasingly important.
- In order to develop competences, more **active environments** for learning are needed than the classic classroom environment.

In order to address these issues a didactical setting that is as realistic as possible is necessary. In order to be able to make the transfer to the real world, the learner must be in **situations that strongly resemble real working situations**. This also means interaction with other people: fellow students, but also coaches or teachers.

Information and communication systems are, how sophisticated they may be, insufficient to share and spread knowledge as a skill. This asks for the **rearrangement of learning processes**, in which employees, students, externals, teachers, coaches and others share with each other knowledge and can create new knowledge. We can transfer, however, the key of the information, with which someone self can construct knowledge.

A **blended solution** combines e-Learning with a number of active arts such as action-learning, workshops, and simulator trainings in learning surroundings.

**ALLCITY provides a broad, cross-sector, commonly useable knowledge platform**
- that starts from a **competence driven** approach;
- that as an **anchor project** acts between both the education and businesses;
- in which **both** invest;
- to which the **collaboration projects** between education and industry within the framework of the development of the Antwerp RTC are coupled.

More detail on the ALLCITY project objectives and infrastructure is available in the appendices to this report.
Pilot partners and associate partner status

Strong links have been established with all four partners, and initial plans have been put in place, as described in sections above. All the principal partners will be invited to take up associate partner status once the associate partner programme is launched.

2.3 Evaluation and testing of technical aspects

The task of WP4 is to validate all aspects of the integrated TENCompetence system. This includes both usability and effectiveness of the system when used by authentic users, and also technical aspects of the system. Two actions are planned to address the latter aspects, Technical Evaluation, and Performance Testing. The outputs of these will be reported together with the results of the pilots in order to provide a complete picture of the capabilities of the system. This will provide valuable information for the project, which will be useful not only in reporting to project reviewers, but also to potential associated partners, adopters and the wider user group.

We note that the usability inspection of the system is led by WP3 with the participation of WP4, and it covers the overall workings of the system rather than the evaluation of single functional components. The integrated components along with the integrated system are expected to be tested and validated primarily before the launching of the pilots. Such preliminary testing is done by WP3 and is conceived to ensure the quality and proper functioning of the system and the inherent components. WP4 and WP3 will then coordinate after the launching of the pilots on deepening such evaluation and provide a validation of the whole design, implementation, and testing approach taken in the development of the system.

Technical testing of the integrated system

The role of technical testing in the project is to ensure the quality and coherence of the integrated system, and in particular the code produced by the project in the context of WP 3. Such testing can be done on a number of different levels (acceptance test, system test, integration test, unit/module test). The technical testing planned here focuses on the two lowest levels: unit testing and integration testing.

In the Technical Testing Plan, provided as an annex to this report, procedures and guidelines are provided for unit testing and integration testing. The test process is described and the sub-steps of the test process are specified.

The purpose of unit testing is to verify that each individual component functions according to the technical specifications. The procedure searches for defects in, and verifies the functioning of, software elements (e.g. modules, programs, objects, classes, etc.) that are separately testable. This may be done in isolation from the rest of the system, depending on the context of the development life cycle and the system.

Unit testing typically done by the programmer and not by testers, as it requires detailed knowledge of the internal program design and code.

The purpose of integration testing, on the other hand, is to verify that the interaction between the various units, which make up the integrated system, is satisfactory. According to the plan the implementer delivers a component, which has been successfully, unit tested to the integrator. The integrator merges this component into intermediate builds. Step by step, bottom-up, each component will be integrated according to the build plan. After each step, the intermediate build is submitted to the integration test. This procedure ensures that each component added is compatible with the components that have already been integrated.
All defects found in either aspect of testing are registered and managed in a bug tracking system.
The Technical Testing Plan, provided as an annex to this report, includes a description of the roles to be carried out, quality requirements and checklists to be used in testing.

**Technical evaluation of the integrated system**

Once the integrated system has passed through unit and integration testing it becomes a candidate for a release. Each full release of the system (as opposed to minor updates with bug fixes) undergoes a technical evaluation process, which is defined in the Technical Evaluation plan, provided in an appendix to this report.

This defines the criteria to be followed in evaluating the technical features of the TENCompetence prototypes.

Tests defined are those which will ensure effective integration of prototype, and that the usability and functionality of technical aspects of the system are of an acceptable standard in a range of conditions and environments.

The technical evaluation of the prototype is centred on the client/server architecture features, and so the evaluation criteria, which it defines, are related to these two aspects. The server is evaluated in terms of installation procedures, hardware and connectivity requirements, software requirements and their capabilities in terms of platform portability and stress loads.

As regards the client installation, hardware and software evaluation is carried out in a similar way to the server, with additional attention paid to conformance to design guides and browser compatibility.
3. Planning for the cycle 1 pilots

3.1 Proof of concept

The whole TENCompetence project may be seen as a research undertaking which
- identifies a set of problems in Life Long Learning;
- hypothesises that a specific set of functionalities will improve the provision of Life Long Learning;
- develops an infrastructure to deliver those functionalities;
- runs pilots to test the hypothesis.

In an RTD project such as TENCompetence, however, the system requirements are not clearly defined when work commences. Consequently in phase 1 (UP Inception and Elaboration phases), the requirements for cycle 2 are formulated. At the same time however - following the Unified Process, which informs the structure of the project, each cycle of the project covers the full workflows of requirements definition, analysis, design, implementation and testing. This is why a first integrated version of the TENCompetence infrastructure will already be produced and tested in the pilots of the first cycle. Thus an iterative process is established, and the outcome of the testing, which is carried out in these pilots, provides input into new formulations of the system, rather than a definitive statement of validity.

The aim of validation in Cycle 1 is to provide proof of concept. The domain which the TENCompetence concept addresses is defined by the seven problems, which it addresses, and which are identified and described in the DOW. The solutions, which TENCompetence proposes to these problems, are also set out in the DOW and represent the TENCompetence concept. The sum of the technical and methodological innovations developed to provide these solutions constitutes the TENCompetence the evolved and operationalised TENCompetence concept, and it is this that is validated in trials. Before discussing Cycle 1 validation, therefore, we review the seven solutions, which the TENCompetence project seeks to provide.

1) New, promising, innovative pedagogical approaches for lifelong competence development, supported by the TENCompetence infrastructure.
2) Tools to support individuals, groups and organisations in Europe to find the best solution for their formal or informal learning problem.
3) Policies and software agents that support the pro-active sharing of knowledge and learning resources.
4) Models and software tools to assess the competences of individuals, groups and organisations in an exchangeable way.
5) Software for the effective and efficient support of users who create, store, use and exchange knowledge resources, learning activities, units of learning, competence development programmes and networks for lifelong competence development.
6) Software solutions to establish a decentralized, self-organized and empowered management model when using the TENCompetence infrastructure.
7) Integration of isolated tools available in the field.
The second cycle of project pilots will validate that the solutions developed to make the TENCompetence concept a reality are usable, that is to say that they provide effective solutions to real problems in an authentic context.

The third cycle of project pilots will demonstrate to the wider Life Long Learning community the advantages of adopting the TENCompetence concept and the infrastructure, which will have been developed to support it.
3.2 The schedule for validation actions in TENCompetence Cycle 1

The validation actions to be carried out in TENCompetence cycle 1 (including both the pilots and the technical validation actions) may be summarised in the table below. The schedule for additional pilots will depend to some extent on the opportunities that are identified. There are advantages, however, to having them slightly later than the main Digital Cinema pilot, so that they can use a well-established system and perhaps respond to initial findings.

<table>
<thead>
<tr>
<th>TENCompetence validation schedule for Cycle 1</th>
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<tbody>
<tr>
<td>Digital cinema pilot</td>
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<tr>
<td>Jun 06</td>
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<tr>
<td>Additional pilots</td>
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<tr>
<td>Jun 06</td>
</tr>
<tr>
<td>Cycle 2 pilots</td>
</tr>
<tr>
<td>Jun 06</td>
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</tbody>
</table>

*The opportunities for additional pilots are described below, following analysis of the coverage provided by the Digital Cinema pilot.*
3.3 The schedule for updating this deliverable in the context of the project evolution

The overall planning of pilots described in the previous subsection indicates some targets for updating this deliverable:
- End of June 07 for a completely new deliverable including the cycle 2 pilots at the same level of detail of this deliverable for Digital Cinema cycle 1 pilot.

3.4 Aspects of TENCompetence addressed in the pilots

The Cycle 1 Digital Cinema pilot cannot address all the aspects of the TENCompetence concept. This is because (in line with the DOW) a number of the aspects of TENCompetence are not yet implemented in cycle 1. Moreover the Digital Cinema pilot is the first significant trial of the infrastructure in an authentic context. As such it would be unwise to plan large-scale pilots, which committed to meeting the open ended needs of large user groups, which span a number of organisations. Such environments will be required to fully validate some aspects of TENCompetence, such as supporting individuals groups and organisations to find the best solutions to their learning problems. Such pilots will take place increasingly in Cycle 2 and Cycle 3.

Consequently the Digital Cinema pilot in Cycle 1 is designed to validate the first version of the TENCompetence system in a demanding environment, meeting authentic user needs, but in a restricted context where the project team can provide extensive support. The pilot provides the opportunity to address in a quite systematic way the following aspects of the TENCompetence project

- New, promising, innovative pedagogical approaches for lifelong competence development, supported by the TENCompetence infrastructure.
- Integrate isolated tools that are available in the field.
- Software for the effective and efficient support of users who create, store, use and exchange knowledge resources, learning activities, units of learning, competence development programmes and networks for lifelong competence development.
- Initial validation of software solutions to establish a decentralized, self-organized and empowered management model when using the TENCompetence infrastructure.

Thus there are aspects of TENCompetence, which cannot be fully addressed in Cycle 1 Digital Cinema pilot, because the functionality is not scheduled to be incorporated until Cycle 2. There are also aspects which are not addressed because of the particular nature of the Digital Cinema pilot, and the need to limit the scope of the pilot to that which the project can realistically commit to supporting in a first release of the system.

In view of this analysis:
- We have started to identify the opportunities for maximising the results of validation efforts by carrying out focused additional actions.
- Although full formal feedback about the missing issues will not probably be achieved by Cycle 1 Digital Cinema pilot, informal feedback is very important for the future of the project, and that this informal feedback will be looked for during evaluation, and included in the evaluation results of cycle 1.
3.5 Identification and Planning of Additional Pilots

According to the schedule described in 3.2, we have started investigating the need for additional pilots and the opportunities available to develop them since the beginning of August 2006. In that perspective, several ideas were evaluated and two additional pilots have been completely adopted and put into action. For Cycle 1, WP4 will plan and implement the ICT Training pilot (see section 5) under the management of the University of Sofia and in collaboration with the I*Teach project. This pilot will target schoolteachers that would like to acquire ICT skills in order to teach them to the students. It proposed the development of an e-learning approach for acquiring four main competences in the ICT field and provides a training environment for the targeted teaching community.

With the cooperation of INSEAD, the digital cinema game pilot has been conceived as an additional pilot for the second cycle of the project. The idea behind this pilot is to provide an informal learning approach in order to validate the TENCompetence framework from this perspective. The concept of the game encourages social interaction since it asks a team of learners to plan the production phase of a film using the best technology that suits the objectives of each production phase. Cooperation between the learners is key for the success of the group, hence creating a valuable environment where the integrated social tools and communication components can be evaluated.
## D 4.1 Pilot evaluation plan

<table>
<thead>
<tr>
<th>TENCompetence aspect</th>
<th>TEN-Competence product</th>
<th>Digital Cinema Pilot validation</th>
<th>How addressed in the Digital Cinema pilot</th>
<th>Opportunities for additional validation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) New, promising, innovative pedagogical approaches for lifelong competence development, supported by the TENCompetence infrastructure.</td>
<td>Integrated prototype. Learning activities prepared for the DC pilot.</td>
<td>The Digital Cinema pilot will use the cycle 1 infrastructure in an innovative pedagogic application. The pedagogic models being developed in WP 6 will be validated in cycle 2 pilots.</td>
<td>The DC pilot will use innovative pedagogies, resolving a real life training need in an emerging industry, which has pressing retraining needs. The use of recordings of shared desktop interactions will provide opportunities for innovation in both pedagogy and in the technically demanding integration of this form of data into learning activities. The richness of the TENCompetence system is such that no individual pilot can validate the whole range of potential applications. Consequently it would be reasonable here to run some smaller, more focused pilots, which explore the potential of the system to support innovative pedagogies.</td>
<td>Trials of the system to experiment with specified innovative pedagogies and contexts (e.g. open learning, discussion groups, problem based learning, learner led learning, etc). These may be small-scale trials, and if necessary can involve non-authentic contexts.</td>
</tr>
<tr>
<td>2) Tools to support individuals, groups and organisations in Europe to find the best solution for their formal or informal learning problem.</td>
<td>Products of WP 8.</td>
<td>The Digital Cinema pilot does not address this aspect, as these tools will not be incorporated in the system until cycle 2.</td>
<td>Apart from the lack of tooling, the level of institutional complexity required for a full validation of this aspect is not compatible with the validation of an initial prototype. It will be validated in Cycle 2.</td>
<td>Proposals have been made for the development of simulations to address this aspect, but no concrete plans are in place.</td>
</tr>
<tr>
<td>3) Policies and software agents that support the pro-active sharing of knowledge and learning resources.</td>
<td>Products of WP 5</td>
<td>The Digital Cinema does not address these aspects, as policies and software agents will not be available in Cycle 1. These aspects will be validated in Cycle 2.</td>
<td>It would be valuable in Cycle 1 to explore the potential of the TENcc client (and other available OS infrastructure) for: a) Supporting the pro-active sharing of knowledge and learning resources. b) Mapping learning resources to competences This would not only provide some initial proof of concept, but also provide a reference point, which will make it possible to evaluate the added value of subsequent additional functionality.</td>
<td>Focused trial of linked competences and learning resources in a context where there is a need for this functionality. Focused trial of system in a context where there is a need for peer sharing of resources. Trials could be in partner institutions.</td>
</tr>
</tbody>
</table>
### D 4.1 Pilot evaluation plan

<table>
<thead>
<tr>
<th>4) Models and software tools to assess the competences of individuals, groups and organisations in an exchangeable way.</th>
<th>Products of WP 6 &amp; 7.</th>
<th>The Digital Cinema does not address these aspects tools for assessing competences will not be ready by end of cycle 1. These aspects will be validated in Cycle 2.</th>
<th>Initial proof of concept for the exchange of competences would provide valuable additional information.</th>
<th>Mapping competences from an authentic context onto the formats to be used and validating their interoperability. In conjunction with formative evaluation carried out in WP6&amp;7 this will provide a deep insight.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5) Software for the effective and efficient support of users who create, store, use and exchange knowledge resources, learning activities, units of learning, competence development programmes and networks for lifelong competence development.</td>
<td>TENcc prototype</td>
<td>Addressed by Digital Cinema cycle 1 pilot (DC pilot).</td>
<td>The DC pilot will provide the opportunity to use the full range of facilities built into TENcc client in an authentic learning environment, with authentic professional users. The creation of competence development programmes and networks for lifelong learning will only be addressed in a minor way in the DC pilot.</td>
<td>This could be addressed in less formal (and less mission critical) pilots. These could be combined with additional pilots for aspects 3 and 6.</td>
</tr>
<tr>
<td>6) Software solutions to establish a decentralized, self-organized and empowered management model when using the TENCompetence infrastructure.</td>
<td>TENcc prototype</td>
<td>Addressed by Digital Cinema pilot. Will need more pilots to validate the self-organisation aspect. This will be addressed in Cycle 2, in particular in the Antwerp pilot.</td>
<td>The DC pilot will be directed to a heterogeneous group of professionals working in the area of digital cinema. These people are both decentralised and self organised, and to this extent they provide a good opportunity for trialling the system. On the other hand the organisational structure is very flat, as they are all on the same level, and outside an institutional context. More functionality will be available to address this aspect in cycle 2. Nevertheless, it would be valuable to run a pilot where the potential of the TENC system for increasing self-organisation and empowerment among users could be examined, if an appropriate environment could be identified.</td>
<td>If an appropriate context can be identified, then the TENcc client to a number of professionals, with some guidance and facilitation support. The pilot would examine the use, which is made of the infrastructure in self-organised activities. This activity could be related to aspect 3) and 5) above.</td>
</tr>
<tr>
<td>7) Integrate isolated tools that are available in the field.</td>
<td>TENcc prototype</td>
<td>Addressed by Digital Cinema pilot Integration validated by the formal trials and technical tests and evaluation</td>
<td>The DC pilot will validate the integration of tools and services in the TENcc client by using them in an authentic eLearning task. Technical evaluation and technical tests will also be carried out to ensure both integration of the tools and the overall performance and functionality of the system.</td>
<td>Incorporation of online help recording, and analysis of results</td>
</tr>
</tbody>
</table>
The additional actions proposed fall into three groups:

1. Trials of the system to experiment with specified innovative pedagogies and contexts (e.g. open learning, discussion groups, problem based learning, learner led). These may be small-scale trials, and if necessary can involve non-authentic contexts.

2. Focused trial of linked competences and learning resources in a context where there is a need for this functionality. Some validation provided by DC pilot, but the context is too limited to provide strong results. Focused trial of system in a context where there is a need for peer sharing of resources. Trials could be in partner institutions.

3. Use of the TENCompetence client in self-organisation activities. Provision of the client to a number of professionals, with some guidance and facilitation support. The pilot would examine the use, which is made of the infrastructure. Finding an appropriate context might be challenging.

### 3.6 Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Use in TENCompetence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case study</td>
<td>A longitudinal study in a real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Extensive material is gathered and a narrative developed. More effective is validated by participants, and cross-compared. In many ways they produce similar results to Ethnographic Studies, but with a wider range of inputs and less rigorous observation processes.</td>
<td>Case studies will be developed as reports on all the main pilots carried out.</td>
</tr>
<tr>
<td>Cost analysis</td>
<td>The costs of creating, implementing or using the resource to be evaluated can be assessed, and this information is useful in the construction of a business case for its adoption or continued development. This can consider a range of factors such how long it takes to input content, administrative workload, technical support required, hardware costs, how long it takes to program etc. It may also be desirable to establish the comparative costs with the status quo, and offset these against the benefits of the new resource. However many benefits can be intangible and hard to quantify in cost terms.</td>
<td>This technique will be considered in the final pilots in cycle three of the TENCompetence project.</td>
</tr>
<tr>
<td>Ethnographic study</td>
<td>‘In situ’ observation, with the events being observed should be as little disturbed and as authentic as possible. Sources of information may include: - Naturally occurring documentation. - Participant observation. - Audio and video recording. - Field notes and transcribed conversation. The strength of Ethnographic study for the purposes of TENCompetence is that it provides an in depth rich picture of the multi-layered impact of the TENCompetence pilots.</td>
<td>Ethnographic Studies present two difficulties for TENCompetence a) They are very time consuming, and the results are contingent on the skill and expertise of the ethnographer. b) They present problems of privacy when working with professional groups, and practical difficulties with distance learning. Consequently Ethnographic Studies will not be used in the first cycle of pilots, but will be considered for later phases.</td>
</tr>
</tbody>
</table>
### Experiment
Specific design features may be investigated with a focused experiment investigating the participants’ performance of specified tasks, or their perception of particular features. As a general guide experiments should use at least two groups of people with 15 participants per group if the results are to be significant.

**Experiments will be used in addressing those aspects of TENCompetence where a clear hypothesis can be formulated and subjects are available.**

### Focus groups
A moderated meeting of ‘involved’ people discussing their experience. Unlike an individual interview, a focus group enables the participants to influence each other’s views as they emerge during the discussion. The advantage of this is that through disagreement and discussion, a wider range of views may emerge. The potential disadvantage is that dominant characters in the group may suppress the views of the less dominant. It is therefore normal to form groups from people of similar status.

Focus groups could be used effectively as a debriefing activity at the end of pilots.

### Interviews
Interviews are appropriate for gathering in-depth data from small numbers of people. More structured interviews make it easier to record parallel data from all interviewees, while unstructured interviews can catch responses that were not anticipated by the evaluators. They are also useful for collecting issues, which can then be measured in larger numbers with a questionnaire.

Semi-structured interviews will be one of the main ways in which we obtain information from pilot participants.

### Observations
Observations involve observation of users at work with the resource. This can be done with a checklist to record how the user gets on with particular features of the resource. Observations can be useful for highlighting specific navigation issues, or for finding anomalies in the content. One option is for the evaluator to offer him or herself as a helper so that the user will ask when there is a problem, which in itself helps to highlight issues. If the sessions are recorded on video then more detailed analysis can be conducted, and events, which were not noticed at the time of recording, may be seen to be significant.

Observation can reveal a great deal about the TENCompetence infrastructure. It does however raise serious ethical and privacy issues, and can impact on the authenticity of the pilot. One option would be to have a “semi-authentic” user following the course, that is to say, a person who is part of a partner institution, who has a genuine interest in the course content but willing to participate as a member of the validation team.

### Questionnaires
Questionnaires can be used to canvass very large numbers of users or potential users, and data can be gathered from each respondent in far less time than with an interview or focus group. They are generally better for unambiguous, factual data than for opinions or descriptions that require explanation or justification.

Closed or structured questions that allow only a limited range of answers require the designers to anticipate the likely responses. This can be made easier by using the range of answers given in interviews and focus groups as a basis for questionnaire design.

More "open" questions can be included, but these require more thinking and more time on the part of the respondent and are therefore less likely to be answered.

Structured questionnaires will be used extensively. Some more open questions will also be included when administered in person to those who have completed pilot courses (where the chance of a high response rate is good).

While questionnaires have their limitations, the ease with which they can be administered and processed mean that they provide a data which would otherwise be too time consuming to gather.
Low response rates are a common problem with questionnaires and frequently results in data being gathered from a small number of self-selecting and therefore unrepresentative respondents.

| System log data | This data is useful in tracking users’ preferences and navigational choices, and can be triangulated with observations, questionnaires and interviews. Most servers keep logs of every access to every page on the server, and these can reveal patterns of use. | In addition to analysis of server logs, in TENCompetence it is planned to implement a context sensitive help system, which will provide additional focused data. |
| Textual data | Text can be harvested from email and conferencing systems and analysed. This technique complements the analysis of System log data. | The TENCompetence validation effort will not analyse the text generated by users, because of privacy concerns. It is however planned to provide features within the system, which encourage users to provide feedback to the development team at a common mailbox. |
| User diaries | A diary kept over a period of using the product is in many ways a longitudinal think-aloud. This enables the evaluator to build up a rich picture of how the user’s responses evolve over time. The diary is often a valuable complement to more structured records of use, and may provide starting points for interview discussions. | A “semi-authentic” user (see observation above) could also keep a user diary. |

The following popular evaluation methods will not be used with the TENCompetence pilots (although they may well be used in evaluation actions in the course of development work carried out in other workpackages). This is because they require a non-authentic environment.

- **Think-aloud**: in this approach the user is asked to describe his or her thought processes to the evaluator as he or she is using the resource.

- **Reviews**: external experts or peers may review the product. The quality of the evaluation depends very much on the expertise of the reviewer.

- **Usability inspection**: a set of methods based on having evaluators inspects or examine usability-related aspects of a user interface.

### 3.7 Categorisation of methodologies

A valuable perspective on the methodologies identified above is provided by the framework proposed by Oliver, M. 1998. Three criteria are identified: scale, exploration and authenticity.

- **Scale** is measure of the number of participants who need to be involved in this type of evaluation.

- **Exploration** refers to a continuum between those methodologies, which provide support for testing (and so dismissing or favouring options) and those,

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7 Oliver, M "Innovation in the Evaluation of Learning Technology". University of North London, 1998. The methods and criteria described here are closely based on the summary of Oliver in the ELT toolkit. The table, which follows, however, includes a different range of methodologies and weightings to those selected by Oliver and ELT toolkit.
which are about understanding (and so increasing the range of options available). A 1-4 scale is used, with the following suggested meanings:

1. Testing a hypothesis;
2. Considering a range of possibilities;
3. Generating a range of possibilities, focused on a particular topic or issue;
4. Generating possibilities based on an immersion in the context.

- Intervention in context distinguishes between methodologies, which are about controlling possible influencing factors from those that are about understanding the effects of context. A 1-4 scale is used, with the following suggested meanings:
  1. Any factors that could influence the intervention are controlled whenever possible.
  2. The group is sampled in some way, but beyond this, factors are not controlled.
  3. An existing group is used, but the evaluation is intrusive.
  4. The evaluation takes place without disturbing the existing context.

When these criteria are applied to the methodologies to be used in SCOPE the results are as follows:

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Exploration</th>
<th>Intervention in context</th>
<th>Scale</th>
<th>Use in Cycle 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost analysis</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>2. Experiment</td>
<td>1</td>
<td>1</td>
<td>30+</td>
<td>Yes</td>
</tr>
<tr>
<td>3. Observation</td>
<td>2</td>
<td>2</td>
<td>1+</td>
<td>Yes</td>
</tr>
<tr>
<td>4. Questionnaire</td>
<td>2</td>
<td>2</td>
<td>30+</td>
<td>Yes</td>
</tr>
<tr>
<td>5. System log data</td>
<td>2</td>
<td>4</td>
<td>10+</td>
<td>Yes</td>
</tr>
<tr>
<td>6. Focus group</td>
<td>3</td>
<td>2</td>
<td>4-8</td>
<td>Yes</td>
</tr>
<tr>
<td>7. ‘Open’ questionnaire / interview / user diary</td>
<td>3</td>
<td>2</td>
<td>10-30</td>
<td>Yes</td>
</tr>
<tr>
<td>8. Textual data</td>
<td>3</td>
<td>4</td>
<td>10+</td>
<td>Yes</td>
</tr>
<tr>
<td>9. Case study</td>
<td>4</td>
<td>4</td>
<td>1+</td>
<td>Yes</td>
</tr>
<tr>
<td>10. Ethnographic study</td>
<td>4</td>
<td>4</td>
<td>1+</td>
<td>No</td>
</tr>
</tbody>
</table>

Thus it may be seen that the proposed methodologies are evenly spread over the range of the "exploration" scale, and the methodologies are ordered according to their score on this scale. The “intervention in context” scale is less evenly spread, but there are nevertheless methodologies from both extremes of the scale.

### 3.8 Actors involved in the validation process

The activity of the participants in the pilots may well shift over time. For example, the same person who one day defines competences may the next day design a competence development programme. Similarly a learner following a formal competence development course may also use the infrastructure in a peer network, providing learning resources for colleagues. Thus the following actors refer to roles that users can take up, rather than individual people.
The following actors are involved as respondents in the validation process

- authors of competence development programmes
- authors of LLL networks
- authors of competence assessment
- competence definers
- HR managers (Human Resources managers, or others responsible for personnel development in organisations)
- learners (in formal competence development courses and activities)
- learning Designers (of advanced units of learning)
- peers (using the TENCompetence system in peer networks)
- teachers (in formal competence development courses and activities)
- technical staff (responsible for installing and maintaining the TENCompetence infrastructure)
- users with LLL management needs

### 3.9 Validation actions to be used in TENCompetence

Taking the methodologies and actors into consideration the following actions can be defined, using the numbers in the methodologies list above.

2. Experiment
   2.1 Experiment with sharing policies and agents
   2.2 Experiment when introducing system into new environment

3. Observation of users in pilots (if pilot permits)

4. Questionnaires
   4.1 Structured questionnaires for competence assessment authors
   4.2 Structured questionnaires for competence definers
   4.3 Structured questionnaires for competence development program authors
   4.4 Structured questionnaires for competence development learners
   4.5 Structured questionnaires for competence development teachers
   4.6 Structured questionnaires for HR managers
   4.7 Structured questionnaires for “peer users”
   4.8 Structured questionnaires for technical staff

5. System log data
   5.1 System log data from general use
   5.2 System log data of contextual help requests

6. Focus Group of users involved in pilots

7. Interviews
   7.1 Semi-structured interviews with assessment authors
   7.2 Semi-structured interviews with competence authors
   7.3 Semi-structured interviews with competence development programme authors
   7.4 Semi-structured interviews with LLL networks authors
   7.5 Semi-structured interviews with competence development learners
   7.6 Semi-structured interviews with competence development teachers
   7.7 Semi-structured interviews with HR managers
7.8 Semi-structured interviews with “peer users”
7.9 Semi-structured interviews with technical staff

8. Textual data generated by user help requests

9. Case studies (including focus groups)

### 3.10 Schedule of instruments and outputs

<table>
<thead>
<tr>
<th>Action</th>
<th>Planned use</th>
<th>To prepare</th>
<th>Date of preparation</th>
<th>Output</th>
<th>Date of output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cost analysis</td>
<td>Cycle 3</td>
<td></td>
<td></td>
<td></td>
<td>Cycle 3</td>
</tr>
<tr>
<td>2.1 Experiment with sharing policies and agents</td>
<td>Cycle 1, if appropriate opportunities are available</td>
<td>Experimental design and instruments</td>
<td>Dependent on opportunities in pilots</td>
<td>Report and research paper</td>
<td>M21 or Cycle 2</td>
</tr>
<tr>
<td>2.2 Experiment when introducing system into new environment</td>
<td>Cycle 1, if appropriate opportunities are available</td>
<td>Experimental design and instruments</td>
<td>Dependent on opportunities in pilots</td>
<td>Report and research paper</td>
<td>M21 or Cycle 2</td>
</tr>
<tr>
<td>3. Observation of users</td>
<td>Cycle 1, if appropriate opportunities are available</td>
<td>Observation protocol</td>
<td>January 1(^{st}) 2007 (if observation scheduled for Digital Cinema pilot)</td>
<td>Observation transcript and summary report with conclusions</td>
<td>M21</td>
</tr>
<tr>
<td>4.1 Structured questionnaires for competence assessment authors</td>
<td>Cycle 1 pilots</td>
<td>Model questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses b) Report with conclusions</td>
<td>a) As available b) M21</td>
</tr>
<tr>
<td>4.2 Structured questionnaires for competence definers</td>
<td>Cycle 1 pilots</td>
<td>Questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses b) Report with conclusions</td>
<td>a) As available b) M21</td>
</tr>
<tr>
<td>4.3 Structured questionnaires for competence development programme authors</td>
<td>Cycle 1 pilots</td>
<td>Questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses b) Report with conclusions</td>
<td>a) As available b) M21</td>
</tr>
<tr>
<td>4.4 Structured questionnaires for competence development learners</td>
<td>Cycle 1 pilots</td>
<td>Questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses b) Report with conclusions</td>
<td>a) As available b) M21</td>
</tr>
<tr>
<td>4.5 Structured questionnaires for competence development teachers</td>
<td>Cycle 1 pilots</td>
<td>Questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses b) Report with conclusions</td>
<td>a) As available b) M21</td>
</tr>
<tr>
<td>4.6 Structured questionnaires for HR managers</td>
<td>Cycle 1 pilots</td>
<td>Questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses b) Report with conclusions</td>
<td>a) As available b) M21</td>
</tr>
<tr>
<td>4.7 Structured</td>
<td>Cycle 1 pilots</td>
<td>Questionnaire</td>
<td>January 1(^{st}) 2007</td>
<td>a) Initial collated responses</td>
<td>a) As available</td>
</tr>
</tbody>
</table>
### D 4.1 Pilot evaluation plan

<table>
<thead>
<tr>
<th>Questionnaires for “peer users”</th>
<th>Cycle 1 pilots</th>
<th>Questionnaire</th>
<th>January 1st 2007</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) Initial collated responses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Report with conclusions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) As available</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) M21</td>
</tr>
<tr>
<td>5.1 System log data</td>
<td>Cycle 1 pilots</td>
<td>Specification of data to be gathered</td>
<td>January 1st 2007</td>
<td>a) Regular collated results</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Report with conclusions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) As available</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) M21</td>
</tr>
<tr>
<td>5.2 System log data of contextual help requests</td>
<td>Cycle 1 pilots</td>
<td>Help monitoring system in place</td>
<td>January 1st 2007</td>
<td>a) Regular collated results</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) Report with conclusions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>a) As available</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b) M21</td>
</tr>
<tr>
<td>6. Focus Group</td>
<td>Cycle 1 pilots</td>
<td>Focus group protocol (including questions)</td>
<td>January 1st 2007 (to be revised in the light of initial evaluation results)</td>
<td>Report (input into case study)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M16</td>
</tr>
<tr>
<td>7.1 Semi-structured interviews with assessment authors</td>
<td>Cycle 2 pilots (unless functionality available in Cycle 1)</td>
<td></td>
<td></td>
<td>Cycle 2</td>
</tr>
<tr>
<td>7.2 Semi-structured interviews with competence authors</td>
<td>Cycle 2 pilots (unless functionality available in Cycle 1)</td>
<td></td>
<td></td>
<td>Cycle 2</td>
</tr>
<tr>
<td>7.3 Semi-structured interviews with competence development programme authors</td>
<td>Cycle 1 pilots</td>
<td>Interview protocol with questions</td>
<td>January 1st 2007</td>
<td>Report (input into case study)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M16</td>
</tr>
<tr>
<td>7.4 Semi-structured interviews with LLL networks authors</td>
<td>Cycle 2 pilots</td>
<td></td>
<td></td>
<td>Cycle 2</td>
</tr>
<tr>
<td>7.5 Semi-structured interviews with competence development learners</td>
<td>Cycle 1 pilots</td>
<td>Interview protocol with questions</td>
<td>January 1st 2007</td>
<td>Report (input into case study)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M16</td>
</tr>
<tr>
<td>7.6 Semi-structured interviews with competence development teachers</td>
<td>Cycle 1 pilots</td>
<td>Interview protocol with questions</td>
<td>January 1st 2007</td>
<td>Report (input into case study)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M16</td>
</tr>
<tr>
<td>7.7 Semi-structured interviews with HR managers</td>
<td>Cycle 2 pilots</td>
<td></td>
<td></td>
<td>Cycle 2</td>
</tr>
<tr>
<td>7.8 Semi-</td>
<td>Cycle 1, if</td>
<td>Interview</td>
<td>January 1st 2007</td>
<td>Report (input into</td>
</tr>
<tr>
<td>7.9 Semi-structured interviews with technical staff</td>
<td>Cycle 1 pilots</td>
<td>Interview protocol with questions</td>
<td>January 1st 2007</td>
<td>Report (input into case study)</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>----------------</td>
<td>-----------------------------------</td>
<td>------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>8. Textual data</td>
<td>Cycle 1 pilots</td>
<td>Unified feedback and support mechanism and repository</td>
<td>January 1st 2007</td>
<td>Text corpus and report</td>
</tr>
<tr>
<td>9. Case studies (including focus groups)</td>
<td>Cycle 1 pilots</td>
<td>Case study plan, specifying materials to be collected</td>
<td>January 1st 2007</td>
<td>Case study analysis and report</td>
</tr>
</tbody>
</table>
3.11 Questions to be addressed

The question, which the validation actions described here seek to answer, is “In what ways and to what extent do the TENCompetence infrastructure and methodologies improve the provision of Life Long Learning?”

In order to structure project work in answering this question the validation effort addresses the seven aspects of TENCompetence, and for each of these areas this general question is reformulated.

Finally specific questions are provided for each aspect.

It will be observed that some aspects have more questions than others. This does not reflect the importance of the aspect, but rather degree to which they need to be articulated for a number of different types of users, or functionality.

**General question:** In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL

<table>
<thead>
<tr>
<th>Aspect 1: In what ways, and to what extent, does the TENCompetence project provide innovative approaches for life long learning?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can the system effectively support all the pedagogical approaches, which teachers want to use?</td>
</tr>
<tr>
<td>Do the learners using the system perceive that it supports them in providing innovative pedagogical approaches?</td>
</tr>
<tr>
<td>Do the outcomes of the learning activities match those, which were anticipated by the teachers?</td>
</tr>
<tr>
<td>Does the system provide an effective environment for defining competence development programmes, and what improvements could be made?</td>
</tr>
<tr>
<td>Does the system support teachers in providing implementing innovative pedagogical approaches?</td>
</tr>
<tr>
<td>How can the system be used to support pedagogic innovation, and how effective is it?</td>
</tr>
<tr>
<td>What specific opportunities for pedagogic innovation do teachers perceive that the system offers?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aspect 2: In what ways, and to what extent does the TENCompetence infrastructure and methodologies enable users to find the best solutions for their formal and informal problems?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can users navigate easily and effectively between networks for LLL? What problems do they encounter?</td>
</tr>
<tr>
<td>Does the infrastructure provide learners with the information they need to find solutions to their formal and informal learning problems?</td>
</tr>
<tr>
<td>Does the infrastructure represent some learning solutions better than others?</td>
</tr>
<tr>
<td>Does the system provide an effective environment for defining networks for LLL, and what improvements could be made?</td>
</tr>
<tr>
<td>How does the system support users in finding the best solution for their formal and informal learning problems?</td>
</tr>
<tr>
<td>Is the representation of networks for lifelong learning competences clear, and sufficient for the needs of users?</td>
</tr>
<tr>
<td>To what extent, and how, are the various aspects of system functionality useful to users in finding solutions to their formal and informal learning problems?</td>
</tr>
<tr>
<td>What problems do users encounter in navigating between competence development programmes?</td>
</tr>
</tbody>
</table>
### Aspect 3: In what ways and to what extent do the TENCompetence infrastructure and methodologies provide policies and software agents that support the pro-active sharing of knowledge and learning resources

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can teachers provide learning activities for learners easily and effectively? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Can teachers provide learning resources for learners easily and effectively? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Can users easily and effectively exchange learning resources with their peers and teachers?</td>
<td></td>
</tr>
<tr>
<td>Can users provide learning activities for peers easily and effectively? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Can users provide learning resources for peers easily and effectively? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Does the system enable learning resources to be provided for learners easily and effectively?</td>
<td></td>
</tr>
<tr>
<td>How can the system be used to promote exchange of knowledge resources, and how effective is it?</td>
<td></td>
</tr>
<tr>
<td>To what extent do software agents used in support the pro-active sharing of knowledge and learning resources?</td>
<td></td>
</tr>
<tr>
<td>To what extent do specific policies support pro-active sharing of knowledge and learning resources?</td>
<td></td>
</tr>
<tr>
<td>What are the significant variables in policies to support pro-active sharing of knowledge and learning resources, and what are their consequences?</td>
<td></td>
</tr>
<tr>
<td>Which are the significant variables in policies to support pro-active sharing of knowledge and learning resources, and what are their consequences?</td>
<td></td>
</tr>
</tbody>
</table>
### Aspect 4: In what ways and to what extent do the TENCompetence infrastructure and methodologies enable users to establish a decentralized, self-organized and empowered management model when using the TENCompetence infrastructure?

<table>
<thead>
<tr>
<th>Question</th>
<th>Evaluation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are competences represented in the system in a clear and effective way, and what improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Do competence development programmes in run time correspond to the author’s intentions?</td>
<td></td>
</tr>
<tr>
<td>Do teachers find the representation of competences in the system easy to understand? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Do the models of competences used provide an effective means of assessing competences?</td>
<td></td>
</tr>
<tr>
<td>Do users find the representation of competences in the system easy to understand?</td>
<td></td>
</tr>
<tr>
<td>Does the format of competence assessments, the way that users complete them, and the content of them match the author’s expectations?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide a clear and effective environment for implementing competence development programmes</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective and accurate environment for carrying out competence assessments?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective and accurate means of assessing competences?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective environment for carrying out competence assessments, and what improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective environment for defining competences, and what improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective environment for defining competence development programmes, and what improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective means of communicating competences? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Does the system provide an effective means of representing and communicating competences?</td>
<td></td>
</tr>
<tr>
<td>Does the way in which the users complete competence assessments, and does the format and content of the results match the author’s expectations</td>
<td></td>
</tr>
<tr>
<td>How easy is it to carry out a competence assessment?</td>
<td></td>
</tr>
<tr>
<td>How is the system used by organisations to meet their competence management needs</td>
<td></td>
</tr>
<tr>
<td>Is the assessment of competences effective and accurate?</td>
<td></td>
</tr>
<tr>
<td>To what extent can the representations of competences and learning activities be used in other systems?</td>
<td></td>
</tr>
<tr>
<td>What difficulties do learners face in carrying out a competence assessment?</td>
<td></td>
</tr>
<tr>
<td>What problems do users encounter in creating competence assessments?</td>
<td></td>
</tr>
<tr>
<td>What variables can be identified in the degree to which the system successfully handles different categories of competences?</td>
<td></td>
</tr>
</tbody>
</table>

### Aspect 5: In what ways and to what extent do the TENCompetence infrastructure and methodologies provide users with an effective and integrated system which enables them to create, store, use and exchange knowledge resources, learning activities, units of learning, competence development programmes and networks for lifelong competence development.

<table>
<thead>
<tr>
<th>Question</th>
<th>Evaluation Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are LLL networks represented in the system in a clear and effective way, and what improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>Are the tasks to be carried out by learners clear to understand and carry out?</td>
<td></td>
</tr>
<tr>
<td>Can learners provide materials for teachers easily and effectively? What problems do they encounter?</td>
<td></td>
</tr>
<tr>
<td>Can teachers provide learning resources for learners easily and effectively? What problems do they encounter?</td>
<td></td>
</tr>
</tbody>
</table>
Can users easily and effectively exchange learning resources with their peers?

Do LLL networks in run time correspond to the author’s intentions? What differences can be identified?

Do the learning activities as they are carried out on the system match the intentions of the teachers?

Does the system provide an easy and effective environment for peers to share knowledge and learning resources? What problems do they encounter?

How can the system be used to manage and implement competence development programmes and networks of LLL, and how effective is it?

How easy is it for learners to understand what they have to do in order to carry out a learning activity? What problems do they encounter?

How easy is it for users to navigate between competence development programmes? What problems do they encounter?

How effective is the support provided for users to define competence development programmes? Which facilities are most useful, and which actions present users with problems?

How effective is the support provided for users to define learning activities? Which facilities are most useful, and which actions present users with problems?

How effective is the support provided for users to define networks for LLL competence development? Which facilities are most useful, and which actions present users with problems?

How well can users understand the representation of competence development programmes? Which aspects present them with problems and why?

How well can users understand the representation of networks for LLL?

Is representation of networks for LLL clear and sufficient for the needs of users? What improvements could be made?

Is the relationship between learning resources, learning activities, competence development programmes, and networks for LLL clear to the users?

Is the representation of networks for LLL clear and sufficient for the needs of users?

What problems do learners encounter in understanding and carrying out the activities they are assigned?

What problems do teachers face in defining learning activities?

What problems do users encounter in understanding the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences?

What problems do users face in creating competence development programmes?

What problems do users face in creating networks for lifelong learning competences, and in understanding what they represent?

What problems do users face in defining learning activities for their peers?

What problems do users face in navigating between networks for lifelong learning competences?

What problems do users face in understanding what competence development programmes represent, and navigating between them?

What problems do users face in understanding what they have to do in order to carry out a learning activity?

Which areas of the system are most useful to users?

Which areas of the TENCompetence system do users put most effort into learning how to use? Which aspects do they find most difficult?

Which features of the system do users find most useful in organising and managing their activities?

Which TENCompetence facilities are most valuable to learners in carrying out the tasks which they are assigned, and why? What problems do they encounter?
**Aspect 6: In which ways and to what extent do the TENCompetence infrastructure and methodologies enable users to establish a decentralized, self-organized and empowered management model?**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How can the system be used effectively to facilitate collaboration between peers in the development of LLL competences?</td>
<td></td>
</tr>
<tr>
<td>How can the system be used to establish a decentralized, self-organized and empowered management model, and how effective is it?</td>
<td></td>
</tr>
<tr>
<td>How does the effectiveness of the system vary in different organisational contexts?</td>
<td></td>
</tr>
<tr>
<td>How does use of the system differ in various organisational contexts?</td>
<td></td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation? What improvements could be made?</td>
<td></td>
</tr>
<tr>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td></td>
</tr>
</tbody>
</table>

**Aspect 7: To what extent are the TENCompetence infrastructure and methodologies successful in integrating the isolated tools that are available in the field**

- Does the user at any point have the perception that they are moving into a different application or space?
- How well do users understand the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences? What improvements could be made?
- How well does the system perform in providing LLL, and how well does it integrate with other IT infrastructure.
- What problems do users encounter in using the system?
- What set-up, administration and performance problems are there with the TENCompetence infrastructure. What improvements could be made?
3.12 Developing validation instruments

These questions have been mapped onto the methodologies to be used and the respondents to produce a table, which will be used to guide the development of instruments. The table is available in the appendices to this deliverable.

As shown in the schedule for validation actions above, the development of instruments will be carried out for Cycle 1 from October to December 2006, when the details of the Digital Cinema pilot will be sufficiently clear to be able to inform preparation of detailed questions.

3.13 Data collection and processing methods

<table>
<thead>
<tr>
<th>Data collection method</th>
<th>Data interpretation method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis of requests for help and FAQ accesses</td>
<td>Report identifying recurrent problems</td>
</tr>
<tr>
<td>Case studies</td>
<td>Identification of specific examples of pedagogic innovation</td>
</tr>
<tr>
<td>Experiment (introducing TENCompetence into a LLL environment, different agents, different policies)</td>
<td>Statistical analysis and report</td>
</tr>
<tr>
<td>Server log file analysis</td>
<td>Statistical analysis and graphical representations</td>
</tr>
<tr>
<td>Meta-analysis of results of other actions</td>
<td>Report drawing out the conclusions</td>
</tr>
<tr>
<td>Observation</td>
<td>Transcript and report drawing out conclusions</td>
</tr>
<tr>
<td>Structured questionnaires</td>
<td>Analysis with a database and graphics tools</td>
</tr>
<tr>
<td>Semi structured interviews</td>
<td>Report summarising key themes</td>
</tr>
<tr>
<td><strong>Additional methodologies for use in formative evaluation of the system</strong></td>
<td></td>
</tr>
<tr>
<td>Heuristic analysis</td>
<td>Report identifying problem areas</td>
</tr>
<tr>
<td>Expert inspection</td>
<td>Transcript and report drawing out conclusions</td>
</tr>
<tr>
<td>Talk through</td>
<td>Report summarising key themes</td>
</tr>
</tbody>
</table>

3.14 Validation actions and questions

Mapping the validation questions, methodologies and respondents produces the following table.

<table>
<thead>
<tr>
<th>Method</th>
<th>Question addressed</th>
<th>Principal respondents</th>
<th>Main Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Experiment with sharing policies and agents</td>
<td>To what extent do specific policies support pro-active sharing of knowledge and learning resources?</td>
<td>Peers, Teachers, Learners</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Which are the significant variables in policies to support pro-active sharing of knowledge and learning resources, and what are their consequences?</td>
<td>Peers, Teachers, Learners</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>To what extent do software agents used in support the pro-active sharing of knowledge and learning resources?</td>
<td>Peers, Teachers, Learners</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>What are the significant variables in policies to support pro-active sharing of knowledge and learning resources, and what are their consequences?</td>
<td>Peers, Teachers, Learners</td>
<td>3</td>
</tr>
<tr>
<td>2.2 Experiment when introducing system into new environment</td>
<td>Do the models of competences used provide an effective means of assessing competences?</td>
<td>Teachers, Learners, HR managers</td>
<td>4</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td>HR managers, All users</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>How does use of the system differ in various organisational contexts?</td>
<td>HR managers, All users</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL?</td>
<td>All users, All</td>
<td></td>
</tr>
<tr>
<td>3. Observation of users</td>
<td>Which areas of the system are most useful to users?</td>
<td>All users</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Which areas of the system do users put most effort into learning how to use?</td>
<td>All users</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Which aspects of the system do users find most difficult to use?</td>
<td>All users</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do teachers face in defining learning activities?</td>
<td>Teachers, Learning designers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users face in defining learning activities for their peers?</td>
<td>Peers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users face in understanding what they have to do in order to carry out a learning activity?</td>
<td>Learners</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users face in creating competence development programmes?</td>
<td>Learning designers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users face in understanding what competence development programmes represent, and navigating between them?</td>
<td>Users with LLL management needs</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users face in creating networks for lifelong learning competences, and in understanding what they represent?</td>
<td>HR managers, Learning designers, Peers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users face in navigating between networks for lifelong learning competences?</td>
<td>Users with LLL management needs</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do users encounter in understanding the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences?</td>
<td>Users with LLL management needs</td>
<td>5</td>
</tr>
<tr>
<td>4.1 Structured questionnaires for competence assessment authors</td>
<td>Does the system provide an effective environment for carrying out competence assessments, and what improvements could be made?</td>
<td>Competence assessment authors</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Does the way in which the users complete competence assessments, and does the format and content of the results match the authors expectations</td>
<td>Competence assessment authors</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>What problems do users encounter in creating competence assessments?</td>
<td>Competence assessment authors</td>
<td>4</td>
</tr>
<tr>
<td>4.2 Structured questionnaires for competence definers</td>
<td>Are competences represented in the system in a clear and effective way, and what improvements could be made?</td>
<td>Competence definers</td>
<td>4</td>
</tr>
<tr>
<td>Section</td>
<td>Question</td>
<td>Rating</td>
<td></td>
</tr>
<tr>
<td>---------</td>
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<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Does the system provide an effective environment for defining competences, and what improvements could be made?</td>
<td>Competence definers</td>
<td>4</td>
</tr>
<tr>
<td>4.3</td>
<td>Are competence development programmes represented in the system in a clear and effective way, and what improvements could be made?</td>
<td>Competence development programme authors and learning designers</td>
<td>1</td>
</tr>
<tr>
<td>4.4</td>
<td>Do the learners using the system perceive that it supports them in providing innovative pedagogical approaches?</td>
<td>Learners</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Does the infrastructure provide learners with the information they need to find solutions to their formal and informal learning problems?</td>
<td>Learners</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>To what extent, and how, are the various aspects of system functionality useful to users in finding solutions to their learning problems?</td>
<td>Learners</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Does the infrastructure represent some learning solutions better than others?</td>
<td>Learners</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>What are the significant variables in policies to support proactive sharing of knowledge and learning resources, and what are their consequences?</td>
<td>Learners</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Does the system provide an effective and accurate means of assessing competences?</td>
<td>Learners</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Does the system provide an effective means of representing communicating competences?</td>
<td>Learners</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>What difficulties do learners face in carrying out a competence assessment?</td>
<td>Learners</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Do users find the representation of competences in the system easy to understand?</td>
<td>Learners</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Does the system enable learning resource to be provided for learners easily and effectively?</td>
<td>Learners</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Can users easily and effectively exchange learning resources with their peers and teachers?</td>
<td>Learners</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Are the tasks to be carried out by learners clear to understand and carry out?</td>
<td>Learners</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>What problems do learners encounter in understanding and carrying out the activities they are assigned?</td>
<td>Learners</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Which TENCompetence facilities are most valuable to learners in carrying out the tasks which they are assigned, and why? What problems do they encounter?</td>
<td>Learners</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Do the outcomes of the learning activities match those, which were anticipated by the teachers?</td>
<td>Learners</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>What problems do users encounter in navigating between competence development programmes?</td>
<td>Learners</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Is the representation of competence development programmes clear, and sufficient for the needs of users?</td>
<td>Learners</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Is representation of networks for LLL clear, and sufficient for the needs of users?</td>
<td>Learners</td>
<td>5</td>
</tr>
<tr>
<td>4.1 Pilot evaluation plan</td>
<td></td>
<td></td>
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<tr>
<td>--------------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Is the relationship between learning resources, learning activities, competence development programmes, and networks for LLL clear to the users?</td>
<td>Learners</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation?</td>
<td>Learners</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities?</td>
<td>Learners</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Which features of the system do users find most useful in organising and managing their activities?</td>
<td>Learners</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td>Learners</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Does the user at any point have the perception that they are moving into a different application or space?</td>
<td>Learners</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL?</td>
<td>Learners</td>
<td>All</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.5 Structured questionnaires for competence development teachers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the system support teachers in providing implementing innovative pedagogical approaches?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Does the system provide an effective and accurate environment for carrying out competence assessments?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Does the system provide an effective means of representing and communicating competences?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Can teachers provide learning resources for learners easily and effectively? What problems do they encounter?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Can learners provide materials for teachers easily and effectively? What problems do they encounter?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Can teachers provide learning activities for learners easily and effectively? What problems do they encounter?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Do the outcomes of the learning activities match those, which were anticipated by the teachers?</td>
<td>Teachers</td>
</tr>
<tr>
<td>How easy is it for learners to understand what they have to do in order to carry out a learning activity? What problems do they encounter?</td>
<td>Teachers</td>
</tr>
<tr>
<td>How easy is it for users to navigate between competence development programmes? What problems do they encounter?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Is the representation of competence development programmes clear and sufficient for the needs of users?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Can users navigate easily and effectively between networks for LLL? What problems do they encounter?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Is the representation of networks for LLL clear sufficient for the needs of users?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Is the relationship between learning resources, learning activities, competence development programmes, and networks for LLL clear to the users?</td>
<td>Teachers</td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation?</td>
<td>Teachers</td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Which features of the system do users find most useful in organising and managing their activities?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Does the user at any point have the perception that they are moving into a different application or space?</td>
<td>Teachers</td>
</tr>
<tr>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL?</td>
<td>Teachers</td>
</tr>
</tbody>
</table>
4.6 Structured questionnaires for HR managers

<table>
<thead>
<tr>
<th>Question</th>
<th>HR managers</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the assessment of competences effective and accurate?</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Does the system provide an effective environment for defining competence development programmes, and what improvements could be made?</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Is the representation of competence development programmes clear, and sufficient for the needs of users?</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Does the system provide an effective environment for defining networks for LLL, and what improvements could be made?</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Is the representation of networks for lifelong learning competences clear, and sufficient for the needs of users?</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure change the provision of LLL</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

4.7 Structured questionnaires for “peer users”

<table>
<thead>
<tr>
<th>Question</th>
<th>Peers</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the system provide an easy and effective environment for peers to share knowledge and learning resources? What problems do they encounter?</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Does the system provide an easy and effective environment for peers to share learning activities? What problems do they encounter?</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Is the relationship between learning resources, learning activities, competence development programmes, and networks for LLL clear to the users?</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Which features of the system do users find most useful in organising and managing their activities?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Does the user at any point have the perception that they are moving into a different application?</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL</td>
<td></td>
<td>All</td>
</tr>
</tbody>
</table>

4.8 Structured questionnaires for technical staff

<table>
<thead>
<tr>
<th>Question</th>
<th>Technical staff</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent can the representations of competences and learning activities be used in other systems?</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>What set-up, administration and performance problems are there with the TENCompetence infrastructure</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

5.1 System log data

<table>
<thead>
<tr>
<th>Question</th>
<th>Technical staff</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>To what extent do specific policies support pro-active sharing of knowledge and learning resources?</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>To what extent do software agents used in support the pro-active sharing of knowledge and learning resources?</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>What set-up, administration and performance problems are there with the TENCompetence infrastructure</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

5.2 System log data of contextual help requests

<table>
<thead>
<tr>
<th>Question</th>
<th>Learners</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>What problems do learners encounter in understanding and carrying out the activities they are assigned?</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Question</td>
<td>Respondent</td>
<td>Sample size</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Which areas of the TENCompetence system do users put most effort into learning how to use? Which aspects do they find most difficult?</td>
<td>All users</td>
<td>5</td>
</tr>
<tr>
<td>How effective is the support provided for users to define learning activities? Which facilities are most useful, and which actions present users with problems?</td>
<td>Peer users, Teachers</td>
<td>5</td>
</tr>
<tr>
<td>How well can users understand the representation of competence development programmes? Which aspects present them with problems and why?</td>
<td>All users</td>
<td>5</td>
</tr>
<tr>
<td>How well can users understand the representation of networks for LLL?</td>
<td>All users</td>
<td>5</td>
</tr>
<tr>
<td>How effective is the support provided for users to define competence development programmes? Which facilities are most useful, and which actions present users with problems?</td>
<td>Authors of competence development programmes</td>
<td>5</td>
</tr>
<tr>
<td>How effective is the support provided for users to define networks for LLL competence development? Which facilities are most useful, and which actions present users with problems?</td>
<td>Authors of LLL networks</td>
<td>5</td>
</tr>
<tr>
<td>6. Focus Group See Case study, point 9. below</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.1 Semi-structured interviews with assessment authors</td>
<td>Does the system provide an effective environment for carrying out competence assessments, and what improvements could be made?</td>
<td>Competence assessment authors, Learners</td>
</tr>
<tr>
<td>Does the format of competence assessments, the way that users complete them, and the content of them match the author’s expectations?</td>
<td>Competence assessment authors</td>
<td>4</td>
</tr>
<tr>
<td>7.2 Semi-structured interviews with competence authors</td>
<td>Does the system provide an effective environment for defining competences, and what improvements could be made?</td>
<td>Competence definers</td>
</tr>
<tr>
<td>Are competences represented in the system in a clear and effective way, and what improvements could be made?</td>
<td>Competence definers</td>
<td>4</td>
</tr>
<tr>
<td>7.3 Semi-structured interviews with competence development programme authors</td>
<td>Does the system provide an effective environment for defining competence development programmes, and what improvements could be made?</td>
<td>Learning designers, Teachers</td>
</tr>
<tr>
<td>Are competence development programmes represented in the system in a clear and effective way, and what improvements could be made?</td>
<td>Learning designers, Teachers, Learners</td>
<td>4</td>
</tr>
<tr>
<td>Do competence development programmes in run time correspond to the author’s intentions?</td>
<td>Learning designers, Teachers</td>
<td>4</td>
</tr>
<tr>
<td>Does the system provide a clear and effective environment for implementing competence development programmes</td>
<td>Learning designers, Teachers</td>
<td>4</td>
</tr>
<tr>
<td>7.4 Semi-structured interviews with LLL networks authors</td>
<td>Does the system provide an effective environment for implementing and running LLL networks? What improvements could be made?</td>
<td>HR managers, Learning designers, Peers</td>
</tr>
<tr>
<td>Are LLL networks represented in the system in a clear and effective way, and what improvements could be made?</td>
<td>Users with LLL needs</td>
<td>5</td>
</tr>
<tr>
<td>7.5 Semi-structured interviews with competence development learners</td>
<td>Do LLL networks in run time correspond to the author’s intentions? What differences can be identified?</td>
<td>HR managers, Learning designers, Peers, Learners</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td></td>
<td>What specific opportunities for pedagogic innovation do learners perceive that the system offers?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>To what extent, and how, are the various aspects of system functionality useful to users in finding solutions to their formal and informal learning problems?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Does the infrastructure represent some learning solutions better than others?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Do the models of competences used provide an effective means of assessing competences?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Do the models of competences used provide an effective means of communicating competences?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Is the assessment of competences effective and accurate?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>How easy is it to carry out a competence assessment?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Can users easily and effectively exchange learning resources with their peers?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Is the representation of networks for LLL clear and sufficient for the needs of users?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>How well do users understand the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>To what extent is the system perceived by users as being valuable in self-organisation?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>In what ways do users of the system use its features in organising and managing their activities?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Which features of the system do users find most useful in organising and managing their activities?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td>Learners</td>
</tr>
<tr>
<td></td>
<td>Does the user at any point have the perception that they are moving into a different application?</td>
<td>Learners</td>
</tr>
<tr>
<td>7.6 Semi-structured interviews with competence development teachers</td>
<td>What specific opportunities for pedagogic innovation do teachers perceive that the system offers?</td>
<td>Teachers</td>
</tr>
<tr>
<td></td>
<td>Can the system effectively support all the pedagogical approaches, which teachers want to use?</td>
<td>Teachers</td>
</tr>
<tr>
<td></td>
<td>Does the system provide an effective means of communicating competences? What improvements could be made?</td>
<td>Teachers</td>
</tr>
<tr>
<td></td>
<td>Is the assessment of competences effective and accurate? What improvements could be made?</td>
<td>Teachers</td>
</tr>
<tr>
<td></td>
<td>Do teachers find the representation of competences in the system easy to understand? What improvements could be made?</td>
<td>Teachers</td>
</tr>
<tr>
<td></td>
<td>Can teachers provide learning resources for learners easily and effectively? What improvements could be made?</td>
<td>Teachers</td>
</tr>
<tr>
<td>Can teachers provide <strong>learning activities</strong> for learners easily and effectively? What improvements could be made?</td>
<td>Teachers</td>
<td>3</td>
</tr>
<tr>
<td>Do the learning activities as they are carried out on the system match the intentions of the teachers?</td>
<td>Teachers</td>
<td>5</td>
</tr>
<tr>
<td>Is the representation of networks for LLL clear and sufficient for the needs of users? What improvements could be made?</td>
<td>Teachers</td>
<td>5</td>
</tr>
<tr>
<td>How well do users understand the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences?</td>
<td>Teachers</td>
<td>7</td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation?</td>
<td>Teachers</td>
<td>6</td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities?</td>
<td>Teachers</td>
<td>6</td>
</tr>
<tr>
<td>Which features of the system do users find most useful in organising and managing their activities?</td>
<td>Teachers</td>
<td>6</td>
</tr>
<tr>
<td>Does the user at any point have the perception that they are moving into a different application?</td>
<td>Teachers</td>
<td>7</td>
</tr>
<tr>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL?</td>
<td>Teachers</td>
<td>All</td>
</tr>
<tr>
<td><strong>7.7 Semi-structured interviews with HR managers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td>HR managers</td>
<td>6</td>
</tr>
<tr>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL?</td>
<td>HR managers</td>
<td>All</td>
</tr>
<tr>
<td>Does the system provide an effective means of communicating competences? What improvements could be made?</td>
<td>HR managers</td>
<td>4</td>
</tr>
<tr>
<td>Is the assessment of competences effective and accurate? What improvements could be made?</td>
<td>HR managers</td>
<td>4</td>
</tr>
<tr>
<td>Is representation of networks for LLL clear and sufficient for the needs of users? What improvements could be made?</td>
<td>HR managers</td>
<td>5</td>
</tr>
<tr>
<td>How well do users understand the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences? What improvements could be made?</td>
<td>HR managers</td>
<td>7</td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation?</td>
<td>HR managers</td>
<td>6</td>
</tr>
<tr>
<td>In what ways do users of the system use its features in organising and managing their activities? What improvements could be made?</td>
<td>HR managers</td>
<td>6</td>
</tr>
<tr>
<td>Which features of the system do users find most useful in organising and managing their activities?</td>
<td>HR managers</td>
<td>6</td>
</tr>
<tr>
<td>Does the user at any point have the perception that they are moving into a different application?</td>
<td>HR managers</td>
<td>7</td>
</tr>
<tr>
<td><strong>7.8 Semi-structured interviews with “peer users”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How well do users understand the relationship between learning resources, learning activities, competence development programmes, and networks for lifelong learning competences?</td>
<td>Peers</td>
<td>7</td>
</tr>
<tr>
<td>To what extent is the system perceived by users as being valuable in self-organisation? What improvements could be made?</td>
<td>Peers</td>
<td>6</td>
</tr>
<tr>
<td>Section</td>
<td>Question</td>
<td>Respondents</td>
</tr>
<tr>
<td>---------</td>
<td>--------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>4.1</td>
<td>In what ways do users of the system use its features in organising and managing their activities? What improvements could be made?</td>
<td>Peers 6</td>
</tr>
<tr>
<td></td>
<td>Can users provide learning resources for peers easily and effectively? What improvements could be made?</td>
<td>Peers 3</td>
</tr>
<tr>
<td></td>
<td>Can users provide learning activities for peers easily and effectively? What improvements could be made?</td>
<td>Peers 3</td>
</tr>
<tr>
<td></td>
<td>Do the learning activities as they are carried out on the system match the intentions of the peers who created them?</td>
<td>Peers 5</td>
</tr>
<tr>
<td></td>
<td>What is the impact on the management practice of organisations when they start using the system?</td>
<td>Peers 6</td>
</tr>
<tr>
<td></td>
<td>Does the user at any point have the perception that they are moving into a different application?</td>
<td>Peers 7</td>
</tr>
<tr>
<td></td>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL</td>
<td>Peers All</td>
</tr>
<tr>
<td>7.9</td>
<td>What set-up, administration and performance problems are there with the TENCompetence infrastructure. What improvements could be made?</td>
<td>Technical staff 7</td>
</tr>
<tr>
<td>8.</td>
<td>What problems do users encounter in using the system?</td>
<td>All users Technical staff 7</td>
</tr>
<tr>
<td>9.</td>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL</td>
<td>HR managers All</td>
</tr>
<tr>
<td></td>
<td>How does the provision of LLL change when the system is introduced to an organisation</td>
<td>HR managers All</td>
</tr>
<tr>
<td></td>
<td>How can the system be used to support pedagogic innovation, and how effective is it?</td>
<td>Teachers, Learning designers, Learners, Peers 1</td>
</tr>
<tr>
<td></td>
<td>How does the system support users in finding the best solution for their formal and informal learning problems</td>
<td>All users 2</td>
</tr>
<tr>
<td></td>
<td>How can the system be used to promote exchange of knowledge resources, and how effective is it?</td>
<td>HR managers All users 3</td>
</tr>
<tr>
<td></td>
<td>How can the system be used to establish a decentralized, self-organized and empowered management model, and how effective is it?</td>
<td>HR managers All users 6</td>
</tr>
<tr>
<td></td>
<td>How is the system used by organisations to meet their competence management needs</td>
<td>HR managers All users 4</td>
</tr>
<tr>
<td></td>
<td>How can the system be used to manage and implement competence development programmes, and how effective is it?</td>
<td>Teachers Learning designers Learners 5</td>
</tr>
<tr>
<td></td>
<td>How can the system be used to manage and implement competence development programmes and networks of LLL, and how effective is it?</td>
<td>Teachers Learning designers Learners 5</td>
</tr>
<tr>
<td></td>
<td>How can the system be used effectively to facilitate collaboration between peers in the development of LLL competences?</td>
<td>Peers 6</td>
</tr>
<tr>
<td></td>
<td>How well does the system perform in providing LLL, and how well does it integrate with other IT infrastructure.</td>
<td>Technical staff 7</td>
</tr>
<tr>
<td>Meta-analysis of evaluation results relating to competences</td>
<td>What variables can be identified in the degree to which the system successfully handles different categories of competences?</td>
<td>None</td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td>How does the effectiveness of the system vary in different organisational contexts?</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>In what ways and to what extent does the use of the TENCompetence infrastructure improve the provision of LLL</td>
<td>None</td>
</tr>
</tbody>
</table>

4.1 Articulating the domain for the pilot

The TENCompetence project has established collaboration with IP RACINE, an integrated project focused on the Digital Cinema production chain.

IP RACINE has produced an analysis of the professional roles and workflow in analogue and digital cinema. This has been of great assistance in analysing the competence domain to be addressed by the Digital Cinema, which can be divided into three areas:

- Production;
- Postproduction;
- Distribution and projection.

The different parts of this workflow are represented in the following graphic:

Digital Cinema Workflow (Copyright IP Racine)

This workflow is carried out by a large team of professionals, all of whom have training requirements, as set out in the following graphic:
### Candidate TENCompetence courses for Digital Cinema

The domain of competences for digital cinema defined in the previous section is very extensive, and involves a large number of competences. Of these the following aspects have been identified as being practicable and appropriate to address within TENCompetence:

- On Set Virtual Studio techniques
- Studio Illumination
- Colour Correction
- Editing
- Sound Design
- Audio Mixing (surround)
- Character Animation (+rigging)
- VFX Animation
- Keying and Rotoscopying
- Shader Artist/Rotoscopying

### The first TENCompetence Digital Cinema Pilot: On Set Virtual Set Studio Technician

In the first phase of the pilot it is planned to focus on one particular role: On Set Virtual Studio Technician. Extension of the pilot approach to other areas of the domain in later phases of the project should not prove to be too difficult, since:

- The initial pilot is situated within a well-articulated domain.
- The competences for the other actors in the domain are well defined using the same methodology as that used for the initial pilot.
• The relationships and workflow in which the various actors carry out their professional activities is well understood.

Extension of the pilot to additional areas would however raise additional aspects to be tested, such as the analysis and facilitation of professional trajectories through the competence space of digital cinema, and the representation of and navigation through related competences.

The pilot course aims to train professionals, for both the Television and Cinema industry, providing them with the competences required to working with Virtual Sets. The competences relate to the entire production process, including pre and postproduction.

**A brief introduction to Virtual Sets**

Virtual studios are an alternative to traditional studios in which real objects are replaced by virtual ones. The movements of a real camera are tracked and a virtual camera simulates the same movement. The resulting virtual picture can then be seamlessly mixed with the one provided by the real camera. In production a number of additional demands are made on the system, such as:

• Updating numbers and texts, object shapes and positions, colours and textures as user events or representing the data being received in real time.

• Reading or controlling mixers, lights, audio devices, video servers, etc., in sync with the evolutions of the Virtual Set.

• Executing many of the standard capabilities of commercial 3D packages, like animations, particles, morphing, deformations, etc, in real time.

• A wide range of demands generated by the creative work of directors.

Brainstorm (http://www.brainstorm.es/) specialises in the development of interactive real-time 3D graphics applications and is a leader in the field of virtual sets and on-air graphics for television and feature film production. The eStudio application to be used in the TENCompetence pilot is both a stand-alone application and a foundation for building 3D graphics solutions.

The applications of Brainstorm eStudio include:

• Elections: 3D graphics can be interfaced to external data, with the current totals of votes being turned into a graphical representation using 3D objects, textures, various colours, etc, together with logos or pictures of candidates.

• 3D Presentations. Corporate companies can use the same studio space to produce different shows with completely different branding in each one. These presentations often use PowerPoint or Excel, and these can be converted directly to 3D.

• TV Tickers: Sometimes there is a need to display changing data in a graphical form. For example financial data can be shown directly from a database or other source, and displayed in real time.

• Shopping channels: Graphics are linked directly to the channel’s database of products to be sold, and the setting changes each time the product changes.

• Virtual sets: Virtual sets are widely used for news, sports shows, interviews, chat shows, film reviews etc.

• Film pre-visualisation: The director can see a composite of the final shot rather than looking at a green screen during shooting.
4.2 The pilot competence development programme

During the design of the digital cinema pilot, we have defined a competence development program (CDP) entitled “virtual sets curriculum”. This CDP is designed to develop competences related to the virtual sets production process, including pre and postproduction. It is directed at the Television and Cinema industry professionals, principally television and cinema professionals, visual effects students and practitioners, stage designers.

The aim is for the learners to acquire competences in

- creating a virtual set;
- assisting the director in shooting tasks by providing him with real-time pre-visualization of the virtual set;
- refining, setting up, and rendering the virtual set for the final composition.

In order to enrol in the virtual sets curriculum, a learner must possess a minimal set of related competences required to ensure that s/he can:

a) understand the curriculum. This involves expertise in stage design and composition.
b) carry out learning activities in the digital environment used in the course.

These competences are low proficiency basic computer competences: computer operation, classic internet applications, and text editors. No special computer skills are required.

The learning path associated with the virtual sets curriculum is composed of five competence development programs (CDPs) being:

- blue screen shooting;
- framing and camera movement;
- 3D techniques for modelling;
- editing, and rendering animations, cinema composition;
- brainstorm eStudio usage.

The learning path’s composition in terms of precedence relationships among the CDPs is subject to preconditions such as the facts that framing and camera movement CDP is a prerequisite of blue screen shooting.

The blue screen shooting CDP addresses three competences that enable the preparation of the blue screen stage for shooting, understanding the operability of the shooting equipments, calibrating virtual equipments with real ones on the stage, and others. The framing and camera movement CDP assures only one competence that concentrates on match moving theory and setting the camera movements’ tracking systems. The 3D techniques CDP encompasses a set of image editing and manipulation techniques distributed on five different competences dealing with polygonal modelling, UV mapping, advanced texturing, basic real-time rendering, and advanced rendering consecutively. The composition CDP provides learner with a single competence that covers composition and colour correction theory as well as experience in composing live action shots with computer-generated images. Finally, the brainstorm eStudio CDP teaches the competences associated with the usage of this application. It helps the learners to acquire the competence of setting up advanced virtual sets using eStudio.
Competence Development Programmes (CDPs)

- **Blue Screen Shooting**
  - **Advanced Blue Screen Stage Set-up**
    Description: Ability to prepare a blue screen stage for shooting, making the camera tracking process easier.
  - **Basic Camera Usage**
    Description: Knowledge of the shooting equipment and ability to use the camera for live action shooting.
  - **Advanced Camera Sensors Calibration**
    Description: Ability to connect the shooting equipment to the virtual set software and calibrate the system in order to synchronize the real camera with the virtual one.

- **Framing and Camera Movement**
  - **Advanced Camera Tracking**
    Description: Knowledge of match moving theory and ability to set-up a tracking system in order to retrieve the camera movements.

- **3D Techniques (modelling, texturing, shading, illumination, rendering and procedural animation)**
  - **Basic 3D Polygonal Modelling**
    Description: Ability to build optimized tri-dimensional meshes that represent scenic objects taken from the real world or from drawings.
  - **Proficient UV Mapping**
    Description: Ability to unwrap the UV coordinates of a three-dimensional object, in order to prepare the texturing process.
  - **Advanced Texturing**
    Description: Ability to create a wide range of textures for the representation of the meshes’ surface’s colour.
  - **Advanced Rendering**
    Description: Knowledge of the image rendering systems and ability to correctly set-up the render engine, in order to obtain a static image or a sequence of images of the virtual stage. Ability to generate a pre-rendered version of the scene’s textures.
  - **Basic Real Time Rendering**
    Description: Ability to create an interactive representation of the virtual set.

- **Composition (chroma key, tracking, color correction)**
  - **Proficient Compositing**
    Description: Knowledge of compositing and colour correction theory and ability to compose live action shots with computer generated images.
• Brainstorm eStudio Usage
  • Advanced Virtual Set Set-up (Brainstorm e-Studio)
    Description: Ability to use the Brainstorm’s e-Studio software in order to produce a real-time visualization of the integration between the live action shoot and the virtual set.

### Competences

- **Basic 3D Polygonal Modelling**
  Description: Ability to build optimized tri-dimensional meshes that represent scenic objects taken from the real world or from drawings.

- **Proficient UV Mapping**
  Description: Ability to unwrap the UV coordinates of a three-dimensional object, in order to prepare the texturing process.

- **Advanced Texturing**
  Description: Ability to create a wide range of textures for the representation of the meshes’ surface’s colour.

- **Proficient Lighting**
  Description: Ability to choose the correct type of virtual lights and set-up them, in order to transmit the correct emotions to the audience.

- **Advanced Rendering**
  Description: Knowledge of the image rendering systems and ability to correctly set-up the render engine, in order to obtain a static image or a sequence of images of the virtual stage. Ability to generate a pre-rendered version of the scene’s textures.

- **Basic Real Time Rendering**
  Description: Ability to create an interactive representation of the virtual set.

- **Proficient Compositing**
  Description: Knowledge of compositing and colour correction theory and ability to compose live action shots with computer generated images.

- **Advanced Camera Tracking**
  Description: Knowledge of match moving theory and ability to set-up a tracking system in order to retrieve the camera movements.

- **Advanced Blue Screen Stage Set-up**
  Description: Ability to prepare a blue screen stage for shooting, making the camera tracking process easier.

- **Basic Camera Usage**
  Description: Knowledge of the shooting equipment and ability to use the camera for live action shooting.

- **Advanced Camera Sensors Calibration**
  Description: Ability to connect the shooting equipment to the virtual set software and calibrate the system in order to synchronize the real camera with the virtual one.

- **Advanced Virtual Set Set-up (Brainstorm e-Studio)**
  Description: Ability to use the Brainstorm’s e-Studio software in order to produce a real-time visualization of the integration between the live action shoot and the virtual set.
Curriculum as planned (6 courses):
The advertised curriculum includes the five competence development programs along
with a sixth introductory course on E-Learning tools foundations

E-LEARNING TOOLS FOUNDATION (Introduction to the system) 2 hours

VIRTUAL SETS FOUNDATION (History and applications) 10 hours
- Background Production
- Pre-visualization (SFX Shooting Assistance)

SCHEME FOUNDATION 20 hours
- Abstract, Storyboard, Concept Image and Layouts.

SET DESIGN 20 hours
- Digital Architecture rules and Floor plans

VIRTUAL SET PRODUCTION 140 hours
- Modelling
- Texturing
- Rendering
- Integration: Photoshop, 3D application, eStudio and UtilitiesB

ROADCAST and Cinema Production 18 hours

4.3 Practical aspects of the pilot

Knowledge resources
The materials will be developed in English to maximise reusability. The content itself
will be provided by the IP-Racine, and TENCompetence will provide support in
digitising classifying and publishing it on the project infrastructure. The knowledge
resources will be developed in September, October and November 2006.

Learning activities and roles (UML diagram)
A UML diagram has been prepared which specifies the roles to be taken in the pilot,
and the flow of activities. Readers with access to the TENCompetence project server
can find this at
http://www.tencompetence.org/file.php/15/Pilot_planning/Phase_1/pilotUML/Virtual
Sets.htm

Learner profile
The course is aimed at cinema professionals who would like to obtain competences
required in order to become On Set Virtual Set Technicians. This is a particularly
appropriate target group because there is a shortage of skilled professionals, and
hence a demand for a competence development programme. The users will have
technical skills in cinema, but not necessarily in digital technologies, beyond basic
computer skills. It is planned to produce the course materials in English, and so
comprehension of English will be essential. The course activities can be carried out in
English or Spanish, depending on marketing decisions and availability of teachers.
The learners will be widely distributed, as the course will be largely distance learning,
with only two weekend in person sessions (or equivalent). All participants will be
expected to pay a registration fee in order to participate in the course.
There are two pools of learners that we are targeting at the moment:

- Postgraduate Students from the UPF.
- AV Digital Content Producers, Postproduction artists and technicians, set designers, broadcast and cinema art directors or 3D Artists.

The targeted number of students for the course is between 20-30 persons at the moment. If demand on the course is more than that, and if the servicing architecture allows it, we might consider augmenting the number.

**Location of learners and teachers:**
Teachers will be located at the UPF and can work locally with the machines servicing the learning activities. Students connect remotely to the servers from within the UPF (or from outside if needed). The courses require high-speed ADSL connections for live broadcasting and remote desktop applications.

**Technical and functional support structure**
Technical support for the pilot will be provided by WP3, who will ensure that the server provides a high quality service, and will provide support for the installation and user problems with the client. The IP-Racine team together with the TENCompetence WP4 pilot team will provide the functional support structure required to deliver the competence development programme.

### 4.4 Activity and time plan for the digital cinema pilot

<table>
<thead>
<tr>
<th>Activity</th>
<th>Jun 06</th>
<th>Jul 06</th>
<th>Aug 06</th>
<th>Sep 06</th>
<th>Oct 06</th>
<th>Nov 06</th>
<th>Dec 06</th>
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<td>Define detailed sessions</td>
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**Detailed pre-launching plan:**
First Period: Preparation of L.D. strategy and materials
- Create CDPs, Competences, and Competence Development Map
- Compose different acceptable learning path descriptions (WP7)
- Create Curriculum
- Design registration policy
- Prepare and publish marketing materials
- Open registration (1 November)

Second Period: Content Development and architecture design (1 Nov. 2006)
- Compose the CDPs digital content
- Develop assessment methodology
- Compose help documents and video

Third Period: Integration, testing, and primary evaluation (25 Nov. 2006)
- Integrate functionalities (WP3)
- Evaluate integration and robust testing
- Launching (1-February)
5. Cycle 1 ICT Training pilot: Initial pilot implementation

5.1 Pilot description

A number of surveys in the domain of the labour market identify as crucial and essential for the knowledge-based economy the ICT-skills and the so-called “soft skills”, such as information and knowledge articulation and presentation, information search, gathering, evaluation, and effective use, project working, team working, problem solving, and competences for life-long learning. These soft skills can be considered to be an essential part of the ICT skills of every citizen and worker, and in this respect we can speak about enhanced ICT-skills.

This pilot tries to show how TENCompetence framework and approach can be used for the implementation of the innovative and complex training methodology, developed in the frame of the Leonardo project The Innovative Teacher project (I*Teach). This project develops practical methodology, approaches and tools targeted at day-to-day utilization by the teacher trainers and teachers of four identified enhanced ICT competences in their work. These four enhanced ICT competences are information, presentation, working on a project, and working in a team.

As a result, teachers have to obtain new competences. This particular pilot will be used for the training of Bulgarian in-service teachers in order to obtain these new competences. During next three years, Bulgarian ministry of education is performing massive educational reform aiming to improve the use of ICT in schools. There are several national government-funded programmes for training and re-training of in-service teachers. This is a great opportunity to test the TENCompetence platform in combination with the methodology and training resources developed by I*Teach project, in order to prove the significance, usability and effectiveness of it’s use in a complex authentic learning settings. University of Sofia is involved as one of the main participant in these training programmes, so the use of the TENCompetence platform will be easy and natural, as it is completely fitting to this case. Our partners (and possible associate partners for TENCompetence) will be the Ministry of Education, as well as some other Universities and training centres.

The domain of Teacher training how to use ICT in teaching provides rich opportunities for testing the TENCompetence system. This pilot project has established a strategic partnership with the Leonardo project I*Teach, which is addressing the field of teacher training, identifying enhanced ICT competences, development of methodology handbook, and rich set of training programmes and resources. The main goal of the pilot will be to adapt the training methodologies and curricula in order to use the TENCompetence framework, and to evaluate both the I*Teach methodology, as well as TENCompetence framework.

Thus the Teachers training in using ICT domain is challenging in a number of ways, which provide rich opportunities for validating the TENCompetence infrastructure, both in the Cycle 1 pilot and in later phases of the project.
1) **There is real and urgent need for development of new competences – enhanced ICT competences.** In order to face the challenges of the new education paradigm, the definition of Enhanced ICT-competences needs to be developed, and key pedagogical concepts, methodologies and practices concerning Enhanced ICT-competences teaching has to be identified. On the base of this new theories and pedagogies, methodological handbook and training framework has to be developed and implemented.

2) **Teacher training involves the definition, development and management of a complex recursive set of competences.** First of all, we need to train the pedagogy experts about the new education metaphor – enhanced ICT competences. Then, we need to train teachers and teacher trainers how best to acquire these enhanced ICT competences. And, finally, we need to teach them how to teach others (pupils, other teachers) on acquiring enhanced ICT competences. This recursive process involves different professionals, each with their own set of competences, which are highly inter-related and dependent on each other.

3) **The competences required by the teacher training how best to use ICT are fast developing and changing.** The use of traditional methods is rapidly changed by the inquiry of new methods, based on the use of ICT. In such a way ICT becomes also new learning and teaching medium.

As these changes become introduced very fast and constantly, the competences definitions for the domain also need to be changed, providing a challenging environment for testing the TENCompetence infrastructure for managing competences.

4) **The training is based on the flexible and learner-centred schemes.** There are several possible training schemes, each one oriented to support on-the job training. The main principle of the training is to be done at the authentic environment, following the needs and abilities of the trainees. The use of E-learning and distance education infrastructures is a necessity.

5) **The training is oriented to the strong use of community of practices and learning networks.** The social interaction and group work is the main instrument in the training of the new enhanced ICT competences. This means that TENCompetence framework is best suited to meet the training needs of the domain.

### 5.2 The pilot competence development programme - Enhanced ICT competences

There are four main competence development programmes included in this pilot:
1. Teaching information skills using ICT
2. Teaching presentation skills using ICT
3. Teaching working on a project skills using ICT
4. Teaching working in a team skills using ICT
The first one – how to teach information skills - includes the following sub-competences:

1. teaching the ability to determine the information problem
2. teaching the ability to identify the relevance of the various information sources
3. teaching systematic search by application of relevant searching techniques
4. teaching how to localize and acquire the found information
5. teaching how to evaluate the found information and (if necessary) to readjust the search
6. teaching how to process the found information effectively, in order to reach the preset goal
7. teaching how to use the found information ethically and legally

The second one – how to teach presentation skills – includes the following sub-competences (skills):

1. teaching how to order and select information
2. how to teach language proficiency
3. how to teach the building of a presentation
4. how to teach presentation design
5. how to teach the ability to account for information
6. how to teach the ability to use the proper tool properly

Four sub-domains have been identified with specifics of the presentation skills.

a. Written presentation
b. Oral presentation
c. Short presentation
d. Web presentation

Here follows a specification of the presentation skills per domain:

Written presentation:

1. how to teach the ability to order and select information
2. how to teach the command of the language
3. how to teach the ability to build up a report
4. how to teach the ability to lay-out a report
5. how to teach the ability to make correct references and citations
6. how to teach the ability to use a word-processor properly

Oral presentation:

1. how to teach the ability to order and select information
2. how to teach the fluency in the language
3. how to teach the ability to build up an oral presentation
4. how to teach the ability to design an oral presentation
5. how to teach the ability to make correct references and citations
6. how to teach the ability to use a presentation tool properly
7. how to teach the ability of public speaking

Short presentation:

1. how to teach the ability to order, select, and compress information
2. how to teach the command of the language
3. how to teach the ability to build up an short presentation
4. how to teach the ability to lay out a short presentation
5. how to teach the ability to make correct references and citations
6. how to teach the ability to use a desk top publishing tool properly
7. how to teach the ability to focus on the target group

Web presentation:

1. how to teach the ability to order and select information
2. how to teach the command of the language
3. how to teach the ability to build up an web presentation
4. how to teach the ability to design a hyper structure
5. how to teach the ability to make correct references, citations, and links
6. how to teach the ability to use a web publishing tool properly
7. how to teach the ability to select and use multi media

The third one – how to teach working-on-a-project skills – includes the following sub-competences (skills):

1. how to teach the ability to identify tasks and subtasks
2. how to teach the ability to make a planning
3. how to teach the ability to divide tasks
4. how to teach the ability to communicate internally
5. how to teach the ability to communicate externally
6. how to teach the ability to keep track of the progress
7. how to teach the ability to integrate results
8. how to teach the ability to use the proper tools properly

The fourth one – how to teach working-in-a-team skills – includes the following sub-competences (skills):

1. how to teach the ability to communicate internally
2. how to teach the ability to communicate externally
3. how to teach the ability to give feedback
4. how to teach the ability to receive feedback
5. how to teach the ability to resolve conflicts
6. how to teach the ability to support the team loyally, as a good colleague
7. how to teach the ability to take responsibility

In general, communication skills can be seen as the basis for all of the other skills. Most of the presentation skills are also used and are necessary while working on the development of working on a project or working in a team skills. The last two major skills also share some common sub-skills.

The I*Teach project is currently working on the development of detailed map of links, relations and dependencies between all skills and sub-skills, which will be available at the end of this year.
5.3 The ICT Training Pilot’s Pedagogical Approach

The pedagogical approach is based on applying active learning methods (see Figure 1):

- Learning situations should recall problems and methodologies adopted in professional contexts. Authentic tasks should be presented, combining two different approaches (see Figure 2):
  - tasks of interest for the students;
  - task allowing to connect with the extra-scholastic world.

**Example**

_Aim_: To increase motivation, by proposing, within the learning of a well defined topic, tasks of real interest

_Problems_
- Creation and maintenance of the school journal, or of a forum on a topic of interest
- Creation and maintenance of the school web site
- Evaluation of usability of a web site
- Peer review activity

**Figure 2.** Examples of learning situations

- Activities should be **flexible** enough to allow their adaptation (to some extent) to different time needs, learning difficulties, abilities involved, ... This is needed for the development of project working abilities at different levels of complexity (see Figure 3)
Activities should suggest **interdisciplinary** connections and collaboration, to be representative of actual project working, where usually it is required to integrate different capabilities and competences (see Figure 4).

**Example 1**

*Aim:* To help students acquire cognitive and metacognitive capabilities of envisioning a problem in its whole, recognising the different aspects, understanding their mutual dependences, planning a solution; social capabilities of learning from each other, integrating different view, ...

*Activity*

Prepare a presentation about ‘The house in ancient Rome’, analysing the problem from both the historical and the architectural points of view

**Example 2**

*Aim.* To help students identify similarity and differences of situations, work out common methodologies, plan a negotiated solution

*Activity*

>**Individual work**
- Prepare an annotated sitography about ‘web resources for learning English’
- Prepare an annotated sitography about ‘Web resources for learning French’

>**Work in pair:** Read and comment the sitography prepared by your mate. Devise a common procedure for preparing an annotated sitography about ‘Web resources for learning a foreign language’

>**Classroom discussion** Can the proposal be extended to learning other languages? Is the proposal apt to students of different languages and cultural backgrounds? ..

**Figure 3.** different approaches to the development of a project working ability

**Figure 4.** Examples of project working oriented activities
Suitable **scaffolding** should be provided, and should be adapted to the students’ level of performance. Scaffolding is a metaphor introduced by constructivist researchers, and refers to the student-teacher interactions that produce learning [Wood, Bruner, & Ross 1976]. Scaffolding is related to Vygotsky’s studies about *the zone of proximal development*, that is the zone between what someone can do by himself, and what someone can do with the expert’s help [Vygotsky 1978]. In practice, scaffolding refers to all kinds of stimuli, suggestions, supports intentionally aimed to help students to tackle a task [Jonassen, Mayes & McAleese 1993]. Scaffolding is crucial in supporting students to become an active part in constructing learning [Rasku-Puttonen, Eteläpelto, Arvaja & Häkkinen 2003]: all activities, and tools provided to carry out them, should be organised taking into account this fact. Examples of scaffolding tools aimed to facilitate the learning of project working abilities are given in Table 1; different types of scaffolding are considered, together with examples of possible developments and tools.

Activities should be **clearly presented** to students, in order to increase motivation, connect the work to previous knowledge, prevent disorientation. The teacher must describe objectives, prerequisites, abilities and content expected to be learnt as a result of the work, and he-she must give any information about time needed, tools provided, overall organisation, task to be completed, and evaluation.

Activities should **integrate the learning of specific competences** (content, methods and tools) **with that of working in a project**, that is to handle and articulate a problem, to actively participate, with different roles, into planning, monitoring, evaluating and adjusting its execution, taking into account views and contributions of all involved into the project. This includes (group) evaluation, self-evaluation, reporting activities, collections of good practice, discussions, organisation in subtasks of a complex work, …

### Table 1. Types of scaffolding, related examples and tools

<table>
<thead>
<tr>
<th>Scaffolding type</th>
<th>Examples</th>
<th>Tools</th>
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<tbody>
<tr>
<td><strong>Motivational Scaffolding</strong></td>
<td>- Presentation of the activity and of its objectives</td>
<td>Personal feedback</td>
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<tr>
<td>Supports motivation, self-confidence, …</td>
<td>- Examples already developed</td>
<td>Careful classification of the activity with respect to the abilities involved</td>
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<td></td>
<td>Opportunity to access repositories of examples and problems already solved</td>
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<td></td>
<td>Electronic mail</td>
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<tr>
<td><strong>Procedural scaffolding</strong></td>
<td>- Introductory explanation of tools to be used, meaning and opportunities of their use</td>
<td>Guides/help to the use of the electronic tools provided</td>
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<tr>
<td>Supports the proper use of resources and tools</td>
<td>- Activities dedicated to practice with tools</td>
<td>FAQ service</td>
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<td>Electronic mail</td>
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<tr>
<td><strong>Cognitive Scaffolding</strong></td>
<td>Manipulation and analysis of a problem from different points of view:</td>
<td>Simulation tools</td>
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<td>Supports to reasoning and to the construction of perspectives on a</td>
<td>- Guidelines to the organisation of a problem in subtasks</td>
<td>Calculation instruments</td>
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<td>Electronic communication tools</td>
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### 4.1 Pilot Evaluation Plan

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<tr>
<th>competency area</th>
<th>tasks</th>
<th>tools</th>
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<tbody>
<tr>
<td>project/problem, identification, formulation, organisation of tasks</td>
<td>- Exercises aimed to evaluate the effect of a choice on other choices</td>
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<td>- Exercise aimed to help to find out resources</td>
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<td>- Questions aimed to orient a group activity regarding the structuring</td>
<td>Simulation tools, Presentation tools, Calculation instruments,</td>
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<td>of a project</td>
<td>Systems for document management, Electronic communication tools,</td>
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<td>Discussion lists, Portfolio, Cahier de board</td>
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<td>Metacognitive Scaffolding</td>
<td>In-progress exam of the work carried out. Guide work to:</td>
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<td>Supports self-regulation, control, monitoring and evaluation</td>
<td>- Analysis of the material at disposal</td>
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<td></td>
<td>- Integration of different solutions to similar problems</td>
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<td>- Integration among different parts of the same problem</td>
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<td></td>
<td>- Self-evaluation and peer review</td>
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<td>- Comparison between different solution proposals</td>
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<tr>
<td>Strategic Scaffolding</td>
<td>Planning complex activities/projects</td>
<td>Knowledge management tools (including documents, agenda, news service,</td>
</tr>
<tr>
<td>Supports planning, organisation and work control and integration of results</td>
<td></td>
<td>group management)</td>
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<td>Group management software</td>
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</table>

### 5.4 I*Teach methodology

The I*Teach methodology is based on Project and Problem based learning methods. The methodology idea is: to develop some competence, trainee should build all the needed ICT-enhanced skills through **continuous, repeatable and gradually accumulated experiences** and **expanded activities** leading to concrete **goals** by performing specific **tasks** in different **context**. The **goals** expected to work on some core skills and to be a **challenge** for the students and coming from a real live - not just a problem for somebody in the world. As in real live necessary skills to go to the final goal are complementary. That is why the idea of methodology is that ICT-enhanced will be build interweaving during the path to the goal.

The I*Teach methodology tries to find the **balance** between the full freedom (involving the risk of being lost in the jungle) and the full direction (following your master by leash and not being let to explore the environment).

**Educational scenarios** are foreseen as a **methodological framework**.

**Scenario**

The **scenario** is a composition of tasks in the context of an active learning environment leading the students to a general goal (producing a specific product).
via a path (working/learning process) **traced by milestones** (intermediate objectives/stages of the product development).

**At each milestone** pupils are expected to have **finished a concrete stage of the product development** and **mastered a concrete skill**.

By passing along the set of milestones the students/pupils would hopefully build up a set of *ICT-Enhanced Skills naturally interweaved* with predetermined teaching objectives.

Each stage/phase could be completed by completing a task or list of tasks.

Certain fragments (phases and tasks) are given in variants so that the teacher could provide their students/pupils with a **flexible choice**.

Depending on age and experience of student/pupils:

- when I*Teach methodology is applied with smaller or less experienced pupils **milestones** could be established **frequently**.
- when I*Teach methodology is applied in class with bigger or more experienced pupils **milestones** could be established **rarely**.

### Task

The **task** is a **building element of a scenario**. Performing concrete task student/pupil will **work on concrete skill(s) or sub-skill(s)**. Describing the scenario as composition of tasks ensuring **reusability in different contexts**.

Task is consequence of activities with concrete outcomes.

Depending on age and experience of student/pupils:

- in case of work with smaller or less experienced pupils list of tasks could be spited in more activities (more detailed description of path which pupil should go).
- in case methodology is applied in class with bigger or more experienced pupils tasks could be in more activities (more detailed description of path which pupil should go).

### Knowledge resources repository

All the tasks and scenarios are stored in a central knowledge repository. The main functionalities of the repository system are listed bellow:

- **Manage RO (Repository Object)**\(^8\) in repository: Management of the pool of repository objects (tasks and scenarios) – create, store, edit, evaluate, translate, delete RO, and support corresponding links between tasks and scenarios. RO are described by templates (scenario and task description templates). The system should allow both online and offline development of RO. In online development of scenario RO, users fill up corresponding RO template using web forms (based on templates for description of scenario and task). In offline creation scenario RO, users upload RO as `.rtf` file, orXML document (which should be validated according to the xsd schema based on given templates for scenario and task), and the system should automatically extract and store this RO in the database. Each RO should be available for download. Users should be able to download a given scenario as an archive, with all the tasks included.

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\(^8\) By RO we mean scenario or task objects.
in it (the system should be able to generate this zip archive automatically, with scenario and it’s tasks description data in rtf or pdf format for example).

- **Search for RO Module**– Users should be able to search for RO by different criteria/filters according to the search requirements.
- **Registration and User management Module**.
- **Notification Module** – All users with assigned role teacher should receive automatically notification via e-mail (*once per month*) for all the newly created RO in the repository. Also the teacher should receive notification via e-mail when an evaluator post his comments on teacher's RO, and should respond as necessary. Additionally, when a user logs in to the system, a notification is given on his/her Home page, about newly created RO in the system, and which one are for evaluation, for editing, and for approval, according to the user role.
- **Communication Module** – Users should have the possibility to discuss common problems (discussion boards based on subjects).

In the repository each task is seen as an independent unit that can be used for building a scenario. The task should be reusable object and should have possibility to be used in different scenarios.

The repository should keep tasks separately from scenarios, but scenario should keep links to each task that is used in it. When user downloads a scenario, the file should contain description of scenario together with the description of each task used in it. For each RO in the repository one of the two meta-data types will be kept, depending on the type of the RO (task or scenario)

Some meta-data for the scenario object will be inherited automatically from the task objects that are used in this scenario (see scenario description template).

All meta-data are extracted automatically from the scenario and task template description (all fields marked with asterisk are metadata).

Here we give descriptions of all metadata fields:

- Title
- Author(s)
- Evaluator(s)
- Abstract
- Key words
- Language
- Age of pupils
- Subject(s)
- Recommended duration
- Enhanced ICT skill working on
- Type of work – meta-data for task which shows whether the task is for individual or in team work.
- Translated on language – keep information on which language the RO is translated and it is used as a connection between original RO and its translations.
- Adaptation – keep information about how much adaptation on RO are made and it is used as a connection between original RO and its adaptations.
- Status – show state of RO. The status of RO is described in section 4
Each RO in repository takes up one of the following states:

- **New** – the RO is just created/uploaded in the system and it is not evaluated yet.
- **In evaluation** – when one teacher takes the RO to evaluate it. The RO in this status can not be changed until author receives evaluator’s comments/remarks.
- **Evaluated** – the RO is evaluated, i.e. the author is received the reviewer’s comments.
- **Edited** – based on the evaluation author edit the item.
- **Final** – evaluator can make RO final when he approve the revised edition of the RO or return it to author to edit it again.
- **Used** – a teacher apply scenario in practice or tasks is used in scenario. In this case the RO can not be changed, it can only be adapted.
- **Translated** – a meta-data that keep information in which language this RO is translated. RO marked as translated can not be changed, it can only be adapted.

RO’s state is a meta-data field, that is changed, according to some users’ activities.

There are four different roles identified: guest, teacher, moderator, and administrator. It will be good to have a role student in the system. Each user can be in one of the roles listed above. The role and their privileges are described below. By default, the teacher role is assigned to an registered user. Administrator (or moderator) can change role the from teacher to moderator.

**Guest** – registration is not necessary. User with this role can:

- Search for RO with status final
- View RO with status final
- Download RO with status final

**Teacher** – needs registration. The teachers can manage the RO:

- All guest’s activities
- Create RO
- Edit own RO
- Adapt RO, created by another teacher
- Evaluate RO, created by another teacher and post reviewer’s comments.
- Approved (as a final) or return for editing, RO evaluated by him
- Delete own RO, which has not been evaluated yet or used
- Edit his profile
- View others profiles – name, languages, domain of expertise, and e-mail address
- Post comments with samples of students’ work to RO.

**Moderator** – member of National Virtual Training Centers / I*Teach team (needs registration). Users with role moderator can manage the RO published by teachers from his country

- All teacher’s privileges
- View all RO (newly created, evaluated, edited) from his country
- Distribute new RO to the teachers (from his country) for evaluation
- Return RO with status final (from his country) for additional editing
- Approved (as a final), RO that he return to author for editing
4.1 Pilot Evaluation Plan

- Delete RO (from his country) from repository

**Administrator**
- Manage all moderator’s privileges
- Manage all users
  - Authorize user as moderator
  - Remove user

5.5 *Narrative Scenarios descriptions*

The learning process will take place in an authentic environment. It will start with short face-to-face meetings aiming to give the main idea for the I*Teach methodology, to present the software environment (TENCompetence framework, I*Teach knowledge repository and any additional software tools needed), and to present the time schedule and main actors in the learning process. After that all teachers will continue with their learning in their own authentic environment. They will have access to the TENCompetence framework, and through this framework they will be able to learn and work co-operatively with their colleagues, and will have also constant connection with their trainers. They will use the I*Teach knowledge repository for finding useful examples and case studies, for sharing the results of their work with other teachers and with their mentors, as well as to work co-operatively in a team or on a project.

There were only three main roles involved: teachers (actual learners in the environment), mentors (experts giving help and support to teachers in respect to the I*Teach methodology) and moderators (experts giving help to teachers with respect to TENCompetence framework and other software tools).

The teachers’ curriculum will be formed by several methodological handbooks, describing how the teacher has to teach enhanced ICT skills. All teachers will be involved in various learning activities during the learning process. The learning process will be actively supported by the Knowledge resources repository. The repository will collect scenarios and tasks (reusable learning resources), which will be main building blocks, used by teachers in their practical activities.

The learning process will follow the following schedule:
1. **Face-to-face session (two days) aiming to:**
   a) Present the main ideas of the I*Teach methodology (four hours)
   b) Present the knowledge repository, main repository objects, and how to work with the repository (four hours)
   c) Present the TENCompetence framework and client, and short training how to use it (four hours)

2. Individual work in authentic environment using the TENCompetence framework aiming to:
   a) Identify the teacher’s competence level and define the needed learning path
   b) Follow all the needed Units of Learning in relation with the individual learning path
   c) Participate in all the planned group activities and team work
d) Use the knowledge repository for inspiration from previous developed
learning materials, sharing results with other teachers, joint work on a project
with other teachers, storing final products in a repository
e) Perform evaluation of own results as well as results from other teachers

3. Final face-to-face session (two days) aiming to:
   a) Present the main results achieved by teachers
   b) Discuss the strong and weak points of the methodology and Repository
   c) Discuss the strong and weak points of the TENCompetence framework
   d) Discuss the plans for the further pilots with teachers acting as trainers in an
      authentic environment, aiming to train pupils and/or lifelong trainees

The learner will follow the learning path as formed by the TENCompetence system.

The learner will use all the collaborative learning components (for sharing products
and documents with others, for looking for help and orientation, as well as for
performing the planned group activities) and most of the individualised learning
components (reading, writing, assessment, personal navigation) from the system.

**Characteristics of the learning process**

Pilot training courses are based on the cascade model. They will be first organized for
teacher trainers, pre-service and in-service teachers. Later on it is expected, that all
teachers will apply the same methodology in their own authentic environment, and
will perform pilot training for pupils and/or lifelong trainees. The first pilots (with
teachers as learners) will be implemented in the beginning of year 2007, during the
first TENCompetence cycle pilots. They will be used to test, evaluate and revise the
developed methodology and associated tools and instruments, to guarantee their
effectiveness, added value, and sustainability from beneficiaries’ (teachers and
teacher trainers) point of view.

At least 20 pre-service and in-service teachers will test the Methodology described in
the Handbook and will be pilot-trained to apply the developed methodologies and
produced teaching and learning instruments (e.g. templates for activities, assignments,
and assessments).

At the first training step the trained teachers will learn how to use the methodology,
handbook, and the online repository in their teaching and will assess and provide
feedback on the quality, practicality, and usefulness of the methodology, handbook,
and the repository. Following the methodology, the teachers will produce a number of
learning tasks (activities, assignments, and assessments) for classroom use with their
students in teaching the enhanced ICT-skills.

At the second step – piloting the methodology and handbook with pupils, the teachers
will assess in the real classroom practice the quality, usefulness and value of the
methodology and the handbook. They will collect feedback on the base of the
delivered and experienced (attained) curriculum and enhanced ICT-skills in the
classroom. The developed by teachers learning tasks will be used in the classroom
teaching. This second step pilots are expected to be performed in the 2007/2008
teaching year, during the second cycle of the TENCompetence pilots.
The curriculum will be developed on the base of the first prototype version of the Handbook and the respective methodologies and teaching practices, developed in the I*Teach project.

The learning process will follow the active learning approach.

The following learning activities are related to active learning:

- Carefully constructed activities, which range from groups of students discussing material during a calculated pause in a lecture, to role-playing, case studies, group projects, and seminars.
- It is about learning from doing, performing, and taking action. The action can be either mental (e.g. reflection) or physical (e.g. case study). It uses such devices as games, simulations, introspection, role playing.
- In active learning, students are much more actively engaged in their own learning while educators take a more guiding role. Related terms/concepts include: experiential learning, hands on learning.
- Systematic process of reflection on action, for the purpose of developing skills and competencies.
- Active learning involves reading, writing, discussion, and engagement in solving problems, analysis, synthesis, and evaluation. Active learning is also known as cooperative learning.

Technical and functional support structure

Technical support for the pilot will be provided by WP3, who will ensure that the server provides a high quality service, and will provide support for the installation and user problems with the client. The functional support structure required to deliver the competence development programme will be provided by the I*Teach project team together with the TENCompetence WP4 pilot team.

5.6 Functional Requirements:

We expect the following components and/or functionalities to be provided by WP3:
- Components for developing Units of Learning in respect to LD specification
- Run-time environment for playing Units of Learning
- Components for providing co-operative learning activities – at least online group discussion boards, ability to share and work co-operatively on documents, chat.
- Ability to connect the TENCompetence framework with external knowledge repository (possibly based on xWiki or Moodle) – in order to search, browse, store and retrieve knowledge repository objects (MS Office documents)
- Ability to make assessment of the learner in order to position the learner regarding the competence development program (peer assessment, 360 degree feedback, portfolio assessment)
- Ability to make assessments of the learner’s achievements after studying a set of Units of Learning (peer assessment, 360 degree feedback, portfolio assessment)
- Ability to use questionnaires for making the assessments (to create a questionnaire, to send questionnaire to the respondents identified, to collect the filled questionnaires, and to offer some simple support for grading of the questionnaires)

If some of the expected functionality is not available, we have to be able to supplement it with identified external open source products (candidates to be included as components in the TENCompetence framework in cycle 2)

5.7 Non-Functional Requirements:

Should be not problem, as the load on the system is expected to be substantially lower than by the users of the Digital Cinema pilot. There will be no more than 20 users of the system, they will not need any sophisticated software and bandwidth. If WP3 needs some specific measures regarding the non-functional requirements, we will provide them.

5.8 Aspects of TENCompetence evaluated by the pilot

<table>
<thead>
<tr>
<th>TENCompetence aspect</th>
<th>TEN-Competence product</th>
<th>Proposed additional validation by the pilot</th>
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<tbody>
<tr>
<td>1) new, promising, innovative pedagogical approaches for lifelong competence development, supported by the TENCompetence infrastructure.</td>
<td>Integrated prototype. Learning resources and activities prepared for the pilot.</td>
<td>In the additional SU pilots we are planning to involve new innovative pedagogical approaches – active learning, and concept and skill based approach for soft skills acquisition (I*Teach project approach and methodology).</td>
</tr>
<tr>
<td>2) tools to support individuals, groups and organisations in Europe to find the best solution for their formal or informal learning problem.</td>
<td>Products of WP 8.</td>
<td>We will try to validate the use of tools developed in I*Teach project (knowledge repository), and how well they can be incorporated inside the TENCompetence framework.</td>
</tr>
<tr>
<td>3) policies and software agents that support the proactive sharing of knowledge and learning resources.</td>
<td>Products of WP 5</td>
<td>Existing knowledge repositories containing educational resources will be tested and validated how well they can be used for sharing knowledge resources inside TENCompetence framework.</td>
</tr>
<tr>
<td>4) models and software tools to assess the competences of individuals, groups and organisations in an exchangeable way.</td>
<td>Products of WP 6 &amp; 7.</td>
<td>The competence model based on the I*Teach learning methodology will be tested how well it can be expressed and used inside TENCompetence framework.</td>
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<tr>
<td>5) software for the effective and efficient support of users who create, store, use and exchange knowledge resources, learning activities, units of learning, competence development</td>
<td>TENcc prototype</td>
<td>All existing tools integrated inside TENCompetence framework will be tested, and also incorporation of some new existing tools inside TENCompetence framework will be also tested and validated.</td>
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programmes and networks for lifelong competence development.

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<tr>
<th>6) software solutions to establish a decentralized, self-organized and empowered management model when using the TENCompetence infrastructure.</th>
<th>TENcc prototype</th>
<th>Will test the TENCompetence approach and TENcc with different group of users from more rich and diverse competence development program.</th>
</tr>
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<tbody>
<tr>
<td>7) integrate isolated tools that are available in the field.</td>
<td>TENcc prototype</td>
<td>Integration of additional I*Teach based tools will be tested.</td>
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The pilot described aims to address all the seven main aspects of the TENCompetence project:

1) new, promising, innovative pedagogical approaches for lifelong competence development, supported by the TENCompetence infrastructure.
2) tools to support individuals, groups and organisations in Europe to find the best solution for their formal or informal learning problem.
3) policies and software agents that support the pro-active sharing of knowledge and learning resources.
4) models and software tools to assess the competences of individuals, groups and organisations in an exchangeable way.
5) software for the effective and efficient support of users who create, store, use and exchange knowledge resources, learning activities, units of learning, competence development programmes and networks for lifelong competence development.
6) software solutions to establish a decentralized, self-organized and empowered management model when using the TENCompetence infrastructure.
7) Integration of isolated tools that are available in the field.

5.9 Development and Deployment Plan

**First Period:** Preparation of L.D. strategy and materials (till the end of November)
- Create CDPs, Competences, and Competence Development Map
- Compose different acceptable learning path descriptions (WP7)
- Develop the Learning Design – main roles, main learning activities, learning resources, main learning scenarios
- Design the Evaluation activities – choose the right evaluation instruments and design the competence evaluation activities
- Analysis of the TENCompetence client functionalities and identification of the missing tools

**Second Period:** Content Development and architecture design (till the end of December)
- Compose the CDPs digital content in the form of a Units of Learning
- Develop all the assessment instruments
- Choice and installation of all missing tools
- Compose help documents and video

**Third Period:** *Integration, testing, and primary evaluation (till the end of January)*
- Integrate all the functionalities (WP3)
- Evaluate integration and robust testing
- Launching

**Fourth Period:** *Forming the pilot groups and start of the pilot (till the end of February)*
- Form the pilots training groups
- Develop all the training packs for all the trainees
- Face-to-face starter workshop (1 or 2 days) with all the trainees

**5.10 Use-Case Specification: ICT Teachers’ Training pilot**

**Brief Description**
This pilot tries to show how TENCompetence framework and approach can be used for the implementation of the innovative and complex training methodology, developed in the frame of the Leonardo project *The Innovative Teacher project (I*Teach)*. This project develops practical methodology, approaches and tools targeted at day-to-day utilization by the teacher trainers and teachers of four identified enhanced ICT skills in their work. These four enhanced ICT skills are related to:
- Information
- Presentation
- Working on a project
- Working in a team

As a result, teachers have to obtain new competences. This particular pilot will be used for the training of Bulgarian in-service teachers in order to obtain these new competences.

**Actors**

**Primary Actors**
Trainee (schoolteacher)
Trainers (facilitator)
Administrator

**Secondary Actors**
Consultant
Resource provider
Program manager
Technical assistant

**Flow of Events**

**Basic Flow**


Assessment of schoolteachers ICT training needs

The challenges education systems are facing in an information society result in a need for new definitions of ICT education: a new balance is needed between 'old' (reproductive) knowledge and 'new' (productive) knowledge, and between existing and alternative forms of education. They are also calling for new forms of teacher education and new forms of support in education. Information and communication technology (ICT) has the potential to play a role in every stage of the change process needed.

Evaluation of pools of candidates competences

Once a ministry of education and training specialist assess a certain level of needs and competences, they can create a pool of candidate competences.

Educational environment assessment, assessment of TENCompetence environment:

- Prepare trainers selection criteria
- Profiles of trainers/training vendors across skills needed and evaluation
- Profiles of technical faculties and evaluation
- Ranking of technical vendors/universities organizations

Creating of Educational Recourses for the ICT Teachers’ Training

The Author uses a friendly Authoring tool to design RO - tasks and scenarios. The learning materials are developed in English in a form of Units of Learning, in accordance with the Learning Design (LD) specification. The content itself is provided by the I*Teach project and TENCompetence provides support in transforming the content in accordance with the Learning Design specification.

- Components for developing Units of Learning in respect to LD specification
- Run-time environment for playing Units of Learning

Author describes RO by templates (scenario and task description templates). The system allows both on-line and off-line development of RO. In on-line development of scenario RO, Author fills up corresponding RO template using web forms (based on templates for description of scenario and task). In off-line creation scenario RO, authors upload RO as .rtf file, orXML document (which should be validated according to the xsd schema based on given templates for scenario and task), and the system automatically extract and store this RO in the database.

Creating a Competence Map and Assessment Methods for the ICT Teachers’ Training

In the repository each task is seen as an independent unit that can be used for building a scenario. The task is reusable object and has possibility to be used in different scenarios. The repository keeps tasks separately from scenarios, but scenario keep links to each task that is used in it. When user downloads a scenario, the file should contain description of scenario together with the description of each task used in it.
For each RO in the repository one of the two meta-data types are kept, depending on the type of the RO (task or scenario). Some meta-data for the scenario object are inherited automatically from the task objects that are used in this scenario (see scenario description template).

All meta-data are extracted automatically from the scenario and task template description. Each RO in repository takes up one of the following states:

- **New** – the RO is just created/uploaded in the system and it is not evaluated yet.
- **In evaluation** – when one teacher takes the RO to evaluate it. The RO in this status cannot be changed until author receives evaluator’s comments/remarks.
- **Evaluated** – the RO is evaluated, i.e. the author is received the reviewer’s comments.
- **Edited** – based on the evaluation author edit the item.
- **Final** – evaluator can make RO final when he approve the revised edition of the RO or return it to author to edit it again.
- **Used** – a teacher apply scenario in practice or tasks is used in scenario. In this case the RO cannot be changed, it can only be adapted.
- **Translated** – a meta-data that keep information in which language this RO is translated. RO marked as translated cannot be changed, it can only be adapted.

RO’s state is a meta-data field that is changed, according to some users’ activities. Each Trainee follows a learning path. The learning path is formed by the corresponding Units of Learning (reusable components from the I*Teach curriculum), linked with the competences the learner wants to achieve. The Trainee has the freedom of choosing, changing and managing his/her own learning path. As a result, following the competence map, schoolteachers have to obtain new competences.

In general, each sub-skill is linked with one Unit of Learning, aiming to teach the corresponding sub-skill. It is possible to have some sub-skills with more than one possible Unit of Learning. Also there is some general Units of Learning, playing the role of the prerequisites for obtaining some specified set of skills. These are related mainly to the basic theory and the ability to work with the knowledge repository.

**Hire trainers**

- Make sure the certifications are current and that the trainer is knowledgeable about the latest trends in the fields policy”, and then switch right back into game mode once the question is disposed of to their satisfaction.
- Ask for testimonials and references regarding their training background

**Individual Education through the ICT Teachers’ Training**

The learning process follows the next schedule:

1. **Face-to-face session (two days)** aiming to:
   - Present the main ideas of the I*Teach methodology (four hours)
   - Present the knowledge repository, main repository objects, and how to work with the repository (four hours)
Present the TENCompetence framework and client, and short training how to use it (four hours)

2. Individual work in authentic environment using the TENCompetence framework aiming to:
   - Identify the teacher’s competence level and define the needed learning path
   - Follow all the needed Units of Learning in relation with the individual learning path
   - Participate in all the planned group activities and team work
   - Use the knowledge repository for inspiration from previous developed learning materials, sharing results with other teachers, joint work on a project with other teachers, storing final products in a repository
   - Perform evaluation of own results as well as results from other teachers

3. Final face-to-face session (two days) aiming to:
   - Present the main results achieved by teachers
   - Discuss the strong and weak points of the methodology and Repository
   - Discuss the strong and weak points of the TENCompetence framework
   - Discuss the plans for the further pilots with teachers acting as trainers in an authentic environment, aiming to train pupils and/or lifelong trainees

Each stage/phase is completed by completing a task or list of tasks. The learner uses all the collaborative learning components (for sharing products and documents with others, for looking for help and orientation, as well as for performing the planned group activities) and most of the individualised learning components (reading, writing, assessment, personal navigation) from the system.

By passing along the set of milestones the schoolteacher build up a set of Enhanced ICT Skills naturally interweaved with predetermined teaching objectives. As a result, teachers obtain new competences.

Collaborative Education through the ICT Teachers’ Training

The learning process follows the active learning approach. The following learning activities are related to active and collaborative learning:

- Carefully constructed collaborative activities, which range from groups of students discussing material during a calculated pause in a lecture, to role-playing, case studies, group projects, and seminars.
- It is about learning from doing, performing, and taking action. The action can be either mental (e.g. reflection) or physical (e.g. case study). It uses such devices as games, simulations, introspection, and role-playing.
- In active learning, students are much more actively engaged in their own learning while educators take a more facilitating and guiding role. Related terms/concepts include: experiential learning, hands on learning.
- Systematic process of reflection on action, for the purpose of developing skills and competencies
- Active learning involves reading, writing, discussion, and engagement in solving problems, analysis, synthesis, and evaluation. Active learning is also known as cooperative learning.
Manage the training process
- Course materials adaptation
- Course schedules
- Students’ presence
- Manage schedule changes, etc

Monitoring (quality assurance) the training process
- Training Phase Reports
- Player Assessment Sheets
- Attendance Records

Evaluate students’ progress
- Suggest and implement improvements into the training program

Alternative Flows

Environment support

Special Requirements
- TENCompetence platform
- The Innovative Teacher project (I*Teach) Frame

Pre-Conditions
- Education and training Plan
- trainers

Post-Conditions
- Trainee has new competence

References:


Appendices

Appendix 1: Pilot environments

UNESCO IHE-Delft pilot

Towards knowledge network support of water professionals

With the expanding possibilities of the use of communication and information technology, the emphasis in development and performance is focusing more on exchange and application of information and data: knowledge. Although people are the main carriers of knowledge, ICT plays an important role in the access, exchange and retrieval of needed knowledge, information and data. Knowledge management driven ICT facilitates processes of communication, interaction, collaboration and competence development.

As part of its educational activities UNESCO-IHE realises the importance of knowledge as part of its strategy to empower its partners in education and research in developing countries and countries in transition.

In the recent past the knowledge network NBCBN (Nile Basin Capacity Building Network) has evolved, in which ICT supports the collaboration of several thematic research groups, crosscutting the ten countries in the Nile basin. Their sharing of experience and knowledge products is facilitated through a webbased knowledge platform. In South Africa WATERNET was established: a collaborative network of universities in South Africa in which each contributes to the realisation of a curriculum in Integrated Water Resources Management. The universities share their resources and accomplishments through the use of ICT. Recently a new knowledge network in Indonesia was launched: CKNet-INA. In this new knowledge network UNESCO-IHE facilitates the collaboration of 10 leading universities in the field of water, infrastructure and environmental management with a capacity building programme an internet based collaborative knowledge platform. The ultimate goal is to make use of each others strengths in delivering new training products and services for the water sector.

Finally UNESCO-IHE invests in and explores the enhancement of its educational activities and impact through the use of ICT in developing and delivering on-line education. Since this implies a re-orientation of structure and method of knowledge transfer, we refer to it also as I-Learning. (Innovative Learning).

Although the internal ICT infrastructure in these countries is workable, the internet-connectivity can still be a problem. Artificially high prices for bandwidth hinder access to available global knowledge and information sources for those that really need it as well.

In our approach attention is not only given to the technical facilitation but also to the socio cultural context of actors and their collaboration processes.

Knowledge network development in the Nile Basin

What started as an idea to facilitate a continuous interaction among water professionals from the Nile region attending courses in a regional training centre, has evolved into a new innovative approach: to support the social network of professionals in their development towards a knowledge-driven network. The main challenge for developing and developed countries is to enhance the speed of knowledge flow from the places where knowledge is available and generated.
(researchers – “scan globally”) to the places where (new) knowledge will be applied (users – “act locally”). In most developing countries the main parts of the knowledge chain are weakly developed: hardly any research tradition and culture, low level of co-operation among researchers and water sector professionals, weak water curricula at higher education level and seldom or none training opportunities in the region for mid-career professionals, and absence or low capacity of the private sector institutions and NGOs. It all can be summarized as a structural lack of capacity in the water sector.

As a result research and programs aiming at improving capacity and competence development in water management in this region and sector need strong support.

The challenges of knowledge network support in the Nile basin

Based on the experiences of the past years with the Nile Basin, the following overview of challenging aspects can be given. All of these topics are related to the political sensitivity of water-related issues, the availability of research capacity in the water sector and the existing institutional conditions.

- **To improve research-capacity in the water sector**
  Most of the Basin countries lack adequate human and institutional capacity to manage water resources in an integrated manner. This situation applies not only to the management of trans-boundary waters, but also to the management of national waters. Water management within each country is still fragmented between sectors, and there is little integration among various sectors of water use, between quantity and quality, and between surface and groundwater. Moreover the diversity of institutional capacities in the region is large. The availability of senior water professionals, for instance, varies from not more than 10 in one country (Rwanda) to a few hundred in another (e.g. Egypt). Moreover, six of the ten riparians have undergone significant civil strife, resulting in a vast backlog of water-related investments, inadequate infrastructure management, and a need for institutional and human resource development. By linking professionals from different countries in the region, the playing field will be leveled.

- **To improve trust and partnership**
  By its very nature, management of trans-boundary waters is a complex matter. In the case of the Nile, collective or joint development of the Nile waters is made even more difficult by the fact that there is limited trade and exchange among the riparian countries. Political, economic, social, and cultural (including language) differences among the countries pose a major challenge to such exchange. Within the water resources sector, there are few opportunities to exchange information and experience on a regional basis. The absence of such opportunities among the Basin countries has been a constraint to building a Nile water community engaged in extensive professional interaction and joint problem solving. The research clusters open opportunities for professionals to work together and to build trust among them. The clusters are part of a regional partnership.

- **To support a regional approach in solving water related problems**
  If one thing has become very clear these last five to ten years then it is the need for a regional approach to cope with the main problems. The character of most of the problems especially related to water and environment goes beyond the boundaries of
the individual countries. However, there is not yet a co-operative framework operational for the Nile region. The Nile Basin Initiative has started as an interim body to deal with regional matters, but it will take time before the set-up will be fully operational. A professional network supported by an Internet-based social learning platform lowers the obstacles to communicate and collaborate.

- **To contribute to life-long on-the-job training**
  Support usually addresses only one link in the knowledge chain. New people are trained and their level of research skills and experience is leveraged. But after the training they go home. And in many cases the potential knowledge relationships within the group setting of the training fall apart. The platform is supposed to facilitate continuous interaction after professionals have been trained and to provide them with a support environment on-the-job.

**Relevance of the TENCompetence pilot for the Nile basin region**

As part of its involvement in the NBCBN network UNESCO-IHE concentrates its activities on

1. To support the knowledge network development process, its (regional) communities of water related professionals and its assumed innovative potential to stimulate (sub)regional dialogue and economic development;
2. To support demand-driven research on Nile Basin related water and environmental engineering topics that help the Nilotic countries to achieve sustainable socio economic development through the optimal use of the common Nile Basin water resources.
3. To deliver on demand academically well trained water professionals and capacity to the region and to support local and regional water related institutions in their capacity building tasks.
4. To improve the accessibility to education and training in River Engineering in the region.
5. To enhance the research capacity in the Nile basin.
6. To enhance communication between experts and institutes in the region and make maximum use of existing capacities in the field of River and Hydraulic Engineering.

These life long learning related challenges are addressed by the TENCompetence framework and contribute to the need for competence development in water management in the Nile basin.
Medical Pilot Overview and Description

Introduction

Progress in the development of medical practices depends on the speed at which new therapeutic knowledge and technologies can be acquired and disseminated. On the frontline where medical science is battling newly diagnosed diseases, heavily funded research activities are formulating new therapeutic strategies based on novel insights into how these diseases form, propagate, and are treated. In many cases this flux of medical knowledge is not sufficiently supported by dissemination infrastructure, especially in certain areas of specialization such as cancer. Here for example, new competences for early diagnosis and prevention of cancer have recently been formulated but are only slowly being acquired by medical practitioners, resulting in loss of lives that might otherwise be saved. To address such gap of knowledge, a system for transmitting and sharing knowledge and information is needed to help medical practitioners acquire state of the art diagnostic and therapeutic competences as the latter are being developed rapidly.

Keeping in touch with advances in scientific areas of medical specialization is a practical challenge in lifelong learning, since medical personnel have a moral commitment to seek the best available cures or treatments. Finding the best therapy or cure available, however, requires continuous monitoring of advances in medical technology and therapeutic strategies. This process usually demands extensive study, starting with a familiarization with newly published literature, workshops, seminars, and empirical work, and extending to many other accessible resources. The primary goal behind the MD pilot research is to facilitate such endeavour by automating the search for newly formulated medical competences and providing a helpful learning environment where medical personnel can acquire such competences. The MD player that will be developed as part of the pilot will be able to differentiate between medical personnel according to their specialties, interests, and needs, and shall present each specialist with a personalized learning environment and competence development program. Under such ability, the player will also offer access to patients who want to learn more about the disease or condition they are facing. Moreover, each of the learners will be able to evaluate his/her progress through an assessment paradigm imbedded in each competence development program. Finally, the learners can benefit from the social tools incorporated within their learning environment to connect with each other and discuss learning concerns, exchange advices, recommendations, and personal experiences.

Such lifelong learning challenges are addressed by the TENCompetence framework under the aim of establishing lifelong competence development programs and bringing them to the learner’s fingertips through the use of digital technology. This framework offers access to a multi-disciplinary learning environment that thrives to encompass the tools and paradigms necessary for providing an accessible, joyful, and uncomplicated learning experience. The TENCompetence framework allows academic entities and corporations to initiate competence development programs and pass them to interested learners who use the navigation and positioning tools inherent in the framework to automatically discover new programs and resources. The social tools provided by the framework do not only connect learners with the same background and interests, but also opens the possibility of social meshing around learning activities where a learner
can dialogue and contact professors and experiences professionals from all fields or interests as well as peers. In short, this framework strives to meet the collective needs generated by lifelong learning activities by bridging the distances between peers as well as learning communities.

The TENCompetence framework is, therefore, an appropriate vehicle for addressing the learning challenges of medical communities, and to that end we propose the pilot definition discussed below in its context. This pilot is intended to test the utility of the TENCompetence framework in answering the primary learning needs of a medical community, and will focus on the community of people associated with colorectal cancer diagnosis and prevention as a main theme. The pilot shall be composed of competence development programs associated with the transfer of diagnosis and prevention knowledge about colorectal cancer, along with a learning player that provides a learning environment targeting several specialized groups of people involved in this process. The pilot will be developed according to the TENCompetence specifications in order to profit from the services and tools inherent in this framework.

**The social and professional context of colorectal cancer diagnosis and treatment**

The social and professional relations around colorectal cancer patients form a complex mesh that involves the social context of patients, such as family, and the professional context of doctors, which includes specialists in therapeutic practices and rehabilitation, psychologists, drug providers, researchers, and others. In the process of colorectal cancer diagnosis, prevention, or treatment, these actors and groups perform a variety of specific roles which need to be addressed in any competence development framework that aims at evolving practices and knowledge associated with colorectal cancer treatment. For practical purposes, doctors and medical personnel usually rely on necessity to address the entire network of people associated with treating a patient due to the complexity of this task and its consumption in time. As a result, such network is often fragmented and lacks inner-communication. The following table provides an initial analysis of the main partners and actors involved in colorectal cancer treatment along with their roles and needs related to lifelong learning and competence development.
<table>
<thead>
<tr>
<th>Group/Person</th>
<th>Role</th>
<th>Main interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>Follows condition</td>
<td>General knowledge/ effects of colorectal cancer/ treatment / prevention</td>
</tr>
<tr>
<td>General Health Doctor</td>
<td>Diagnoses colorectal cancer</td>
<td>Colorectal cancer diagnosis and side-effects</td>
</tr>
<tr>
<td>Doctor specialized in colorectal cancer</td>
<td>Diagnoses/ Selects best treatment</td>
<td>All aspects / in depth understanding of the disease and related prevention measures</td>
</tr>
<tr>
<td>Specialists in treatment and rehabilitations</td>
<td>Supervise the execution of the specialized doctor’s recommendations</td>
<td>Specialized treatments and rehabilitation / therapy</td>
</tr>
<tr>
<td>Supportive medical personnel (nurses, technicians…)</td>
<td>Manage therapy-related activities</td>
<td>Managing new technologies/ therapies/ machinery / prevention …</td>
</tr>
<tr>
<td>Complementary Medics (Psychologists, sociologists…)</td>
<td>Alleviate the effects of colorectal cancer, help reinforce treatment and recovery</td>
<td>Colorectal cancer diagnosis and side-effects</td>
</tr>
<tr>
<td>Researchers &amp; academics</td>
<td>Coin new technologies and therapeutic strategies</td>
<td>All aspects</td>
</tr>
<tr>
<td>Drug manufacturer</td>
<td>Manufactures new drugs, tackle treatment side-effects</td>
<td>Newly developed technologies / treatment side effects / prevention / drugs effectiveness</td>
</tr>
<tr>
<td>Medical unions and associations</td>
<td>Organize workshops, studies, and other activities / monitor the performance of medical personnel</td>
<td>Scientific progress / identification of potential problems / financing and overseeing research / standardizing practices / evaluation of medical personnel</td>
</tr>
</tbody>
</table>

Table 1. Actors and Partners associated with colorectal cancer prevention

**Traditional clinical guides for diagnosis and prevention practices**

Medical personnel usually rely on clinical guides or schemas to understand and follow new methodologies in diagnosis, prevention, or treatment. Each association or group of actors and partners generally utilizes group-specific clinical guides that target the competences of a professional specialization without coordination with the others. These guides are composed of systematically developed recommendations and practices whose primary objective is to orient medical professionals as well as patients during the complex process of decision-making. Such guides are usually presented in the form of diagrams similar to UML that retrace the procedures and the different paths available from the start of the process till its end. They are useful in identifying the available options, choices, or alternatives, along with their significance and impact on the adopted strategy. In short, they illustrate how a medical process works, and promote awareness of new changes and improvements in it. The following schema is one such example, and it has been provided by the Spanish Society for Family and Communal Healthcare and their partners for the diagnosis of colorectal cancer.
Figure 1. A clinical guide schema for colorectal cancer

The deficiencies inherent in the specialized clinical guides start by the fact that they each address a specific group of specialization without referring to the others. The guides do not provide a mean to collect feedback or empirical knowledge that could otherwise be used for evaluating their content. Their rigidity in terms of content forces their users to deal with a clinical approach that encompasses all possible cases or directions as shown in the diagram above, making a case-specific study rather difficult. On the other hand, the logistics associated with producing a clinical guide and distributing it to a targeted group or community leaves little room for frequent updates and changes. As a consequence, publishing clinical guides sometimes follow a loose periodic rhythm where the content of publishing iterations may differ extensively from one publication to another, a practice that can demise the charting the appreciation of the guides by giving rise to confusion and mistrust.

In this pilot we will use the GLIF technical specification for modelling clinical guides. GLIF3 is a methodology that enables modelling and representation of clinical guidelines
in a structured manner that is both opened and global. Such guidelines can be used for clinical decision support applications easily, but this model is very complicated and requires simplifications in order to make it more usable. The GLIF3 model is object-oriented and consists of classes, their attributes, and the relationships among them, which are necessary to model clinical guidelines. The model is described using Unified Modelling Language (UML) class diagrams. The simplifications adopted for this model are based upon restricting the modelling of the clinical guides to deterministic classes.

![Diagram](image)

Figure 2. Modeling a clinical guide in GLIF3

**TENCompetence MD pilot definition**

The objectives of the MD pilot proposed hereafter centre around the emulation of some of the current practices in MD competence development related to colorectal cancer diagnosis and prevention. The pilot will utilize the principle of clinical guides to address the learning challenges and in this way will present its users with a familiar learning methodology augmented by digital media technology as well as the TENCompetence infrastructure. Thus the pilot will capitalize on the advantages of digital technology (in particular distributed collaborative work environments, connectivity and accessibility to information, virtual settings, and others…) to propose an encompassing solution for the lifelong learning challenges of colorectal cancer diagnosis and prevention. It also sets out to address the various groups of actors and partners involved in the process, especially doctors and patients as a first step.

The learning activities implemented in the pilot will seek to differentiate between the needs of each group of learners according to the personal knowledge, expertise, and requirements of each individual. In this we take into consideration the actions usually performed by the learners in the context of their work as well as their roles and their motives behind learning how to diagnose and prevent colorectal cancer. As a first step, the pilot will address two groups, being the doctors and their patients. Patients include not only those who are suspected or confirmed sufferers of colorectal cancer, but also those with personal worries or interest in the subject as well as their family and friends. Personalization of the competence development program will be taken to a deeper level
where individuals are taken into account in the formatting and presentation of information. Personalization includes the ability to safeguard and retrieve a person’s learning activities, evaluation results, and learning progress as s/he progresses in the competence development program. In summary, the pilot will represent the competence development program associated with colorectal cancer, and provide learning activities, which are centred on the learner and their knowledge and interests, in relation to a specific diagnostic case. In this manner, the learner can inquire about several cases simultaneously by recording and retrieving them as s/he progresses. This will provide an overview of the actions performed inside every case as well as the progress in diagnosis and prevention. When such undertaking reaches a conclusive step, the learner obtains a case-specific diagnosis and prevention strategy, which would be conclusively evaluated.

The pilot asks each of its users to define, fill, and submit an e-portfolio that describes the user’s academic background, profession, experience, and interests. The e-portfolio of each learner will also encompass sections on professional knowledge associated with cancer in general and colorectal cancer in particular, as well as previous experiences in diagnosing and treating this disease. On the other hand, the e-portfolio will not contain background information on specific learning cases at hand since the pilot shall support learners in creating and managing multiple learning instances each reflecting a specific diagnosis or prevention case. As the diagnosis proceeds, the learner feeds the results and findings back to the case’s instance on the player that processes the data and visualizes the path taken so far as well as the choices and possibilities ahead. This strategy assumes that each learning instance should address one personalized case of diagnosis or prevention, and will encourage professionals to incorporate the player in their work environment to learn how to address each type of cases that arises in the context of their work. In parallel, patients can benefit from this type of personalization to learn about their case of interest, being their personal situation or that of someone they care about. In this manner, the player can act as a personal guide for the patients and as a professional guide for the doctors. Hence, the player will also provide the opportunity to learners to follow up several cases as being several independent learning paths each stored within the context of the player and retrieved during learning activities. In this way the pilot will be an innovative exploration of how functionalities from the work environment of medical professionals can be built into their learning environment. The approach will be tested through the introduction of functionalities that enable medical professionals to ask for medical tests and analyze their results within the context of the player itself, but using the data and information saved in the player about the case at hand.

The competence development programs will be based on the clinical guides who represent the decision flow and information related to the roles involved in learning about colorectal cancer diagnosis. Each of these programs will encompass all of the available information related to a diagnosis and prevention strategy regardless of the group of people it intends to address. In other words, a player’s competence development program might as well be the fusion of the aggregation of a number of clinical guides each designed for a specific group. The TENCompetence infrastructure will format the data present in a competence development program by using information abstraction based upon the data provided in the learner’s e-portfolio reflecting his professional background and interests.
The pilot will acknowledge that the needs for a communication and interaction platform between individuals of the same group of actors as well as cross communication between different groups will be addressed and covered by the tools and components available in the TENCompetence framework, and hence shall not be addressed as part of the pilot itself. However, efforts will be exerted to define these needs in the context of colorectal cancer diagnosis and prevention to provide proper scenarios and use cases for testing the utility of tools adopted within this framework.

The pilot assumes that the learning activities associated with colorectal cancer diagnosis and prevention should be continuous and lifelong, in parallel with developments in research and development in that area. Moreover, the pilot will adopt a teaching strategy compatible with self-managed learning activities in accordance with the personalization inherent in the needs of the learners. Attention will be given to supporting learners in the social aspects of learning, enabling learners to contact expert peers and other learners for information and exchange of knowledge, opinions and experience in the context of the communication and interaction framework provided by TENCompetence. Evaluation and accreditation are addressed in a non-formal or informal perspective since colorectal cancer diagnosis and prevention competence development lies in the realms of non-formal and informal learning as defined in the TENCompetence framework. In essence, each competence development program will address a specific type of colorectal cancer diagnosis, encompassing a clinical guide containing an exhaustive collection of orientation information along with auto-evaluation questions associated with this information that the learners can use to measure their understanding of the materials at hand, along with their progress in mastering new clinical strategies for diagnosis and prevention of colorectal cancer.

The architecture of the MD Pilot

The pilot’s internal architecture follows a straightforward approach based on IMS specifications and XML technology. Each competence development program will be represented with an XML schema, including the entire set of information associated with a specific clinical guide. The schema’s structure and attributes enable the system to distinguish the abstraction levels associated with each unit of information in order to address the information requirements of each type of learner appropriately. The XML schema adopted will be compatible with IMS Learning Design specifications for portability and compatibility with other players or platforms that wish to utilize it.

An application will create a graphical model of each competence development program that transforms the XML schema into a representation that contains all the data embedded in this schema. This application is expected to be an adapted IMS Learning Design player, although the way in which it will be integrated into the rest of the TENCompetence infrastructure will not be clarified until the end of Phase One of the project. The graphical model will then be instantiated according to the data provided by the learner when registering diagnosis and prevention actions taken and their relevant results. The learning process is thus represented by a sequence of graphical representations each representing a stage in the diagnosis and prevention procedure. Functionalities in the player allow learners to compare different stages, rethink their earlier actions, and possibly revise some of them in order to obtain a better result. This paradigm makes the diagnosis and prevention process navigable in time and in reverse time hence facilitating the formulation of awareness on the consequences of an action or
the cause of a situation that might arise in the proceedings of a diagnosis or a prevention strategy.

Management of the graphical representations (or instances) is handled by the navigator component, which enables the learners to create new instances of the clinical guide schema, update their data, and navigate forward and backward in time. The navigator accesses the learner’s e-portfolio to determine the level of abstraction that should govern the instantiation of the clinical guide’s schema. This process is automated and is part of the interface that links the player to the TENCompetence environment. The navigation also provides functions external to the TENCompetence framework such as the ability to request medical tests and to integrate their results in the player through the data input window. Through this window, doctors can import such results as data instead of having to retype it themselves, hence saving the learner’s time and integrating the learning process into his/her working environment. The following figure illustrates the functioning of the player’s internal components described above:

Figure 3. The player’s internal components

The integration of the MD pilot’s player into the TENCompetence environment will take into consideration the player being a standalone application. Since the player is based upon the standards adopted in the context of TENCompetence, integration and compatibility problems should be minimized. In other words, the player answers the requirement of the framework by defining the playable competence development programs according to the models of TENCompetence. Moreover, each of these programs contains a set of questions and answers that can be utilized by the learner to perform auto-assessment probes and evaluations. In turn, these questions and answers are formulated using the IMS QTI specifications. Assessment is conducted outside the specialized player, and is handled by the assessment services already inherent in the TENCompetence service packages. These assessment services interact with the player directly through the interface linking the player to the TENCompetence environment. Finally, the player is able to connect, read, and understand e-portfolios directly without the learner’s intervention, since the latter will be stored in a standardized format.
For its part, the TENCompetence framework will provide learners with services synchronized with the player’s activities. Learners can hence use services like forums, chat rooms, and others to relate to peer-learners and learners with similar interests by using the TENCompetence social networking tools. Positioning and navigation services ensure that the learners learning context be preserved and updated according to their progress by visualizing their positions in relation to the reachable competence development programs as well as their progresses in acquiring pre-defined competences. The relationship between the player and the TENCompetence environment is presented in the following figure.

Figure 4. The player as an integrated component in the TENCompetence framework

**Hospital Clinic Pilot use cases**

**Use case 1**

Antonio González is a medicine degree student of University of Barcelona. This semester, he chose to register for the subject called “Clinical guides in preventive measures”. This subject is given by means of e-Learning and will use the TENCompetence infrastructure. Its curriculum concentrates on colorectal cancer early detection and prevention, based on a clinical guide produced by Hospital Clinic. The diagnosis generated by the system will be used to follow up on real situations and with real patients as part of the student’s training to commence his junior practice.

**Primary Actors:** Student, Teacher;  **Secondary Actors:** Peer students, member of the life long network
Flow of Events
- The student register as a user of TENCompetence, installs and learn to use the client. Registration entails uploading profile information and other data.
- The student quickly locates the course he was searching for and registers it.
- The student introduces himself to his colleagues by writing a post in the course’s blog or forum.
- The student searches for cases to solve as required by the course’s proceedings.
- The student interacts with several types of clinical guide schemas representing real cases, and take testing and evaluation exams that assess his performance.
- The student keeps up the communication with other peers in order to share advice and solict support in addressing the challenges generated by the clinical guide.
- On the other hand, the student can post his/her questions and comments on the course’s forum.
- Finally, the student should be able to use a web explorer to seek more information from external sources.
- The student can take exams on several levels to assess the expertise and knowledge he gained so far.
- The teacher always monitors the student’s work and is ready to provide personalized advice that guide the student toward certain clinical schemas to develop his junior skills.

Special Requirements: The student must have internet connection in his/her home.

Pre-Conditions: The student must be familiarized with the basic use of the computers. The student must possess the required medical background.

Use case 2
Pedro Martinez is a simple person suffering from syndromes that might be related to colorectal cancer. The diagnosis procedures and their course is a difficult for him to follow and understand. However, Pedro will be much more comfortable through the diagnosis period if he understood the procedures exactly. Pedro raises the issue with his doctor who recommends him the use of an interactive clinical guide as part of a learning program dedicated to the patients under colorectal cancer diagnosis. The system synchronizes the patient’s digital copy of the clinical guide with the information recorded on his doctor’s computer, and simplifies medical matters in order to make the process understandable by non-medical persons.

Primary Actors: Patient Secondary Actors: Doctor

Flow of Events
- The doctor provides the patient with the necessary guidelines to register and get access to the TENCompetence client.
- The patient registers and logs on to the network, and chooses the interactive informal course on colorectal cancer.
- The patient registers his doctor’s clinical schema that represents his name on the application.
The patient starts learning how his diagnosis process has evolved since the beginning, and understands better why certain alternative procedures were disregarded.

- The patient helps his doctor by giving more minute details about his symptoms and compliance with the treatment or medication.
- The patient may also fill more detailed information about diseases in his family.
- The patient then joins other patients to chat and share information and comfort by using the social network.
- After the treatment has ended, the patient stays connected to the network and from time to time logs in to share his experience with other patients.

**Pre-Conditions**
The patient must have internet connection in his/her home. The patient must have knowledge about surfing by internet.

**Use case 3**
The Doctor Arnau Ribas is a specialist in trauma and oncology, but during most of years in his practice, he has only concentrated on trauma specialities as part of his work in the local hospital. Recently, a post in the hospital has opened for an oncology specialist, so he decided to give it a try since he was beginning to get bored working as a trauma specialist. On the other hand he knows that he needs to refresh his knowledge about oncology area. Dr. Ribas then uses an interactive clinical guide game designed to simulate the diagnosis and prevention measures associated with real cases in order to sharpen his skills in this area. By trial and error, Dr. Ribas is able to recuperate his skills in the area of oncology in a matter of weeks without taking classes or training courses that might be a source of embarrassment to him.

**Primary Actors:** Doctor Arnau Ribas. **Secondary Actors:** Peer Doctors

**Flow of Events**
- Doctor Arnau Ribas registers and logs in to the TENCompetence environment.
- He registers for the practical oncology course and starts customizing his learning environment accordingly.
- Dr Ribas searches for oncology cases from the knowledge repository and selects a few interesting ones.
- He also creates some cases himself by entering data from the files of real patients in the hospital.
- Dr. Ribas starts working on several cases simultaneously, simulating the work load he will get in the new position.
- For each case, the Dr explores several possibilities of treatment, learning how to relate symptoms with diagnosis methods more efficiently.
- The Dr can take a quiz by which several difficult cases with many complications are provided. His performance on the quiz is recorded and used to evaluate his skills.
- Dr. Ribas has access to several social tools by which he can contact with peers in order to re-establish a professional relation with his work group.
- Dr. Ribas can also search for the latest information on advances in oncology using the navigation tool of the knowledge repository.
Pre-Conditions: The doctor must have internet connection in his/her home. The doctor must have knowledge about surfing by internet. The doctor must have sufficient knowledge about the topic of the clinical cases addressed.

Use case 4
Dr. Zakarov is trying to diagnose a patient with unfamiliar set of symptoms in order to prevent the development of colorectal cancer. In his work at the local hospital in an isolated city south of Finland, he has difficulties maintaining contact with groups of experts from other distant hospitals in order to share knowledge and experience and help each other to deal with unfamiliar cases. He decided to use an online e-learning and knowledge sharing system through which he can maintain relationships with other doctors and solicit support whenever needed. The system uses clinical guides as a platform to share cases since they retain the history and the evolution of each case. Doctors can respond to questions from peers quickly and efficiently without having to spend a lot of time of studying the relevant case.

Primary Actors: Dr. Zakarov Secondary Actors: Peer Doctors

Flow of Events
- Dr. Zakarov registers as a user of the TENCompetence platform
- He updates his profile and personalizes the TENCompetence environment to suit his purpose.
- The doctor starts identifying online societies and focus groups sharing the same interests and practices.
- The doctor registers to a course that teaches how to exchange clinical guides between doctors for efficient cooperation.
- The course leads the doctor on the ways to write and prepare clinical guides, as well as read and interact with them.
- The doctor starts translating some of his cases into clinical guides and sharing them with peer doctors.
- One of the doctor’s peers recommends him some training courses based on clinical guides
- The doctor follow some of these courses in a similar fashion as described in the Use case above but with more focus on social interaction and peer participation.

Pre-Conditions: The doctor must have internet connection in his/her home. The doctor must have knowledge about surfing by internet.
Antwerp ALLCITY project

Objectives of the ALLCITY project and structure

- The interface between education and industry will be **bi-directional**
  - Professional education must match better with businesses.
  - Businesses must fundamentally incorporate lifelong learning in their activities.
- ALLCITY, as an anchor project, **advises, guides and monitors** secondary projects to ensure they are anchored in the ALLCITY strategy.
- ALLCITY uses a **combined top-down / bottom-up** implementation methodology in order to create a strong basis of support for the project.
- ALLCITY and its secondary projects use a **common basic IT infrastructure**, consisting of an ASP services platform (hard & software). This launching platform exclusively uses international standards and intelligently uses the existing Antwerp broadband infrastructure, completed with wireless networks and local engagements in the field of interactive television. This enables **citywide ambient lifelong learning**.
- A central **Knowledge and Change expert team**: the region of Antwerp will pool its available academic and industrial expertise in the field of knowledge and change management in order to
  - create the necessary **awareness and synergy**;
  - promote, tune and support the ALLCITY secondary projects;
  - cluster and exchange **experiences**;
  - organize **trainings** concerning:
    - the use of collectively useable didactical materials;
    - the use of collectively useable IT infrastructure;
    - change management.
- An ALLCITY Compliance team. This team advises all supporting secondary projects concerning:
  - **optimal usage** of the common platform;
  - **compliance** with international standards
- A central Knowledge and Change expert team: the region of Antwerp will ALLCITY as a partner in European collaboration projects
  - ALLCITY will pool the expertise within the Antwerp association in order to make Antwerp a recognized lifelong learning city through the initiation of and connection with **international research projects**.

Basic elements of the ALLCITY knowledge infrastructure

**Sharing of infrastructure**

The ALLCITY project will provide a pre-competitive and shared use of a common IT-platform. In this platform a number of basic functionalities that cover competence driven learning will be enclosed in a **modular, standardized and exchangeable** way:
RID content
The ALLCITY platform departs from the RIA principle for its content (both learning content and competences):
- Reusable
- Interoperable
- Accessible
- Durable

Competence driven
Education, businesses and public employment services are becoming more and more competence driven. Within the scope of the constructivist model, competences are the reusable common currency for the interface between education and businesses. Learning, and especially ‘blended learning’, will become the main method for developing competences.

ePortfolios
Eventually the results of competence driven learning will be stored in a personal, standards-compliant ePortfolio. The data in the ePortfolio can easily be exchanged between education, industry and employment services.
ALLCITY narratives

First Narrative: Kevin Verbeek

Kevin Verbeek is a 28-year-old welder who works at the General Motors Automotive Plant at the Antwerp Harbour. These days being a welder at an automotive plant involves a range of complex and difficult tasks and skills that keeps its finger to the pulse of the latest technological innovations in the field.

Recently, GM decided to use new laser-hybrid welding techniques for its new Astra model. Laser-hybrid welding is a welding process that combines laser light and arc welding technology and is a major innovation for the automotive industry, as it is considered better and cheaper than its predecessors.

Because GM encourages its employees to engage in learning activities in order to keep up with the latest developments in the trade, and actively supports this through increased promotional chances and offering learning opportunities during working hours, Kevin decides to look for a way to learn about this new welding technology. Kevin visits the e-learning and training department of GM and has a meeting with a counsellor. The counsellor will be the central reference point throughout this specific learning process. He learns about the ALLCITY project. The counsellor gives him all the information that he needs, including brochures and instructions on how to log in to the portal. Kevin and the counsellor collaboratively design a customized pedagogical when Kevin logs into his account, he accesses his ePortfolio and gladly finds out that his personal profile is already partly filled with data that the GM HR department streams to the ALLCITY portal. He continues exploring the portal and finds out that there are online courses about virtually every subject. Kevin was advised to take some courses that are in the line of his competencies and fit into the strategic objectives of GM, and doesn't have to plow through all the courses. There are some other courses he is interested in and he can read user experiences about them in the forums, but for now he will only take the one he has set his mind to.

He is pleased to find a new online course about laser-hybrid welding and decides to enrol. After he enrols, he can find a variety of information regarding who is also enrolled in the course and what proficiency level they have regarding laser-hybrid welding. He can contact his peer learners with questions and consult forums to find answers and discuss the course. The course itself consists of two parts: a theoretical course and test, and a practical simulation.

Phase 1
First Kevin learns everything he needs to know in the theoretical course and other sources he is referred to by the ALLCITY system and then takes tests to determine his progress. All learning and test data is streamed to Kevin's ePortfolio, so that future employers can determine his technical as well as learning competencies if he wishes so.
Phase 2
After taking the test and passing it the system grants Kevin access to the simulation part. There Kevin can have a hands-on experience with the look and feel of the new laser-hybrid welding system that is to be implemented in the GM plant. Every aspect from the real working situation is represented in the simulation, such as configuring the welding robot, testing, reporting, etc.

Phase 3
Entering the third phase, Kevin will go to a training centre that has a specialisation in that type of laser-hybrid welding system. It is located in Düsseldorf and offers a personalized training, based on the data it received regarding Kevin's proficiency so far. Together with his tutor, Kevin gets a detailed and thorough training with the actual welding installation in a test setting. The results of this training are streamed back to the ALLCITY portal and included in Kevin's ePortfolio.

Phase 4
After the course Kevin decides to share some of his practical knowledge with his peer learners. He does this through diverse channels of ALLCITY portal, such as forums, collaborative documents, chats, etc. He also discusses some topics with more advanced learners, with whom he will stay in contact for a considerable time.

When he has completed all the levels of his individualised learning path, Kevin can show the results of his work in his ePortfolio and his competency map is updated automatically, so that the GM HR department use this information in their human capital process engineering activities. For example, now Kevin can be used in processes in which the laser-hybrid welding systems are operated.

To summarize, Kevin has found perfect blended, low-cost learning solutions for his needs. And his company is reaping the benefits, too.

Second Narrative: Bert Goedschalckx

Bert is a 48-year-old teacher at the Royal Atheneum of Schoten. The Royal Atheneum is well known for its excellent technical and vocational education. The school has always put a great deal of effort in establishing good relationships with local industry and other educational institutions in order to stay up to date with the latest developments in the technical industry.

Bert has studied innovations in residual hydrocracking with dispersed catalysts using supercritical water-syngas as a hydrogen source, a petrochemical process used to increase the gasoline yield from the residuals in the process. Because major refineries are all switching to this new way of residual hydrocracking, he judges it important that the students of his Chemical Process Techniques class learn about this innovation. After all, he has a reputation to live up to.

Phase 1
Bert accesses the ALLCITY platform to look if there is anything on residual hydrocracking. He finds out that there is a group of stakeholders, comprised of Belgian
and Dutch petrochemical scientists, managers, teachers, content parties, knowledge center employees and regional and local government officials, that has taken up the subject in the ALLCITY environment. Although the work seems to still be in an early stage, the group of stakeholders sure looks promising. Bert updates his ALLCITY profile so that it shows he is interested in updating the residual hydrocracking subject for the Chemical Process Techniques class. A few hours later, after the social networking tools have kicked in, he opens his mailbox and sees that the first welcome messages and preliminary questions from his peer learning designers have already poured in, and apparently rss feeds on the subject are also streamed to his personal bulletin board on his profile page.

**Phase 2**

The learning designer peer group decides to set up a workspace titled "residual hydrocracking with dispersed catalysts update" under the learning design workspace category. The workspace has a forum, a chat, a collaborative authoring tool, messaging services and netmeeting tools. The group decides to have a net meeting to get to know each other a bit more and to decide what has to be done. In the meeting they discuss a role division and what else they could need. Because Bert is a teacher, he volunteers to aggregate the content the other peers will provide and pour it into a pedagogical scenario, which can then be worked out more specifically in a later stage.

**Phase 3**

Bert designs the pedagogical scenario, containing theoretical aspects, a process simulation, rich media content and assessments for the students. He then downloads the ALLCITY authoring/assessment tool and authors the content he has received from his peers according to the scenario. When his first draft, he wraps the learning objects into a SCORM package and uploads it to the collaborative "residual hydrocracking with dispersed catalysts update" workspace. Now the other peers review the content and can adjust it simultaneously, thanks to an advanced versioning system already present on the ALLCITY platform. Once there is a consensus on the learning material, the status is changed to 'published'.

**Phase 4**

Bert assigns his Chemical Process Techniques students, who all have ALLCITY logins and profiles, to the course. He informs his class about the new course via mail and in the classroom and explains them their learning trajectories. During the learning activities of the students, Bert can monitor their progress, their assessment results and their individual competencies and he can make all kinds of statistical extrapolations very easily and flexibly, thus being able to support his students in a personal, highly effective manner.
Preplanning of Digital Cinema Game Additional Pilot

Several potential pilots are currently being considered for the second cycle of the project. In this section we shed light on the preplanning efforts of the Digital Cinema Game pilot that was officially endorsed by WP4 after careful considerations. Other additional pilots are still potential ones and their adoption is still uncertain, and hence will be left out of this report for the time being.

Context of work of the digital cinema game pilot

The movie industry is very dispatched and composed of a big competitive chain of specific suppliers. It is very market driven and competition is fierce, driving entities to constantly monitor the rise of cutting edge technologies in order to integrate them. Such environment abolishes the greater aspects of resistance to the introduction of new technology and makes of it a continuous phenomenon. Therefore the innovation diffusion is imposed from the big players in the market who normally take the innovative lead, forcing suppliers to readapt their production techniques in accordance with the requirements of the new technologies.

People involved in the movie industry know what they must do to upgrade their knowledge and resources and are generally motivated to do so by competitive requirements. Such fact was learned during a pre-planning meeting with Media Pro (large media company based in Barcelona) where we discussed the usefulness and success of a potential pilot that encourages the utilization of digital technology in the production of cinema films. In that sense, developing a pilot that targets market resistance to the digital technology as previously though makes little sense. The change to digital cinema is happening. It is only a matter of time until the whole production workflow gets digitized. For example, in several countries, distributors and movie theatres handling analogical films have now become a minority.

Digital cinema game pilot definition

Based on that, it currently is difficult to compose an abstract technological specification for a movie project. Every movie is a whole new different project, with new specific constraints (creative, budget). Such variety makes the advantages of using digital technology relative to a case-specific scenario rather than generically defined. Amid this type of technological market, the changes that digital cinema technology brings to the cinema industry are virtually undetectable by comparison between digital and non-digital project scenarios. Our pilot proposition targets the production phase of cinema film where a team of planners working for a media company cooperate to devise a plan for its production. The challenges associated with the production chain are to identify the technological requirements suitable for the case at hand and understand the organizational and planning consequences of adopting a specific technology from among many others.
An interesting property of cinema production is that independent directors of photography seldom negotiate their choices. They are more concentrated on the creative and artistic aspect of cinema than on production as an economical process. From the other side, the producer sets the budget without interfering with the creative aspects, generally leaving enough space so directors can manoeuvre on their guise. Financial/administrative directions (i.e. producers) do no interact of lot with the creative directions (general director and director of photography). Therefore we propose to consider a scenario of a movie planning that emphasizes on the analog-digital competence (in)compatibility and market/social constraints in the production of a movie. A potential name could be “Meet the digital cinema market”. It will be based on a set of little missions during which initiatives and decisions impact the whole production planning. Each mission could focus on a specific learning value.

**Figure 3.15.1: Example of potential missions**

<table>
<thead>
<tr>
<th>Mission</th>
<th>Characters</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convince Woody Allen to drop his idea to shoot in Black and White</td>
<td>Director, assistant director, production designer, production manager, director of photography, DC colourist, digital visual effects, photochemical to digital scanner operator</td>
<td>Creative constraints of both the director and the photography director. DC colourist was already contracted. Need to find people with competences fitting the needs of the director. Each decision on these constraints has an impact on the planning of the movie</td>
</tr>
<tr>
<td>Convince Woody Allen to get assisted by an offline editor</td>
<td>Director, assistant director, editor, production designer, Production manager</td>
<td>The editor and the director could not accept to work with an intermediate pass between shooting and editing</td>
</tr>
</tbody>
</table>
Table 3.15.1: Explanation of the potential missions

<table>
<thead>
<tr>
<th>Convince the photography director to work with a digital cinema expert</th>
<th>Photography director, makeup artists, production Manager</th>
<th>Digital Cinema Cameras have different needs in terms of lighting and make up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get the director and his assistants comfortable with Virtual sets and pre-visualization</td>
<td>Director, photography director, director’s assistant, video assist, people from visual effects production, set designer, camera operator, production</td>
<td>Showing and creating the network from postproduction and production people needed to use virtual sets into the production. Explain the good point of using such technology</td>
</tr>
<tr>
<td>Persuade French Distributors</td>
<td>Director, assistant director, DC security and rights, distribution expert, public relation manager</td>
<td>Analog distributors ask for financial help to upgrade their network. Seek a distribution expert with the right competences</td>
</tr>
</tbody>
</table>

The properties of this pilot centre on its informal learning pedagogical model along with the cooperative requirements for its scenarios. In other words, the first main objective of building this pilot converges on the provision of a suitable environment for validating and evaluating the TENCompetence approach from an informal learning perspective. The second objective is to test and evaluate how social interaction and cooperation can be mediated by the TENCompetence infrastructure. Our aim here is to prove that the TENCompetence environment has both a potential to support informal learning pedagogies and provide a framework for computer supported collaborative environments for e-learning.

The pilot will be based upon a game-like environment where a tool will simulate the case at hand and follow on the progress. The team members will need to share information and make decisions cooperatively to comply with the virtual requirements of the game. The pilot will be developed by UPF and INSEAD as part of WP4’s considerations for additional pilots in the project’s second cycle.
Appendix 2: Use of VNC in TENCompetence pilots

1. What is the problem to be solved:

The problems faced by TENCompetence Digital Cinema pilot exemplify those faced in many Life Long Learning scenarios which involve distance learning that is mediated by information technology, or in which a particular application or technique is the topic to be studied. The particular issues addressed here are:

- Enabling those taking the role of teacher, facilitator or coach to monitor the progress of the learners (as the activities are progressing and/or reviewing the work carried out by the learners once it has been completed)
- Ensuring that the activities with the application concerned are seamlessly incorporated into the pedagogic flow of the course
- Embedding the outcomes of the activities in the online environment, so that the context of the work carried out is clear, and the evaluation and feedback provided is integrated with the rest of the course

In the following sections we discuss how this can be achieved for the Digital Cinema pilot addressing the question “How can a teacher evaluate knowledge of programs used by learners in the Pilot, such as MAYA, 3DStudio, eStudio…?”

We look at a number of alternative approaches, but in all cases our aim is to identify the most generic solution.

2. A proposed solution: vnc2swf

Our initial thoughts on meeting this need involved the development of a plug-in for the application used by the learner, which stores and/or transmits all the information about the interaction of the student with the application. At the end of the activity the teacher can reproduce this file with a player and can view all the actions of the student. This would be a practicable approach for many of the applications used in the Digital Cinema pilot, as they are event driven, and these events can be used as the basis for the learner activity log. There are however two drawbacks to this approach. Firstly, the activity log would not provide a full record of the learners’ interaction, as, for example, movements of the cursor would not be recorded. Secondly, the solution would be very specific and hard to generalise.

A much more generic approach is to use a shared desktop. There are a number of proprietary systems, which provide this functionality, and it is built into Microsoft NetMeeting and Macintosh OSX. For TENCompetence, however, we need a cross platform and open source solution, and the obvious candidate solution is Virtual Network Computing (VNC). The software is the result of an open source initiative, which is now developed and promoted by RealVNC. According to RealVNC the software makes it possible to “view and fully-interact with one computer from any other computer or mobile device anywhere on the Internet. VNC software is cross-platform, allowing remote control between different types of computer. For ultimate simplicity, there is even a Java viewer, so that any desktop can be controlled remotely from within a browser without having to install software.” (RealVNC 2002). RealVNC, retrieved 21st May, 2006 from http://www.realvnc.com/
Thus VNC appears to provide the functionality required for a teacher to view the student’s activity using a software application.

Management of this solution for more than a small number of learners is problematic. Managing ten video streams, for example, might prove extremely difficult, although appropriate software might make the task easier. Alternatively all the streams could be recorded, and when the students have finished the teacher can view the videos when he or she has time, and can provide the feedback.

2.1 vnc2swf

There is a cross platform screen recording tool called vnc2swf which is released under the GNU General Public License and available for download⁹. It captures screen motion using the VNC protocol and generates a Shockwave Flash (SWF) movie. The Macromedia suite of Flash products is proprietary, and Macromedia retains control of the SWF format, but the company publishes the specification¹⁰ (excluding specifications of related formats such as AMF). This has led to an extensive community of developers creating Open Source Flash tools¹¹.

We are not aware of a similar application, which exports to a Scalable Vector Graphics (SVG) format, and so use of SWF is probably acceptable. This should however be clarified by the TENCompetence project before development effort is put into this solution.

The vnc2swf package contains:

- vnc2swf.py - Recorder
- edit.py - Movie editor (This is NOT a general SWF file editor. It only supports movies generated by vnc2swf.)
- play.py - Simple movie viewer

On all platforms, the following packages are required:

- Python (2.3 or above)
- Pygame (1.6 or above)
- Optional: PyMedia (1.3.5 or above - required for mpeg encoding)
- You need at least one VNC server, such as realvnc (http://www.realvnc.com) and the instructions to configure all with this VNC server in Windows are at http://www.unixuser.org/~euske/vnc2swf/howto-vnc2swf-windows.html.

vnc2swf runs on many platforms, including Linux, FreeBSD, Solaris, Mac OS X, and Windows. It enables the user to specify the IP and the name of the file destination prior to recording. Vnc2swf does not provide a username and password, but it is possible to configure the server so that all connections have to be manually accepted.

⁹ http://www.unixuser.org/~euske/vnc2swf/
¹⁰ http://www.adobe.com/licensing/developer/
¹¹ See http://osflash.org/
3. Integration with the CopperCore CCS

The current CopperCore CCSI layer and functions are as follows:

It is, however, possible to integrate more services in the CCSI layer, and this could be done for vnc2swf. In this way vnc2swf could function as a service, in the same way as a QTI engine, or a Forum service.

If this service were implemented, then an activity could be carried out within a UOL, which makes use of vn2swf, and the resulting swf file could be saved in the server with a file name generated by the program. The name could be unique, either being built with the name of the activity and the student identification, or with the username or the time of the CPU.

When the activity is finished and the swf file is saved, and vnc2swf also generates an html page which plays the swf file. From this html, the teacher can view the activity that the student has carried out, and can give his/her feedback.
Difficulties in using vnc2swf

The potential difficulties, which would have to be overcome in using vnc2swf in the Digital Cinema pilot, have not been exhaustively explored. One problem which may, however, be foreseen is that vnc2swf is programmed in Python while the CCSI layer is written in Java. Consequently it would be necessary to implement a web service (or some other type interface) to communicate between the CCSI layers with vnc2swf. Fortunately there are web services libraries for Python, which would simplify this process.

4. Conclusions

- Advantages of the VNC approach

  - It works with all types of software, which the learner might use.
  - The only requirement for the students is to have installed a VNC server.
  - The size of the files is reasonable, for instance in a quick test one hour recording the program generated a file of 5.12 MB. The size of the file depends of the configuration of your VNC server. Another factor is that this test was done without interaction with any program, which may also affect file size.
  - It is the best solution; the teacher can view all the interactions of the student with the program.

- Disadvantages of the VNC approach

  - In some VNC software streamed video is not “real”, in the sense that there are servers which are not capable of reproducing video streams which were played on the remote (i.e. source) desktop.
  - Not all VNC servers work with OpenGL, so TENCompetence would have to provide a recommended configuration.

- Tasks, which would need to be carried out

The vnc2swf solution is at this stage a proposal. If it is to be implemented the immediate tasks to be addressed are

  - **Task 1**: We have to answer the question. What is the best solution to integrate vnc2swf? Web services or some other solution?
  - **Task 2**: Building the interface required to integrate vnc2swf.
  - **Task 3**: Decide if it is a good idea to integrate vnc2swf as a service in the CCSI layer, which would facilitate naming and identifying the generated files.
  - **Task 4**: If the result of task 3 is positive, carry out the integration of vnc2swf.
Appendix 3: Unit and integration testing

Introduction

This document

The goal of this document is to provide procedures and guidelines for unit and integration testing. The test process is taken as a basis to describe these. By zooming in on the sub-steps of the test process, each sub-step is explained.

Scope

Testing can be done on a number of different levels (acceptance test, system test, integration test, unit/module test). This document focuses on the two lowest levels: unit testing and integration testing. Chapter 3 explains what these levels entail.

Writing test plans, executing tests and managing defects all fall within the scope of WP3. Because the unit testing is relatively low level, only people from WP3 will be closely involved.

The higher levels (acceptance test, system test) are unrelated to WP3; they are performed as part of the WP4 pilots.

Version control

<table>
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<th>Author</th>
<th>Changes</th>
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<td>1.0</td>
<td>01-06-2006</td>
<td>Sanna Postelmans, Ronald</td>
<td>Initial version.</td>
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<tr>
<td></td>
<td></td>
<td>Cornelissen, Ruud Lemmers</td>
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</tr>
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</table>

Related documents

The following sources were used for writing this document:

[1] Project Initiation Document WP3 Cycle I
Roles and responsibilities

We can identify the following roles within TENCompetence regarding testing:

- **The test manager**: the test manager is responsible for the testing within a project. As WP4 leader, this role lies within UPF.

- **The test team leader**: the daily management of a test project can be handed over to a test team leader. The final responsibility for the test remains, however, with the test manager. The role of the test team leader is similar to that of foreman in the test team, ensuring that everything is organized so that the team is able to carry out its work effectively. This role will be assigned to someone within WP4.

- **The test analyst/executor**: creates the test design and carries out the test cases. He will build up the test set based on the product risks and requirements pertaining to the information system. The test analyst should have knowledge about and experience in the domain area. This role will be assigned to members of WP4.

Unit & Integration test

Unit test

Unit testing searches for defects in, and verifies the functioning of, software (e.g. modules, programs, objects, classes, etc.) that are separately testable. A description of what to do with defects can be found in this appendix. It may be done in isolation from the rest of the system, depending on the context of the development life cycle and the system. Stubs, drivers and simulators may be used. Unit tests are typically done by programmers and not by testers, as it requires detailed knowledge of the internal program design and code. The ideal situation is that another developer then the developer from the software runs the unit test.

The purpose of unit testing is to verify that each individual component functions according to the technical specifications. Unit testing includes several subjects, namely:

- completeness of each unit.
- correct processing by unit.
- relation controls within the unit.
- correct execution of each unit.
- integrity of the database.
- applying standards in case of error handling, logging and such.
- menu structure, short keys.
- screen navigation.
- field controls, value ranges, maximal precision, field length.
- mutation or non-mutation of the proper fields at the right time.
- error handling.
- association with next/previous unit.
- performance of the (components of the) unit.

Annex to Unit and Testing Plan (3) lists the different areas to check on a high level, annex to Unit and Testing Plan (1) shows a concrete checklist.
A successful unit test is one that finds an error. When writing your test plans include data that is most likely to cause an error (use the information about problems during development). Use test data that can be checked easily. When writing unit test plans make sure all paths in the code are covered. There is no need to execute the same test with all possible values if the code will always return the same result. At the end of each phase and/or at the end of the whole integration test, a phase report can be generated.

**Integration test**

The purpose of integration testing is to verify if the interaction between units works correctly. There are several subjects to consider within integration testing:

- Interfaces between units in an application
- Complete processing chain
- Relation controls within the system including several modules and/or in combination with the database

Annex to Unit and Testing Plan (3) lists the different areas to check on a high level, Annex to Unit and Testing Plan (1) shows a concrete checklist.

The implementer delivers his unit tested component to the Integrator. The Integrator merges this component to intermediate builds. Step by step, bottom-up, each component will be integrated according to the build plan. After each step, the intermediate build will be used for the execution of the integration test. The aim of this way of working is to determine if the added components are compatible with the already integrated components.

The entry criteria for the integration test are all the exit criteria of previous tests. As exit criteria can be considered the successful execution of all the integration tests and the testware of the integration test. The list with open issues has to be fixed too.

At the end of each phase and/or at the end of the whole integration test, a phase report can be generated.

**Test approach**

**Test process steps**

The complete test process consists of the following substeps:

1. Collect the software documentation (preferably a functional design, if not available gather information from other sources (publications, working documents, forum info, own knowledge).
2. Make a test plan: Annex to Unit and Testing Plan (2) contains the index and an example for a test plan document.
3. Define the scope (e.g. only the calculating functions and not the personal administration will be tested and which test methods used, e.g. decision table).
4. Determine clusters: paragraph 2.2 describes this and the next two steps.
5. Determine test conditions.
6. Determine test case(s).
7a. Organize the test environment.
7b. Make documentation of the configuration of the test environment (to make the test repeatable).
8. Execute the tests and record the results of each test. This also includes retesting fixed defects. Paragraph 2.3 describes this step.
9. Make a report of the test results (to report on the number of failed and passed tests).

From software to test cases
Each test level can be divided into four stages: preparation, Analysis, Navigation (optional, used for automatic testing) and Execution.

At each stage of test development, the question is: what should be tested and how do we know if the test is reliable enough? Each test can be divided into logical blocks, or 'Test Clusters' in order to achieve a greater degree of reliability. These Test Clusters give the tests a logical structure. Next, a number of Test Conditions are defined within each Test Cluster. These are elaborated into concrete Test Lines (also called Test Cases), which form the transition into the testing itself (Figure 2). The clarity, which this testing structure produces, improves the ease of maintenance and reuse of the test products.
To design the test clusters/conditions/cases, slightly adapted TestFrame (the LogicaCMG method, see Annex to Unit and Testing Plan (5) - Tooling) Excel sheets can be used. These Excel sheets are shown in appendix 4.

**Test Techniques**

Based on the quality attributes (Annex to Unit and Testing Plan (3)) that will be tested by the test cases, matching test techniques should be selected. The table below shows the suitable test techniques for each quality attribute.

Note: descriptions and examples of test techniques can be found in literature, like [4]. Information on test techniques on the web is very limited.
### Executing tests and recording results

**Defects**

All defects found will be registered and managed in a bug tracking system. Either Bugzilla or SourceForge will be used as bug tracking system. For more information about these tools and the selection process, read discussion http://www.tencompetence.org/mod/forum/discuss.php?d=446 and especially the attachment of its first entry.

The person/developer who logs a defect has to keep track of the status of the defect. It is also possible to appoint a defect manager, a person who must therefore ensure that the defects are denoted in a structured manner.

**Report**

Test output can be generated using JUnit:

- The JUnit integration in Eclipse returns documentation of test failures and errors.
- When you write Ant scripts with the Ant JUnit extension, you can generate an HTML report that shows successes and failures.
### Annex to Unit and Testing Plan (1) – Checklist

#### Calamities

<table>
<thead>
<tr>
<th>Aspect</th>
<th>UT</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monkey–test. Random keys, check response by system.</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

#### Functionality

<table>
<thead>
<tr>
<th>Aspect</th>
<th>UT</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range checks / boundary value (boundary value, below boundary value,</td>
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<td>X</td>
</tr>
<tr>
<td>above boundary value, way under boundary value, way over boundary value)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code values. How many allowed values and forbidden values are checked?</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Field type: integer, decimal, character etc. Is it possible to enter</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>the correct values? Are incorrect values refused?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field length</td>
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<td>Precision of field values, correct rounding</td>
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<td></td>
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<tr>
<td>Default values</td>
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<tr>
<td>Validity test date fields (special date validations - 31-02-2006)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Check if overview screens are present</td>
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<td></td>
</tr>
<tr>
<td>Initial cursor position</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Which fields are meant both for input and output? Do both functions</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>work?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paging up and paging down on overview screens</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Functioning of defined function keys</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Alternative ways of input (via different screens, via keyboard, via</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>mouse)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other input validations / dependencies</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Completeness (are all buttons and fields present)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Position on screen (are the objects on the right positions on the</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>screen)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Integration

<table>
<thead>
<tr>
<th>Aspect</th>
<th>UT</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration between the different subsystems of the application</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Testing broadcasts (internal messages) sent from one system to other</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing broadcasts (internal messages) sent from one system to other</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>subsystems within the application</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Storage

<table>
<thead>
<tr>
<th>Aspect</th>
<th>UT</th>
<th>IT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deleting records</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Deletion of multiple records at the same time</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Deletion of all records in one action</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Other status changes of one or multiple records</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Deletion of a ‘parent’ when at least one ‘child’ is still present</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Addition of a ‘child’ record without a parent record</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Adding duplicate keys</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Check addition of a primary key when adding a new record</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Check if all fields are stored correctly when storing a new record</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Locking mechanism: two changes in one record</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Concurrent usage: concurrent read of a record is allowed</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Archiving records: how long are records stored after a logical deletion? How often is the database cleaned up?</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Time out: what is the application’s response when data is not retrieved in time?</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Annex to Unit and Testing Plan (2) – Test plan

Index for the test plan

The test plan should contain:

1 Overview
   1.1 Document control
   1.2 Goals
   1.3 Process flow diagram of the software
   1.4 Requirements (e.g. internet explorer 6.0, Outlook 2003)
2 Objectives and Scope
   2.1 Starting point (software release, documentations)
   2.2 Which quality attributes will be tested
3 Test Approach and Methodology
   3.1 Test objects (the components which will be tested, see also process flow diagram)
   3.2 Types of Testing (Unit Test, integration Test)
4 Test Environment
   4.1 Test tools
   4.2 Configuration management
5 Reporting
   5.1 Defect management
   5.2 Test execution report

Test plan example

1 Overview

Abstract which contains an overview of the application that will be tested and also the needs for the software.
### 1.1 Document control

<table>
<thead>
<tr>
<th>Document ID:</th>
<th>TEST_PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Name:</td>
<td>Project Y System Test Plan.</td>
</tr>
<tr>
<td>Version:</td>
<td>x.x</td>
</tr>
<tr>
<td>Location:</td>
<td><a href="Http://www.tencompetence.org/testplan.html">Http://www.tencompetence.org/testplan.html</a></td>
</tr>
<tr>
<td>Originator:</td>
<td>Bazman</td>
</tr>
<tr>
<td>Approval Date:</td>
<td></td>
</tr>
<tr>
<td>Status:</td>
<td>DRAFT</td>
</tr>
<tr>
<td>Approvers:</td>
<td>COMPANY X: System Test Manager Quality Manager Project Manager 1 Project Manager 2 Project Manager 3</td>
</tr>
<tr>
<td></td>
<td>Test Team Leader Test Team Members</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Document History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
</tr>
<tr>
<td>0.1</td>
</tr>
<tr>
<td>0.2</td>
</tr>
</tbody>
</table>
1.2 Goals

The test goals enumeration, e.g.:
1. Establish if the different interfaces works correctly.
2. Establish if the authorization of the different users accounts are correct.

1.3 Process flow diagram of the software

For this example we use an ATM machine. There may be several units that verify user data: bank account verification, PIN verification, and bank account status verification. All of these individual units would be integrated into the Verification module. The Verification module would be integrated with a Banking module and a driver for the mechanical pieces, into the entire ATM application. After this testing was complete, integration testing could occur between the ATM machines and the bank's ATM application server. If the bank acquires another bank, the corporate ATMs would have to be integrated into a new network. Each cycle of integration adds another layer until a comprehensive test can be performed on the entire system.

1.4 Requirements

The technical requirements for the software. E.g. at least internet explorer version 6, java runtime version 1.2 minimum, etc.

2 Objectives and Scope

The scope is divided in two parts; one part is to review the documentation and the second part is to ……………

…………

…………

5.2 Test execution report

When implementing a test it must be carefully and accurately established - by the tester or by the testing tool - which tests have passed and which haven't. This is shown in the Test Report, in which changes from the expected results are given. These may be minor,
such as a doubtful screen message. More serious would be a fault, which indicates that the system cannot cope with a certain number of transactions and becomes unstable, if this number is exceeded.

Not everyone within your organization will need the same report. Various versions of the report can be made as required.

The report will always contain:

- the identification (including version number) of the application and the test;
- the total number of faults found;
- the number of tests passed as a percentage of all tests;
- a description of the faults.
## Annex to Unit and Testing Plan (3) – Quality attributes

Most testing requirements are clear, especially on usability and performance. To make a good test (plan) it’s important to make all the expected demands on the software visible. The list of quality attributes (based on ISO 9126) shown below can be helpful in this process.

### Quality attributes

<table>
<thead>
<tr>
<th>Quality attributes</th>
<th>Description: the capability of the software product to…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionality</td>
<td>Provide functions, which meet, stated and implied needs when the software is used under specified conditions.</td>
</tr>
<tr>
<td>Suitability</td>
<td>Provide an appropriate set of functions for specified tasks and user objectives.</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Provide the correct or agreed results or effects with the needed degree of precision.</td>
</tr>
<tr>
<td>Interoperability</td>
<td>Interact with one or more specified systems.</td>
</tr>
<tr>
<td>Security</td>
<td>Protect information and data so that unauthorised persons or systems cannot read or modify them and authorised persons or systems are not denied access to them.</td>
</tr>
<tr>
<td>Functionality compliance</td>
<td>Adhere to standards, conventions or regulations in laws and similar prescriptions relating to functionality.</td>
</tr>
<tr>
<td>Reliability</td>
<td>Maintain a specified level of performance when used under specified conditions.</td>
</tr>
</tbody>
</table>
### Maturity
Avoid failure as a result of faults in the software.

### Fault tolerance
Maintain a specified level of performance in cases of software faults or of infringement of its specified interface.

### Recoverability
Re-establish a specified level of performance and recover the data directly affected in the case of a failure.

### Reliability compliance
Adhere to standards, conventions or regulations relating to reliability.

### Usability
**Be understood, learned, used and attractive to the user, when used under specified conditions.**

<table>
<thead>
<tr>
<th>Quality attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understandability</td>
<td>Enable the user to understand whether the software is suitable, and how it can be used for particular tasks and conditions of use.</td>
</tr>
<tr>
<td>Learnability</td>
<td>Enable the user to learn its application.</td>
</tr>
<tr>
<td>Operability</td>
<td>Enable the user to operate and control it.</td>
</tr>
<tr>
<td>Attractiveness</td>
<td>Be attractive to the user.</td>
</tr>
<tr>
<td>Usability compliance</td>
<td>Adhere to standards, conventions, style guides or regulations relating to usability.</td>
</tr>
<tr>
<td>Efficiency</td>
<td><strong>Provide appropriate performance, relative to the amount of resources used, under stated conditions.</strong></td>
</tr>
<tr>
<td>Time behaviour</td>
<td>Provide appropriate response and processing times and throughput rates when performing its function, under stated conditions.</td>
</tr>
<tr>
<td>Resource utilisation</td>
<td>Use appropriate amounts and types of resources when the software performs its function under stated conditions.</td>
</tr>
<tr>
<td>Efficiency compliance</td>
<td>Adhere to standards or conventions relating to efficiency.</td>
</tr>
<tr>
<td>Maintainability</td>
<td><strong>Be modified. Modifications may include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications.</strong></td>
</tr>
<tr>
<td>Analysability</td>
<td>Be diagnosed for deficiencies or causes of failures in the software, or for the parts to be modified to be identified.</td>
</tr>
<tr>
<td>Changeability</td>
<td>Enable a specified modification to be implemented.</td>
</tr>
<tr>
<td>Stability</td>
<td>Avoid unexpected effects from modifications of the software.</td>
</tr>
<tr>
<td>Testability</td>
<td>Enable modified software to be validated.</td>
</tr>
<tr>
<td>Maintainability compliance</td>
<td>Adhere to standards or conventions relating to maintainability.</td>
</tr>
<tr>
<td>Portability</td>
<td><strong>Be transferred from one environment to another.</strong></td>
</tr>
<tr>
<td>Adaptability</td>
<td>Be adapted for different specified environments without applying actions or means other than those provided for this purpose for the software considered.</td>
</tr>
<tr>
<td>Installability</td>
<td>Be installed in a specified environment.</td>
</tr>
<tr>
<td>Co-existence</td>
<td>Co-exist with other independent software in a common environment sharing common resources.</td>
</tr>
<tr>
<td>Replaceability</td>
<td>Be used in place of another specified software product for the same purpose in the same environment.</td>
</tr>
<tr>
<td>Portability compliance</td>
<td>Adhere to standards or conventions relating to portability.</td>
</tr>
</tbody>
</table>
Annex to Unit and Testing Plan (4) – TestFrame *(Excel sheet)*

Cluster card

<table>
<thead>
<tr>
<th>Cluster</th>
<th>System</th>
<th>Test type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster name</td>
<td>System name and version</td>
<td>In which testkind will the cluster be used?</td>
</tr>
</tbody>
</table>

**ASSIGNMENT**

<table>
<thead>
<tr>
<th>Risks</th>
<th>Quality attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which product risks can occur in case this cluster is not executed or when errors occur when in production?</td>
<td>Which quality attributes are addressed in this cluster?</td>
</tr>
</tbody>
</table>

**KEY INFORMATION**

<table>
<thead>
<tr>
<th>Cluster ID</th>
<th>XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;date&gt;</td>
<td>&lt;version&gt;</td>
</tr>
</tbody>
</table>

**Modified by**

<table>
<thead>
<tr>
<th>&lt;name&gt;</th>
</tr>
</thead>
</table>

**Importance**

<What is the relative importance of this cluster as opposed to other clusters? The importance results from the product risks determined. The importance determines testing priority and planning. Use the MOSCOW standard: 'must test', 'should test', 'could test' and 'won't test'. By determining the cluster importance using the product risk, the test manager avoids clusters being assigned the highest priority by stakeholders. Separate prioritising can be assigned to test conditions at a later stage, with high-risk projects.>
### Base documentation

<A reference to documentation should be made on which the test design for this cluster is based. Additional information concerning elimination or reduction of product risks should be added in case default documentation does not provide this.>

### EXECUTION

#### Test approach

<How is the test executed? A test manager's choice depends on test type, quality attribute, available documentation, organization, circumstances etc. Stactical tests: auditing and reviewing? Or use of dynamic testing: decision tables, entity life cycle, data flow analysis? Manual or automated test execution?>

#### Test environment

<Which environment is needed to execute the specified test? Both technical and manitine resources as well as other dependencies should be mentioned. Is a production-like environment needed or is a make-and-break environment enough? Which test data is needed?>

### RESULT

#### Acceptance criteria

<When does the stakeholder accept the cluster? Make sure the acceptance criteria are stated explicitly. The criteria should be known to all parties involved when the test project has finished.>
## Test conditions

This document contains the test conditions for cluster `<clusternamex`.

<table>
<thead>
<tr>
<th>Test condition number</th>
<th>Test condition description</th>
<th>Priority</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXC1</td>
<td>Description test condition 1</td>
<td>High</td>
<td>not started</td>
</tr>
<tr>
<td>XXXC2</td>
<td><code>&lt;description test condition n&gt;</code></td>
<td>must test</td>
<td>not started</td>
</tr>
<tr>
<td>XXXC3</td>
<td><code>&lt;description test condition n&gt;</code></td>
<td>must test</td>
<td></td>
</tr>
<tr>
<td>XXXC4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## D 4.1 Pilot Evaluation Plan

### Test cases

<table>
<thead>
<tr>
<th>Cluster</th>
<th>&lt;clustername&gt;</th>
<th>cluster ID</th>
<th>XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheet</td>
<td>Test cases nn</td>
<td>date last modified</td>
<td>&lt;date&gt;</td>
</tr>
<tr>
<td>Version</td>
<td>&lt;version&gt;</td>
<td>modified by</td>
<td>&lt;name&gt;</td>
</tr>
<tr>
<td>Date</td>
<td>&lt;date&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Author</td>
<td>&lt;author&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>number of test cases</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Precondition for the test

<table>
<thead>
<tr>
<th>test condition</th>
<th>Description test condition 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXC1</td>
<td></td>
</tr>
</tbody>
</table>

### Test case

<table>
<thead>
<tr>
<th>test case</th>
<th>Description of test case 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXC1T1</td>
<td></td>
</tr>
</tbody>
</table>

### Precondition

#### Actions

#### Expected result

#### Actual result

<table>
<thead>
<tr>
<th>test case</th>
<th>Description of test case 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>XXXC1T2</td>
<td></td>
</tr>
</tbody>
</table>

### Precondition
<table>
<thead>
<tr>
<th>Actions</th>
<th>Expected result</th>
<th>Actual result</th>
</tr>
</thead>
</table>

D 4.1 Pilot Evaluation Plan
Annex to Unit and Testing Plan (5) – Tooling

For unit tests, more than one test tool can be used. The final selection for the suited test tool(s) depends on the requirements that need to be tested. If performance, for example, is not included in these requirements, you don’t need a tool that tests performance.

Eclipse

The Eclipse Test and Performance Tools Platform (TPTP) Project provides an open platform supplying powerful frameworks and services that allow software developers to build unique test and performance tools.

JUnit

JUnit is a simple testing framework shipped with Eclipse. JUnit is used by the developer who implements unit tests in java and is also used heavily by the platform to test plugins. The freeware JUnit is an often-used unit test tool in the world of Java. It is used to test the functional working of units.

With JUnit integration in Eclipse, you can get instant feedback in the IDE. However, for automated tests and external reports you need some kind of script to run them. You can write some Ant Scripts to automate the process. The Ant JUnit extension allows you to generate a nice HTML report that shows successes and failures, much like the JUnit reports that the Eclipse organisation generate.

Cruise Control

CruiseControl is a framework for a continuous build process. It includes, but is not limited to, plugins for email notification, Ant, and various source control tools. A web interface is provided to view the details of the current and previous builds.

CruiseControl is more used for automatic builds and the corresponding reports then for unit testing.

TestFrame

TestFrame is not a tool, it is LogicaCMG The Netherlands’ method for structured testing. It supports the whole test process, from test preparation to test execution. Parts of this method have been used for the checklists and templates in this document.

Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defect</td>
<td>A flaw in a component or system that can cause the component or system to fail to perform its required function, e.g. an incorrect statement or data definition. A defect, if encountered during execution, may cause a failure of the component or system.</td>
</tr>
<tr>
<td>Defect management</td>
<td>The process of recognizing, investigating, taking action and disposing of defects. It involves recording defects, classifying them and identifying the impact.</td>
</tr>
</tbody>
</table>
Unit | Part of the program, module, and function.
Unit test | Also known as component, module or program testing.
MoSCoW | A method to prioritize test clusters, test conditions and test cases.

The priorities are (from high to low):
- M - MUST have this.
- S - SHOULD have this if at all possible.
- C - COULD have this if it does not affect anything else.
- W - WON'T have this time but WOULD like in the future.

Test Cluster | A logical block or part of the program. For example, a test cluster can be “basic customer information” with the description: the customer address and contact information.
Test Condition | An item or event of a component or system that could be verified by one or more test cases, e.g. a function, transaction, feature, quality attribute, or structural element.
Test case | A set of input values, execution preconditions, expected results and execution post conditions, developed for a particular objective or test condition, such as to exercise a particular program path or to verify compliance with a specific requirement.

UT | Unit Test
IT | Integration Test

Links
- International Software Testing Qualifications Board (ISTQB)
  http://www.istqb.org/
- Tmap
  http://eng.tmap.net/Home/
- Examples of test documents
  http://www.stickyminds.com
- Linux Test project
  http://ltp.sourceforge.net/
Appendix 4: Technical evaluation of the integrated system

Objective and Scope
The objective of this plan is to define criteria to be followed to evaluate the technical features of the TenCompetence prototypes. These prototypes will be used by the final users in the various pilots and applications.

All the tests described below must be carried out to ensure the integration of the prototype, and that usability and functionality are of an acceptable standard in a range of conditions and environments.

Evaluation Criteria
The technical evaluation of the prototype is centred on the client/server architecture features and is focused on the following criteria.

**Server**

**Installation**
This section is related to the installation of the TENCompetence Server. The aim is to establish if installation is an easy process or not, and if the documentation provided is sufficient to ensure a successful installation.

Ease of installation

**Prerequisites**
Related to prerequisites (e.g., if JVM is required or it is self-installed, if application servers are required or embedded in the prototype).

**Installation process**
Time average, questions to user…

Quality and Scope of the given documentation
Is the documentation sufficient to cover the various installation options? Is there an adequate FAQ, description of platform requirements, etc?

**Hardware**
Physical requirements for the prototype server.
Platform Hardware requirements.
Is there a clear and complete specification of the minimum (at least) hardware configuration required for the prototype and other requirements?

**Processor**

**Memory**

**HD Size**

Other resources
E.g. Ethernet speed

**Systems**

**Databases**

*DBMS used*
Database Management System used (e.g., mysql, postgresql, access, sql Server, oracle,...), features, lacks…

*Managing tools*
Tools available to operate with databases (backup, import/export…)

*Services used (embedded or not)*
Services/Daemons/Servers used with the prototype, e.g. tomcat or jBoss to run the application, sendmail to manage/send mails to learners…

*Other Systems*
Any other systems needed for the prototype (e.g. Cron tasks, nessus to test vulnerabilities…)

*Connectivity with external systems*
Connection to other systems (e.g., Openview/Nino trap collector...)

**Capabilities**

*Platform Portability*
Does the system run well on all target systems?

*Hardware*
Does the system run on all target processors? Are there any differences in performance?

*Operating Systems*
Does the TenC Server run on all target Operating Systems: (Windows 9x, Windows 2000/XP Server/Professional, Linux Systems, BSD Systems, Solaris, MacOS)?

*Servers (application servers)*
To what extent can application servers be exchanged? For example, if the Server normally runs in jBoss or Tomcat, can it run in another application Server (e.g. Sun Application Server) or in another version of the same runtime?

*Databases*
Can the database file be easily transferred from one to move from one database management system to another?

*Extensibility*

*Stress load tests*
Stress load tests are the final step of system stress testing. Here the system is subjected to simulated field conditions. The conditions for these tests are normally more demanding than what the system will have to handle after deployment.

Stress Load Testing Guidelines

- **Overload the system.** During stress load conditions, the system should be subjected to harsher conditions than the field environment. By doing this you can make sure that the system will run stably for extended periods of time. Thus a weekend stress test might give you confidence that the system would survive a month of regular system operation.

- **Load test the system with field type traffic mix.** Run a traffic mix that is close to the expected load in the field conditions. Field traffic mix data can often be obtained from studies and papers on the subject.

- **Load test the system with traffic that is varies over time.** When the system is deployed in the field, it will be subjected to huge fluctuations in traffic. These fluctuations should be simulated in the lab. Keep in mind that there might be bugs in the system, which show up only in fluctuating traffic conditions. Most systems have bugs in handling high load as well as low load conditions.

- **Load test the system with events that have random inter-arrival time.** Run loads such that the inter-arrival traffic distribution is random. This can identify problems in aspects of the code that cannot be foreseen. To make the random tests reproducible, the random number generator is seeded with a known value before the load test. This way the exact test conditions can be recreated by feeding in the same random number seed.

- **Load test the system with events that have random service time.** Do not run load with a fixed call/session duration. Use random session durations during the load tests. For best results use a load generator that works with Poisson inter-arrival and service times.

- **Load test everything.** Do not restrict load testing to subscriber load alone. Load testing fault conditions and operator commands makes sure that these features do not display memory leaks and other slow build up faults.

- **Measure load performance.** Load runs are not just for verifying the stability of the system. Always measure and plot the performance of the system during the entire load test. The best way to do this is to use tools that plot graphs showing system performance.

Security

*Connectivity requirements*
Access needed to run the Server, ports used, protocols, certificates.

*Firewalls*
Firewalls/Routers involved (NAT, access lists...)

*Vulnerabilities*
Is there a lack of security in any of the protocols or process (e.g., sending data it in some vulnerable protocol WEP for example)
**Bugs**
Are there any known or identifiable errors/problems in the design of the prototype?

**Client**
If two or more clients are developed then this section should be duplicated for each client.

**Installation**
This section is related to the installation of the TENCompetence Client. The aim is to establish if installation is an easy process or not, and if the documentation provided is sufficient to ensure a successful installation.

Easiness of installation
Is the installation process automatic? Are there any unanswered questions relating to installation. Are the software requirements for installation clear and reasonable? If it is a web client what are the browser requirements (including flash needed, JavaScript enabled…)

*Quality and Scope of the given documentation*
Is the documentation sufficient to cover the various installation options? Is there an adequate FAQ, description of platform requirements, etc?

**Hardware**
Physical requirements for the client prototype
Specify the minimum (at least) hardware features needed for the prototype and normal hardware requirements, if internet connection is needed.

*Processor*

*Memory*

*HD Size*

*Other resources*

Hardware requirements (computers, memory, resources...)

**Software**
Software requirements
What are the software requirements for successful installation (Javascript enabled, JVM installed...)?

Standards used
For example, is an IMS-LD package handled correctly? Are the files generated by the client well constructed according to the defined schema? Check that XML standards used are really XML standards.
Design Guides
Is the design of the client in accordance with the design guides, which were selected for its development?

Abilities
Devices on which the client can be installed.
On which devices can the client be installed? If it is a desktop application specify if it only runs on PCs or in mobile devices, PDAs etc.

Browsers
If the client is Web based, can it run in any browser? Does it use standard JavaScript? Does it use ActiveX or any other technology than can only runs with the IE engine?

Connectivity requirements
What are the connectivity requirements? For example, does the client require support for SSL? WPA for WLANs?
### Critical Functionality Tests

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<th>Learning Activities</th>
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<td>Users can Logout?</td>
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<td>Users can create an item?</td>
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<td>Users can modify an item?</td>
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